ECONOMIC VALUATION OF RIPARIAN HABITATS PROTECTION IN NAIROBI COUNTY KENYA

BY

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A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF DOCTOR OF PHILOSOPHY IN AGRICULTURAL ECONOMICS AND RESOURCE MANAGEMENT, DEPARTMENT OF AGRICULTURAL ECONOMICS AND RESOURCE MANAGEMENT, SCHOOL OF AGRICULTURE AND NATURAL RESOURCE MANAGEMENT

MOI UNIVERSITY

2024

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DEDICATION

I dedicate this work to my late father Mr. Charles Silas Magembe Nyamira who passed away on 28th October, 2010 and mum Abigael Moraa Magembe, besides my brothers and sister who draw a lot of inspiration from me. I value my dad as a mentor and champion who prioritized girl child education and women empowerment irrespective of community perceptions. His unfaltering support and efforts led to achievement of my career goal however, he passed away before reaping the fruits that he sow. To my dear friend Mary Akinyi Orinda, sincerely you proved to me the value of true friendship and the need for career development. To my mentor Prof. Timothy Kipkemboi Sulo even though you finished your race and rested, your input into this work at its inception is highly recognized and appreciated. To my other Prof. Wilson Nguyo Mwarari who also rested almost the same time with Sulo, you shaped me to be whom I am today, you gave me a good foundation in Agricultural Economics right from undergraduate. May the trio's souls rest in eternal peace.

ACKNOWLEDGEMENT

I wish to acknowledge my university supervisors Dr. Hillary, K. Ndambiri and Dr. Jared Isaboke Mose for their support, encouragement, supervision and healthy criticisms in the friendliest, organized and timely manner. It was indeed a pleasure working with them, and without their guidance, feedback and support this research work would have not been possible. I have acquired knowledge (power) and gained research experience from them which will go a greater milestone in advancing my career. My heartfelt gratitude is extended to the staff of the Department of Agricultural Economics and Resource Management, Moi University for their support and mentorship since I enrolled for my Ph. D studies. Special thanks go to Germany Academic exchange service (DAAD) in collaboration with African Economic Research Consortium (AERC), headed by Prof. Lemma Senbet for the scholarship and research grants. I would also like to thank all the respondents within the research area who spared their time for the interviews. Thank you for providing the data which was used for analysis, it was amazing interacting with you. I am highly indebted to my husband Gilbert Siriba for his economic and social support, encouragement and constant reminder of the need to complete my studies. My dear mum Abigael Moraa Magembe, my sons Duncan Nyamira and Charles Siriba, my daughter Christine Bisieri are highly appreciated for their patience and endurance during the times I was away from home. Thank you for your understanding, kindness and love. Finally, for those who supported me but have not been mentioned, know that your effort and encouragement was felt and appreciated. This academic achievement is for us all. All glory and praise goes to our Almighty God for making a way where there seemed to be no way. God bless Esther, God Bless Moi University, God Bless all.

ABSTRACT

Riparian habitats (RH) provide aesthetic beauty, clean water and environment among others. Despite these values, RH have been threatened and destroyed by effects of human encroachment among others. RH functioning has been hindered despite various state interventions towards RH protection. The habitats have continued to act as dumpsites. From literature, no study has valued RH protection in Kenya. Therefore, this study aimed to carry out economic valuation of RH protection in Nairobi County, Kenya. Specific study objectives were to determine the effect of changes in: Elicitation Format (EF), Bid Range (BR), Payment Vehicle (PV) and the Valuation Good (VG) all on valuation estimates. Welfare economics and utility maximization theories were utilized. Contingent valuation method (CVM) elicited households' willingness to pay (WTP) and its standard deviation (SD). 16 locations were purposively selected for study and stratified into 2 subsamples based on EF, with each subsample further stratified into public and private categories.Within these categories, there were six strata each (Trust, Tax, Raised bid, Lowered bid, Public good, Private good). Stratified proportionate random sampling was used to sample 1000 households. Cross–sectional survey design and experimental cards (Stochastic payment card (SPC) and multiple bound discrete choice (MBDC) generated the data. Primary and secondary data sources were used. Data were collected through structured questionnaires. Two stage random valuation model aided data analysis. Data were processed in STATA and subjected to Mann- Whitney test (MWT) and F test statistics. 64% of households were male, older (>38 years) with mean income of KES. 50,444/Month. 71.8% of households attained post college education level and had smaller family sizes (<4 households) hence found it necessary to protect RH (95%). SPC households expressed lower but consistent WTP values (KES.925.1±48.3) at (p<0.01; MWT=2.717), indicating that such households would consistently make their payments towards protection. Change in EF from SPC to MBDC increased both WTP and its SD by 6.7% and 9.8 % respectively at p<0.01. Raised BR exhibited higher and consistent WTP (KES.1166.6±1003.3). A finding contrary to economic theory where WTP rise with reduction in bid amounts. Regression of change in BR on its estimates, increased WTP and reduced SD respectively by 23.7% and 19.4% at p<0.01. Tax PV showed higher WTP and SD (KES.1180.93.1±1332.6) at (p<0.1; MWT=1.865), evidence that it does not elicit protest responses as noted in the literature. The view of RH as public good elicited higher and inconsistent WTP (KES. 1022.1±1318.5) at p>0.01. Regression of change in VG from Private to Public on VG estimates increased both WTP and SD by 9.9% and 7.9% respectively at p<0.01. Factors: - Age, Distance, income, Necessity to protect RH, EF, significantly affected valuation estimates. In conclusion, households expressed positive WTP amounts towards RH protection. The participation of women, youth, and larger families in protection was limited hence need for sensitization. SPC proved desirable for future valuation given its understated welfare estimates. Change in BR led to households' true valuation of RH protection. Tax PV was preferred for valuation of RH protection due to the distrust expressed by households over the Trust fund. Households viewing RH as private expressed confident support for it. It is suggested that conservationists and natural resource management authorities, such as the Kenya National Environment Management Authority (NEMA), should focus on increasing the participation of women, youth, and larger families in RH protection efforts through targeted awareness campaigns. Incorporating SPC format in future RH valuation studies is essential for ensuring consistency in households' WTP estimates. Utilization of Lowered BR in future valuation studies could produce more accurate and motivating WTP estimates, particularly for areas like Karura Forest. County governments are encouraged to establish a voluntary environmental tax fund for RH protection, ensuring transparency to build public trust. The study also advocates for using tax preferences as a PV in future valuations of environmental goods and services. Leasing public RH by the government to private entities for enhanced protection is also encouraged. Moreover, VG estimates could inform budget and policy proposals for managing various public RH, with adjustments made to ensure socio-demographic equity. Finally, future RH protection strategies should be tailored to consider key factors such as age, distance, income, and perceived necessity, which significantly influence valuation estimates.

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LIST OF ABBREVIATIONS

ADB	African Development Bank
BR	Bid Range
CBS	Central Bureau of Statistics
COEFV	Coefficient Of Variation
CV	Contingent Valuation
CVM	Contingent Valuation Method
DC	Dichotomous Card
EF	Elicitation Format
GOK	Government of Kenya
KNBS	Kenya National Bureau of Statistics
MBDC	Multiple Bound Discrete Choice
NEMA	National Environment Management Authority
NAS	National Academy of Sciences
NCC	Nairobi City County
NRC	National Research Council
OE	Open Ended
PC	Payment card
PV	Payment Vehicle
RH	Riparian Habitats
RVM	Random Valuation Model
SPC	Stochastic Payment Card
UNESCO	United Nations Educational Scientific and Cultural Organization
VG	Valuation Good
WTP	Willingness to Pay

OPERATIONAL DEFINITION OF TERMS

WTP- The monetary measure of the value of obtaining a gain in the provision of good or service or avoiding a loss/difference between maximum amount an individual will pay to have the good and the minimum amount above which he will refuse to pay.

Private household-A person whose place of residence, land, business, farming activities borders riparian homes, within a distance of 6M-30M from the water course.

Public household- A person whose land, place of residence/ business/farming activities does not border RH, nor fall within a distance of 6M-30M, but is deriving utility from the habitats at the point of interview.

Private RH- RH owned and whose moral duty of care belongs to private households.

Public RH-RH owned and whose moral duty of care belongs to the state.

Riparian resources-goods and services used as raw materials to produce commodities.

Contingent Valuation-A stated preference approach of valuing non-market goods and services where households are asked what they are WTP/WTA for a change in provision of a non-market good or service.

Payment Vehicle- A vehicle means a mode of transport. But in this study the term Payment vehicle means the mode of payment for environmental good or service.

RH protection-Taking care of riparian homes through proper maintenance, fencing, cleaning, planting of recommended trees and grass along the banks of a river or water source, and using them in an environmental friendly manner as advocated by National Research Council, 2002.

CHAPTER ONE

INTRODUCTION

1.1 Overview of the Chapter

This chapter presents a comprehensive background on riparian habitats (RH) globally, regionally, and specifically in Nairobi County, Kenya. It introduces the contingent valuation method (CVM) and outlines the statement of the problem, broad and specific objectives, hypotheses, justification, and concludes with the research's scope and limitations.

1.1.1 Study Background

This subsection furnishes an overview of the study's background, commencing with a global outlook and subsequently narrowing down to an African perspective. It furnishes insights into the nature and status of RH in Kenya, particularly within Nairobi. Additionally, it encompasses general information on economic valuation and culminates by summarizing the research gaps targeted for exploration.

1.1.1.1 Global and African Contexts in Background Information

Nature provides benefits to all inhabitants of the planet (Chaplin-Kramer, 2023). Approximately 87% of the world’s population live in areas benefitting from critical natural assets such as RH, while only 16% live on lands containing these assets. Research has shown that conserving and protecting 30 percent of the earth’s land and 24 percent of its waters would sustain 90 percent of nature's contribution to human wellbeing (Mckinnon, *et al.*, 2016). This vital relationship between humans and nature has enormous cultural and economic values by providing food, drinking water, protection of human beings from hazards, mental and physical well-being and many

other priceless benefits (Mckinnon, *et al.,* 2016; Nel, 2020; National Academy of Sciences (NAS), 2002; Nature Trust British Columbia, 2024). Although humans are part of nature, the relationship between humans and nature is complex. Human beings derive benefits from nature and nature is also damaged by humans. In addition, a lot of natural resources and services coming from nature are taken for granted. RH being part of nature have been applauded globally for their enormous contribution towards improvement of human welfare (Singh *et al*., 2021; Chaplin-Kramer, 2023). The word 'riparian' originates from the Latin word 'riparius' which means "of or belonging to the bank" implying any area or land adjacent to the water bank is regarded as a riparian area or reserve (Johnson & Carothers, 1982; Qureshi & Harrison, 2002; GOK, 2016); Jeffrey *et al*., 2014). Whenever the conditions or environment in the riparian areas are favorable to support biotic systems, then these areas become RH which simply means a home for riparian resources. Within the RH, some of the resources exhibit a symbiotic relationship hence forming a riparian ecosystem (Jeffrey *et al*., 2014; Singh *et al*., 2021). Globally, RH are diminishing in size as a result of destruction due to human encroachment activities such as illegal developments, waste dumping and water diversions (Colby & Orr, 2005; Nel, 2020; Karangi, 2017). Additional factors contributing to RH destruction include population growth, urbanization, land scarcity and agricultural activities (Karisa, 2010).

Despite covering a small portion of the landscape, RH are highly productive in terms of plant and animal biomass compared to adjacent areas (Johnson & Carothers, 1982; Qureshi & Harrison, 2002; Karangi, 2017) hence offering numerous benefits to both society and the environment (Nel, 2020; Singh *et al*., 2021; Broadhead, 2000). These benefits, which include hosting diverse flora and fauna, enhancing scenic beauty, serving as wildlife corridors, influencing property prices and providing ecosystem

services, are difficult to quantify and lack market values (Carson, 2000; Ndambiri *et al*., 2015) and the only way they can be valued is through conducting an economic valuation. Economic valuation is the process of measuring the use and non- use benefits derived from a good or service to an individual and usually that value is elicited by determination of the maximum amount a consumer is willing to pay for something (Ndambiri *et al*., 2016; Cameron & Huppert, 1989). This valuation can be applied to both marketable and non -marketable goods and services. For marketable goods, the market prices can be used to elicit their values using either explicit or implicit prices. In addition, it is easier to determine the use values of a good or service since the marketing of such commodities can be observed (Cameron & Huppert, 1989; Holmes *et al*., 2004). Approaches such as hedonic pricing and travel cost method are commonly used to determine the use values of commodities (Ndambiri *et al*., 2015). On the other hand, valuation of non –marketable goods and services is challenging given the fact that no observable market transactions can be realized, hence valuation of such commodities can only be achieved through simulated hypothetical markets generated through conducting experiments (Alberini & Cooper, 2000; Barrena *et al*., 2014; Zhong *et al*., 2016; Neupane *et al*., 2017). To determine the value of these benefits, economic valuation methods such as the Contingent Valuation Method (CVM) and Choice Experiments (CE) are commonly used (Alberini & Cooper, 2000; Barrena *et al*., 2014; Zhong *et al*., 2016; Neupane *et al*., 2017).

The popularity of CVM and its wide application originates from its power and ability to elicit both consumptive and non-consumptive uses of commodities besides option, bequest and existence uses. Moreover, given its ability to elicit valuation gains and losses associated with a good or service using either willingness to pay (WTP) or willingness to accept (WTA) approach, its widely accepted for policy purposes (Cook

et al., 2018) and that is why it was adopted in this study. At international level, there are several bodies and organizations which advocates for conservation and protection of RH. Such bodies include: United Nations Educational Scientific and Cultural Organization (UNESCO) which focuses on development of international framework to promote ecotourism on riparian lands, Man and Biosphere Programme (MAB), convention on Wetlands also known as the Ramsar Convention established in 1971 by UNESCO and the Natura 2000 Network for conservation and protection of biodiversity among others (Schismenos *et al*., 2018; Matunda, 2015; Qureshi & Harrison, 2002). However, even with existence of these bodies, most RH are being destroyed hence impeding their proper functioning. In Africa, where there is no clear separation between people and nature, RH are vital for sustaining livelihoods and are frequently used by households for various activities (Johnson & Karothers, 1982; McKinnon *et al*., 2016). However, increasing population growth and intensified land use threaten these habitats, necessitating greater attention to prevent further destruction (Karangi, 2017).

Despite the fact that RH critiplay a critical role in safeguarding clean water sources and providing habitats for biodiversity, RH in Africa face significant pressures from agricultural activities, urbanization, climate change, pollution and biological invasion (Du Plessis *et al*., 2022; Nel, 2020; Singh *et al*., 2021). Human encroachment continues to pose a major threat to RH, highlighting the urgent need for conservation efforts to protect these invaluable ecosystems (Holmes *et al*., 2008; Holmes *et al*., 2002; NAS, 2002; Mugo *et al*., 2022). Various efforts have been undertaken to protect RH in Africa, including the fencing of RH areas, establishment of conservation initiatives, improvement of existing conservation policies, and raising public awareness on conservation issues. Additionally, authorities such as village elders and chiefs have been involved in efforts to protect these habitats (Singh *et al*., 2021; Matunda, 2015).

However, many of these efforts have faced challenges and achieved limited success, often due to factors such as inadequate support from riparian communities. Furthermore, conservation strategies have often focused on implementing practices without adequately evaluating household participation in RH preservation or formulating comprehensive protection policies (Singh *et al*., 2021).

1.1.1.2 Brief overview of the status of RH in Kenya

RH stand as vital contributors to environmental conservation and human well-being in Kenya. Their multifaceted significance encompasses water regulation, spiritual and social functions, recreational and sporting spaces, research opportunities, birdwatching havens, and diverse flora and fauna hosting. However, despite their pivotal role, RH in Kenya face persistent threats, primarily driven by human activities and encroachment (Mugo *et al*., 2022). Anthropogenic pressures, such as urbanization, agricultural expansion and industrial development, further compound the destruction of these essential ecosystems. Factors such as corruption, poverty, homelessness, greed, and instances of land grabbing contribute to the continuous obliteration of RH. These habitats are often viewed as vacant lands for economic exploitation, and the delayed legal enforcement from government authorities has significantly contributed to their persistent deterioration (Mugo *et al*., 2022). Vulnerable to pollution, deforestation, and land-use changes, RH ability to provide essential services is compromised. Dumping of solid wastes, discharge of harmful chemical effluents, and untreated sewages further degrade their health, hindering proper functioning (Ryan *et al*., 2003; Matunda, 2015; GOK, 1999, National Research Council (NRC), 2002; Muketha, 2020). In Kenya, institutional frameworks like the GOK (2010), National Environment Management Authority (NEMA) and Water Resources Management Authority (WARMA) have been established to conserve RH. At the grassroots level, county governments and local

communities play a pivotal role in addressing shortcomings in RH protection, especially in areas where comprehensive protection programs are lacking. Preserving RH through regulatory or voluntary measures involves considering both regulatory and non-regulatory options at the local level (Jeffrey *et al.*, 2014; Karangi, 2017), such as encouraging households to voluntarily participate in RH protection efforts. Despite the active involvement of non-governmental organizations and state actors such as NEMA in RH protection, challenges persist.

These challenges include fragmented legislation, overlapping institutional mandates, a lack of integrated information platforms, and a failure to fully comprehend the implications of unsustainable land use practices by riparian communities (Karangi, 2017). Moreover, the various provisions of the law in regard to protection of riparian areas do conflict when it comes to the distance required to define those areas. The (GOK, 2012a) explicitly states that no cultivation or tree cutting is permitted within a 2-meter distance from the bank of a water course. Conversely, according to the (GOK, 1998) during land subdivision, reserves and buffer strips along rivers or water courses should not exceed a distance of 10 meters from the water bank (Matunda, 2015; Karangi, 2017). These discrepancies in the defined distances for riparian areas create room for potential destruction. Additionally, there is no specific sectoral Act, law, or provisions governing the use and protection of RH in Kenya. Often, there is a reliance on general principles of environmental law and other constitutional and statutory provisions to safeguard riparian zones (Matunda, 2015). The most commonly relied on Acts and policies for riparian management are: - GOK, 1999, GOK, 2006, GOK, 2007, GOK, 2012a; GOK, 2012b, and the GOK, 2002. The (GOK, 2010) emphasizes that ‘‘The State shall ensure sustainable exploitation, utilization, management, and conservation of the environment and natural resources, and ensure the equitable sharing

of the accruing benefits'' (2010 page 56). Despite this constitutional provision, in Kenya, and particularly in Nairobi County, encroachment and destruction of RH have resulted in increased hardships for households. This is evident through the costs of clean water provision for domestic use, elevated cases of waterborne diseases such as cholera and typhoid, heightened recreation expenses, and sometimes restricted access to recreational facilities, along with fluctuations in property prices (Karangi, 2017). According to Kenya National Beareau of Statistics (KNBS), 2021, to address water scarcity in the country, the Kenya national government allocations on water supplies and related services significantly increased from Ksh 44.5 billion in the year 2019/2020 to Ksh 55.2 billion in the year 2020/2021, and water infrastructure developments accounted for more than 50 percent of the total expenditures. Nairobi County government allocated 900 Million towards provision of clean water and sanitation in the financial year 2019/2020 and the allocations increased to 1.2 billion in the financial year 2020/2021 as per the (GOK, 2021a; GOK, 2021c).

These expenses suggest that the management and protection of RH have not received sufficient attention, despite their crucial roles (Karangi, 2017). Acknowledging the environmental and socio-economic values linked to RH, different collaborative and cooperative efforts at the state level have been launched to safeguard and preserve these areas (GOK, 2010). The latest joint endeavor aimed at consensus-building is the Nairobi rivers catchment protection and restoration programme led by the Nairobi Rivers Commission (NARC) of 2022. This recent collaboration comprises the national government, county government, city agencies, civil society, the United Nations Environment Programme (UNEP), and the academic community. Each of these organizations posses expertise and resources in the protection of RH. The joint effort aims to raise public awareness about the advantages of preserving the natural and

environmental ecosystem, including RH protection. This aligns with various legal provisions and is consistent with the (GOK, 2021a). In addition to these collaborations, other state entities, such as NEMA in collaboration with non-governmental organizations (NGOs), have actively supported environmental and natural resources protection through public awareness campaigns. The focus has been on supporting RH for flora and fauna, regulating water bodies, flood mitigation, and promoting environmentally friendly agricultural practices, in accordance with (GOK, 2010). However, the effectiveness of these efforts has been limited and thwarted by inadequate financing from the government thus RH continue to face challenges of insufficient protection measures.

The destruction of RH in Kenya has prompted a need for a comprehensive economic valuation study to assess their true worth and understand the implications of their decline. Household perspectives become paramount in this context, as studies have demonstrated that well-preserved RH contribute towards reduced property loss, improved scenic views and overall environmental aesthetics, access to clean water, disease prevention and suitable grounds for sports activities (NRC, 2002). Prior to the creation of the current collaborative environmental conservation partnerships, several attempts at achieving consensus in regard to conservation of nature were unsuccessful, including the national climate change action plan and the green economy initiatives of Kenya in the year 2012.

However, many parties have remained committed to the adoption of community collaboration and cooperation strategies to save the Kenyan RH from extinction. In the meantime, and until adequate RH protection policies are formulated, the health and functioning of RH remains in peril as also observed earlier by (Karangi, 2017). As

various courses of action and researches are considered to protect these habitats, the question of the value placed by households on RH protection necessitates clarity. Households form an important population to consider because of the economic outflows experienced as a result of the effects of unprotected RH within the city. Studies have shown that RH that are effectively safeguarded exhibit riparian resources including plants, herbs, fish, clean water for various uses, herbal medicine, birds, livestock forage, shade, fuelwood and timber (NRC, 2002), which contribute significantly to the well-being of many households.

Furthermore, studies indicate that destruction of RH as a result of agricultural related activities leads to the loss of riparian vegetation and habitat. Consequently, areas subjected to such encroachment experience stream bank and channel damage, along with a decline in water quality (Nel, 2020; Du Plessis *et al*., 2022; Muketha, 2020). Before the ongoing collaboration in Kenya aimed at conserving environmental and natural resources, the national government, in partnership with the African Development Bank, civil society, and multinational agencies, successfully advocated for RH preservation. This success was achieved through initiatives such as the "Nairobi Rivers Rehabilitation and Restoration Program, Sewerage Improvement Project" of 2010.

The project focused on pollution control, enhanced waste management, fostering community participation, raising public awareness, capacity building, and formulating legislation related to the Nairobi River Basin system and its ecosystem (Karisa, 2010; Mugo *et al*., 2022). Although the project initially succeeded, the RH around the Nairobi River have, over time, experienced destruction, potentially attributed to a lack of comprehension regarding household support and financial contributions for protection.

Despite coordinated collaborative endeavors, the destruction of RH is on the rise, manifested in illicit developments and environmentally detrimental agricultural practices stemming from human encroachment. Research statistics indicate a significant rise in the construction of permanent houses within RH, from a 9 percent increase between 2000 and 2010 to a 262 percent surge between 2010 and 2017 (Karangi, 2017; Mugo *et al.*, 2022). Additionally, households residing near RH have demonstrated insufficient responsiveness, as evidenced by building collapses, frequent flooding, and recent state-ordered demolitions of structures in these areas. Despite numerous environmental preservation acts and regulations, RH destruction persists. Ideally, such destruction should be prohibited, and the establishment of settlements and cultivation in these areas should be avoided.

However, urban agriculture, human settlement, and solid waste dumping are on the rise in these regions, further contributing to more destruction of these critical habitats. This raises questions for researchers about the observed behavior. Could it be that most people perceive these habitats as public goods, making them susceptible to destruction? Is it that household interests and benefits outweigh societal and protection benefits? Or could it be that there are inadequate policies for the protection of these habitats? The observed scenario calls for measures to counteract human encroachment into these habitats to protect and revive the lost glory of Kenyan RH.

1.1.1.3 Economic valuation

The economic valuation of environmental goods and services through the contingent valuation method (CVM) is a well-established practice. Although this method has been employed for some time, its application in valuing RH protection is limited (Ndambiri *et al.*, 2015). In economic valuation, obtaining accurate values for commodities through

either WTP or WTA depends on the nature of the policy under consideration. WTA is chosen when the policy aims to compensate households for the losses incurred due to, for instance, an improvement in policy or more provision of a commodity. On the other hand, WTP is adopted when the policy seeks to determine how much households would be willing to pay for the enhancement of the policy or their situation, such as through increased provision of a good or service (Fonta *et al*., 2010; Hjerpe & Hussain, 2016; Neupane *et al*., 2017). This study focused on safeguarding RH and utilized the WTP approach to ascertain households' readiness to financially support its protection, especially when they felt negatively impacted by the present condition of deteriorated RH. Given that CVM requires creating hypothetical situations, conducting experiments played a pivotal role in this research.

The economic valuation scenario for RH integrated WTP via the CVM method within an experimental framework. The expanding body of research indicates that WTP is influenced by various factors. These factors encompass household characteristics such as age, income, gender, and household size (Holmes *et al*., 2008; Ndambiri *et al*., 2016; Cameron & Huppert, 1989), institutional aspects like distance and land ownership, and contingent valuation (CV) factors (Carson, 2000; Wiser, 2007; Zawadzki, 2016; Svenningsen & Jacobsen, 2018). According to the burgeoning literature and the CV study guidelines established by Carson in 2000, the CV variables that impact WTP include Elicitation Format (EF), which denotes the format used to generate data in CV; Bid Range (BR), indicating the intervals of bids employed for valuation in experimental designs; Payment Vehicle (PV), representing the preferred mode of payment for households; and Valuation Good (VG), delineating how households perceive the good, whether as a public or private good. Examining the individual influence of these variables on CV estimates, particularly WTP, along with its associated standard

deviation (SD), in the context of RH protection, would enhance the understanding of WTP determinants. This, in turn, would provide valuable insights into CV estimates for RH protection, particularly in a context where the responsibility for caring for RH is presumed to be a government role. Moreover, there was an anticipation that specific households would demonstrate support for RH protection.

Therefore, assessing the authentic WTP and the actual WTP values of these households, while exploring the factors influencing both the true WTP and the disparity (SD) between true and actual WTP values, would provide a deeper understanding of household decision-making concerning RH protection within the city. Additionally, the findings of this study would contribute to the existing knowledge on RH protection, addressing gaps in the literature on the subject. It was hypothesized that the CV variables would not significantly affect either WTP or its SD for RH protection.

1.1.1.4 Summary of identified research gaps

Destruction of RH within Nairobi county occurs despite the presence of various Acts and laws, as well as robust environmental and natural resources conservation and protection bodies (Karangi, 2017; NAS, 2002). This observation suggests a potential limitation in households' involvement in RH protection. The review of economic valuation literature highlighted that although the CVM is widely employed to assess the worth of various environmental goods and services, its use in valuing RH protection, particularly in Kenya, is limited, as observed by Ndambiri *et al*., (2015). This scarcity of application in the Kenyan context was a primary reason for its selection in this study. Furthermore, due to the inadequate funding allocated by the Kenyan government for protection endeavors, as noted by Matunda (2015), understanding household contributions towards protection was deemed necessary. Hence, the study opted for the

WTP approach to determine the economic values associated with RH protection. Furthermore, the ambiguity surrounding the value placed on RH protection by households necessitated the adoption of the WTP approach. Existing studies on WTP have demonstrated that treating WTP as fixed often results in inflated valuation estimates (Cameron & Huppert, 1989; Vossler *et al*., 2004). Additionally, such an approach assumes that all households have a static valuation of their utilities, which is not reflective of reality.

Conversely, several studies have treated WTP as a random variable in the economic valuation of goods and services, leading to more conservative valuation estimates (Wang & Jie, 2010; Wang & Whittington, 2005; Fonta *et al*., 2010). However, the impact of such treatment, particularly concerning the valuation of RH protection in Kenya, remains unclear. A review of literature on the determinants of WTP and its associated standard deviation (SD) has highlighted commonly documented factors such as household characteristics, physical and institutional factors (Ndambiri *et al*., 2015; Holmes *et al*., 2002; Holmes *et al*., 2008; Wiser *et al*., 2007; Fonta *et al*., 2010). Moreover, contingent valuation (CV) variables, including Elicitation Format (EF), Bid Range (BR), Payment Vehicle (PV), and Valuation Good (VG), have been recognized in environmental and natural resources literature (Alberini *et al*., 2003; Vossler, 2003; Vossler *et al*., 2003). Nevertheless, the specific empirical contributions of each of these CV variables to RH protection remain unexplored. Several EF have been used to elicit data for economic valuation under experimental designs and such methods range from open ended, single and double bound method besides payment card (PC). Among the various elicitation methods, the utilization of the PC, particularly the Stochastic Payment Card (SPC) and Multiple Bound Discrete Choice Card (MBDC), face limitations in terms of their application in valuation, despite their capacity to gather

additional data through both numerical and ordinal extensions, unlike the standard PC. Studies examining BR have uncovered gaps in comprehending how variations in BR influence WTP values when split samples are utilized. Several studies have treated BR as a consistent factor across samples. Some have exclusively analyzed the impacts of increased BR on valuation estimates, while others have focused solely on the effects of decreased BR. Nevertheless, there is limited information available regarding the combined effect of constant, increased, and decreased BR on valuation across split samples, particularly concerning RH protection. Various PV have been employed for valuation, and among the available options, the utilization of Tax and Trust (Svenningsen & Jacobsen, 2018) is not commonly observed, making it the preferred choice for valuation in this study. Additionally, the nature of the VG and household perception of the good were deemed influential on valuation. Some researchers have suggested that when the good is perceived as public, it receives lower valuation compared to when viewed as private, and vice versa. However, previous analyses of this nature have been conducted using homogeneous samples, focusing on one good at a time in different study scenarios.

In this study on RH protection, such analyses took a different approach by considering both private and public good perspectives together within the same study context, using split samples. It is against this background that this study examined economic valuation of RH through assessing the households' WTP and its SD for protection together with their determinants and the findings would contribute to the pool of knowledge on RH protection given a dearth of literature. In conclusion, there was a gap in the existing literature regarding the economic valuation of RH protection in Kenya. Understanding the economic value of these habitats is crucial for making informed decisions, implementing effective conservation strategies, and promoting sustainable land use

practices. Economic valuation provides a framework for assessing the tangible and intangible benefits derived from the RH, including clean water provision, recreational and sporting opportunities, aesthetic values, and their contribution to overall environmental health (Costanza *et al.,* 1997). This study aimed to address these existing gaps by conducting a thorough economic valuation of RH protection in Kenya, with a specific focus on Nairobi County. Nairobi, being the capital city and a hub of economic activities, is characterized by intense urbanization and potential threats to riparian ecosystems (Mugo *et al*., 2022).

By quantifying the economic value of RH, this research aimed to offer valuable insights for policymakers, environmental practitioners, and local communities and households. These insights can facilitate informed decisions regarding the protection and sustainable management of these critical ecosystems in Kenya.

1.2 Statement of the problem

Riparian habitats (RH) offer aesthetic beauty, clean water, and numerous environmental benefits. However, these advantages are compromised due to human encroachment, conflicting conservation mandates, inadequate legal enforcement, and other factors, resulting in diminished overall health and functionality of RH. The situation is further worsened by increasing incidents of land grabbing, the effects of climate change, poverty, homelessness, and political interference, despite the presence of protective bodies and organizations. In Nairobi County, challenges such as informal settlements, poor river sanitation, and urban farming exacerbate RH destruction, despite existing legislation. Previous interventions like demolitions and educational campaigns have had limited success, necessitating a nuanced approach to RH protection. The absence of economic valuation studies on RH protection in Kenya impedes informed decision-

making and conservation strategies in the face of increasing environmental threats and human encroachments, as the actual value assigned to these habitats by households remains unknown. The economic valuation process is instrumental in comprehending both the consumptive and non-consumptive benefits of RH protection. Existing literature underscores that well-protected RH contribute to household benefits beyond access to clean water and the provision of a disease-free environment, including offering suitable grounds for sporting and recreational activities. Unfortunately, residents within Nairobi city currently do not enjoy these advantages. The escalating costs of supplying clean water, engaging in recreation, and participating in sports suggest that the role of RH in the city has not received adequate attention. Therefore, understanding households' WTP for RH protection and its determinants is crucial. Moreover, exploring variations in WTP and its determinants could provide valuable insights into decision-making processes related to RH protection in Kenya. From a theoretical and environmental economic lens, the utility gained from utilizing a habitat is expected to impact household WTP. This WTP is influenced by various factors, including institutional, physical, socio-economic, and contingent valuation (CV) variables such as EF, BR, PV, and VG. While the effects of the former three variables on WTP are extensively documented, comprehending the influence of the latter variables on CV estimates (WTP and its SD) for RH protection within Nairobi County would significantly enhance the overall understanding of RH protection drives.

1.3 The General objective

The broad objective of this study was to carry out an economic valuation of RH protection in Nairobi County, Kenya.

1.3.1 Specific objectives

i) To analyze the effect of changing the EF on households' CV estimates towards RH protection in Kenya.

ii) To assess the effect of changing the BR on households' CV estimates towards RH protection in Kenya.

iii) To assess the effect of changing the PV on households' CV estimates towards RH protection in Kenya.

iv) To determine the effect of changing the VG on households' CV estimates towards RH protection in Kenya.

1.4 Hypotheses

i) Changing the EF does not significantly affect households' CV estimates towards RH protection in Kenya.

ii) Changing the BR does not significantly affect households' CV estimates towards RH protection in Kenya.

iii) Changing the PV does not significantly affect households' CV estimates towards RH protection in Kenya.

iv) Changing the VG does not significantly affect the households' CV estimates towards RH protection in Kenya.

1.5 Justification of the study

The significance of RH in regulation of water quality and quantity cannot be overstated. Economic valuation provides a tool to evaluate the economic advantages associated with ensuring clean water provision and meeting the increasing demand for fresh water resources in urban areas (Masese *et al.,* 2015; Nature Trust British Columbia, 2024). This understanding can prove invaluable for policymakers, including entities like the Kenya National Environment Management Authority (NEMA), by empowering them to formulate focused and evidence-driven RH protection strategies (GOK, 2010).

Furthermore, conducting economic valuation studies significantly contributes to understanding the value households place on RH protection. This knowledge facilitates engaging households in protection efforts, as they recognize the economic benefits, such as potential costs saved and improved quality of life. It also enables households to adjust their budgets to reflect their demand for RH protection. Moreover, knowledge on the economic valuation of RH is essential for advocating sustainable land-use practices and garnering support for protection initiatives. By quantifying the economic benefits, both national and county governments can understand the importance of establishing regulations that reflect the true value of RH. Understanding households WTP for RH protection reveals the underlying reasons behind their valuation of RH preservation. This knowledge serves as a cornerstone for formulating policy recommendations and implementing enhanced protection strategies. Additionally, considering the ongoing destruction of RH, there is a legitimate concern that these habitats may face extinction over time if not adequately protected, as previously noted by Matunda (2015). This study aligns with the achievement of sustainable development goals (SDGs), particularly goals number six, fourteen, and fifteen. In light of the recent devolution of environmental and natural resource conservation services from the national to county levels in Kenya, this research would assist counties in planning and prioritizing their investments. It would also strengthen and promote public-private sector partnerships within counties to foster RH protection. Understanding the impact of changing the EF across samples is essential for shedding light on welfare effects and enhancing the reliability of CV studies. Similarly, comprehending BR and its effect on household estimates could enhance the usage and design of payment cards. Valuation of PV and their effects on household WTP could contribute to new developments in PV usage, especially in developing countries where tax as a vehicle is limited. Additionally,

examining the variation of VG and its effect on CV estimates could serve as a basis for developing appropriate policies for the management, restoration, and protection of RH, and could facilitate the review and amendment of existing laws related to RH protection. Lastly, given the existing knowledge gap in economic valuation studies on RH protection in Kenya, empirical evidence is needed to guide protection efforts. Therefore, this study would contribute to filling this gap and lay a foundation for future research and policy development.

1.6 Scope and limitations of the study

The study's scope involved contacting only public households to assess public RH and private households to evaluate private RH adjacent to their residences. This approach was chosen because these households have frequent interactions with the habitats and are presumed to have a better understanding of them. Specifically, the stochastic payment card (SPC) and multiple bound discrete choice card (MBDC) preference uncertainty data generation formats were compared due to their ability to generate both cardinal and ordinal uncertainty values, which were used to adjust WTP values. However, the study encountered several limitations:

1. Data generation relied on hypothetical scenarios because real market transactions for environmental goods and services are non-existent in Kenya, making it difficult to attach monetary values to RH protection. This challenge was addressed by using the CVM which can value both use and nonuse values for environmental goods and services.
2. During the research there were some existing arrangements where private investors invested in riparian areas with the aim or regulation of using them sustainably to derive private benefits but in the process their conservation efforts yielded public benefits which were far reaching to other people and counties.

Those investments were considered private and not joint even though they possessed both private and public characteristics. This is because they were very few and private characteristics surpassed public characteristics.

3. In some instances, some households were suspicious of the study's intentions and were hesitant to answer questions. To address this, researchers showed their research permit and explained that the data collected was solely for research purposes.
4. Certain households were reluctant to provide information, particularly regarding income, age, and household size. Researchers rephrased questions to ensure reliable data collection and also utilized observation methods to gather consistent data.

CHAPTER TWO

LITERATURE REVIEW

The chapter encompasses a discussion of the theoretical framework used to estimate welfare values through contingent valuation, along with its preference elicitation

methods. It also includes an examination of empirical reviews and identifies existing research gaps. Finally, it presents the conceptual framework.

2.1 The Welfare economics theoretical framework

The theoretical foundation of welfare economics revolves around three key concepts: consumer surplus, compensating variation, and equivalent variation. These concepts are derived from either the widely used Marshallian/ordinary demand curve or the Hicksian/compensated demand curves. Consumer surplus (CS), a concept derived from the ordinary demand curve, is central to this framework. Alfred Marshall defines CS as the disparity between a household's marginal willingness to pay (WTP) and the actual market price. The marginal WTP curve represents the household's Marshallian demand curve, often derived from the household's utility function within the confines of a budget constraint and prevailing market prices (Varian, 2005). However, Marshallian CS has its limitations, primarily stemming from assumptions of imperfect knowledge regarding market prices, the existence of numerous substitutes for a given good, and variations in marginal utility among consumers based on factors such as income, preferences, and tastes (Varian, 2005).

These limitations are intertwined with the nature of Marshallian demand curves, which maintain income as constant rather than utility. Despite these shortcomings, the CS owes its strength to the fact that it provides a monetary measure of change in welfare due to a policy change, by measuring the difference in income levels. On the other hand, Hicksian demand curves (compensating and equivalent variations) are regarded as more appropriate measures of welfare compared to Marshallian demand curves (Fonta *et al*., 2010; Neupane *et al*., 2017), because they hold utility constant and allow income to vary thus can be used to measure policy impacts on households' welfare (Ndambiri *et al*., 2016). Contingent valuation method (CVM) owes its theoretical basis to the neo-

classical theory of consumer behavior (utility maximization) that gives rise to the Marshallian demand function. According to Fonta *et al.* (2010), a simple framework for the CVM starts with a household utility function specification as follows:

$$u(s,q) \quad \text{(2.1)}$$

where s and q represent a vector of market and non-market goods respectively. A set of bundles that satisfy the consumer's budget constraint y and vector of prices $p = (ps, pq)$, represents the affordable bundle. One maximizes utility by choosing a level of s, but the level of provision of q is exogenously determined (Neupane *et al.*, 2017). Therefore, the utility maximization problem is formulated as:

$$\text{Max } u(s,q) \quad \text{st } ps \leq y \quad \text{.....(2.2)}$$

Conversely, under the assumption of local non-satiation, equation (2.2) can be rewritten as:

$$\text{Max } u(s,q) \quad \text{st } ps = y \quad \text{.....(2.3)}$$

Solving constrained problem in equation 3 results into a Marshallian demand function expressed as:

$$s_i = h_i(p,y,q) \qquad \text{where } i = 1, \dots k \quad \text{.....(2.4)}$$

which is a function of prices (*p*), income (*y)* and non-marketable good (*q)*. From the Marshallian demand function, the indirect utility function from a non- marketable good at given prices and income levels can be specified as:

$$v(p,q,y) = u[h_i(p,q,y)q] \quad \text{(2.5)}$$

With improvement in quality of the non- market good q, say from q^0 to q^1 due to self-financing, the household's utility function also changes to:

$$u^1 = v(p,q^1,y) > u^0 = v(p,q^0,y) \quad \text{(2.6)}$$

where $u^1 > u^0$, and q^0 represents initial level of utility before self-financing, whereas q^1 stands for the hypothetical improved scenario. Equation (2.6) gives rise to two

measures of utility changes, that is the Hicksian Compensating Variation (CoV) and Equivalent Variation (EV) measures of welfare change, hence:

$$v(y - WTP, p, q^1) = v(y, p, q^0) \quad \text{.....(2.7)}$$

$$v(y + WTP, p, q^0) = v(y, p, q^1) \quad \text{.....(2.8)}$$

Equation 2.7 represents the Hicksian Compensating Variation measure which uses the baseline scenario as a reference point and it is defined as the amount of money that, if taken away from an household after the change in provision level of non -market good from q^0 to q^1, will leave the household just as well off as he was before the change (indifferent). Equation 8 represents the Hicksian Equivalent variation measure of change in welfare. The Hicksian measure uses the improved scenario q^1 as the base case and it refers to the amount of money that when added to the household, he/she will keep his utility constant if the change in q from q^0 to q^1 makes him/her worse off (Ndambiri *et al.*, 2015; Neupane *et al.*, 2017). The empirical model for the WTP function of household j can be described by an array of personal and economic characteristics **w** and the stochastic variable ε of the respondents which can then be formulated as:

$$WTP_j = w_i'\beta + \varepsilon_i \quad \text{.....(2.9)}$$

The choice of either (WTP or WTA) to measure change in welfare, depends on the policy question to be address. If the aim of the policy is to compensate households (WTA), then equation (2.8) is appropriate. However, if the policy plan seeks a reasonable, objective and budget constrained measure of WTP, then, equation (2.7) is the most appropriate measure of a welfare change (Carson, 2000; Carson *et al.*, 2001, Neupane *et al.*, 2017). Given the nature of policy question that this study intended to address, the Hicksian compensating variation measure of welfare change was adopted. This study opted for welfare economics theory given the hypothesized changes in

expenditures and incomes. Moreover, given that no market exists in Kenya for RH protection, welfare economic theory guided the valuation.

2.1.1. Consumer utility maximization theory

This theory is also known as the neo-classical welfare economic theory of consumer behavior developed by Alfred Marshall in 1860. In the theory of consumer behavior, any rational consumer is after utility maximization subject to the budget constraint, or expenditure minimization subject to utility constraint. The study opted for consumer utility maximization through minimization of expenditure as denoted by (Ndambiri *et al*., 2015). Thus, consider the following general expenditure function for a household in Nairobi Kenya who wants to maximize his utility from RH protection by expenditure minimization.

$$e(p, s, x, I, c, u) = y \quad \ldots\ldots(2.10)$$

where ***e*** is the expenditure function, ***p*** is a price vector, ***s*** is the state of the RH, ***x*** is the household social economic characteristics, *I* represent institutional characteristics, c stands for contingent valuation factors, ***u*** is the level of utility, and ***y*** is the minimum income necessary to allow a household to maintain utility level in the city. Furthermore, consider the situation where a policy is proposed to protect RH through reduced degradation. The policy, thus, prohibits all activities that degrade RH. A household is then asked about the amount he/she would be WTP towards RH protection through reduced degradation. The expenditure function for the initial period before the proposed policy would be:

$$e\,(p, s_o, x_o, I_o, C_o, u_o) = y_o \quad \ldots\ldots(2.11)$$

where $\boldsymbol{u_o}$ is the initial level of utility that a household can enjoy given prices **p**, $\boldsymbol{s_o}$ is the initial un-protected state of RH, ***xo*** is the household socio economic characteristics, I represents institutional characteristics, C is contingent valuation

factors, and y_o represents the minimum level of income required to attain utility level u_o. Since the new policy is expected to improve the state of RH in the city from unprotected to protected, the new expenditure function would therefore be of the form:

$$e\ (p, s_{1,} x_{o,} I_{o,} C_o\ u_o) = y_1 \quad \text{.....(2.12)}$$

where s_1 is the improved/protected state of RH after the implementation of the proposed policy and y_1 represents the minimum income level required to attain utility level u_o after the implementation of the proposed policy. The level of utility, u_o, is held constant since Hicksian welfare measures assume that utility remains constant. Hence, the household's WTP for improved state of RH protection would be a compensating variation measure since a household would have to part with a certain amount for the improvement to occur. The compensating variation (CoV) is equal to the household's WTP and is given by the difference between the expenditure functions y_1 and y_0:

$$CoV = WTP = y_{1-} y_0 \quad \text{.....(2.13)}$$

$$\text{CoV} = \{e\ (p, s_{1,} x_{o,,} I_{o,}\ C_o\ u_o) - e(p, s_{o,} x_{o,,} I_{o,}\ C_o, u_o)\} \quad \text{.....(2.14)}$$

The improved state of RH in the county after implementation of the proposed policy, s_1, is supposedly greater than s_o. As utility and prices are held constant, y_1 (the minimum income level required to attain utility level u_o after implementation of the proposed policy) is less than y_0. Therefore, the CoV would be negative meaning that a household has to pay some amount to enjoy the improved/protected state of RH. The utility maximization theory was used given it utilizes the indirect utility functions out of which the WTP values were elicited.

2.2 Empirical reviews

This subsection offers literature reviews encompassing various aspects related to RH within Nairobi city. It delves into the characterization of RH, the measurement of WTP and its determinants from socio-economic, institutional, and physical perspectives. Additionally, it discusses different approaches to data elicitation formats (EF) and reviews on bid range (BR), payment vehicle (PV) and valuation good (VG).

2.2.1 The nature of RH in Kenya and the contingent valuation method (CVM)

In Kenya, a riparian area is defined as "any land adjacent to the ocean, lake, sea, rivers, dams and water courses" However, the scope of this definition has been expanded to include wetlands which comprises of springs, swamps, dams, deltas and mangroves as per Section 2 of (GOK, 2012b). The GOK, 2002 clearly defines riparian area as "land within a minimum distance of 6 meters and a maximum distance of 30 meters from the water course (GOK, 2007; Muketha, 2014; GOK, 2016; Matunda, 2015). In this study, the term RH was used to refer to any land adjacent to water bodies such as (rivers, lakes, oceans, seas, swamps, dams, springs, marshes) with a minimum distance of 6 Meters to 30 Meters from the bank of a water course to the nearby agricultural activity, place of residence or business and with good conditions to support riparian resources as stipulated by (GOK, 2016). RH in Kenya are distinguished by vegetated buffer strips located alongside streams, rivers, lakes, and other waterways. These strips play a vital role in shielding aquatic environments from excessive sedimentation, surface runoff pollutants, and contaminants originating from the neighboring landscape (Muketha, 2020). In numerous countries, these buffer strips constitute an integral component of RH. The situation is not any different in Nairobi. However, in Nairobi County, riparian buffer strips along Mathare and Nairobi rivers are facing major destruction challenges and scientific support to have these buffer strip homes protected for the survival of

humanity is needed. Degradation and destruction of RH occur due to incomplete user rights and ownership rights (Qureshi & Harrison, 2002; Karangi, 2017). Ownership of Kenyan RH are bestowed to the state as per the fragmented environmental and land laws (Matunda, 2015; Karangi, 2017). However, households or entities with lands adjacent to riparian properties can avail themselves of certain user rights. These rights include ownership of the land extending up to the watercourse, the privilege of water flow onto the land, and the authority to safeguard property from flood-related damage, as well as preventing land erosion. Additionally, landowners are entitled to utilize water and are responsible for allowing the unobstructed passage of water without diversion or pollution, which could potentially infringe upon the rights of others (GOK, 2012b). The situation in Nairobi city presents a unique challenge. Some riparian properties on the outskirts of the city, particularly along riverbanks, dams, and swamps, have been entrusted to the care of village elders and chiefs who lack the capacity to regulate their usage effectively. This neglect and reluctance from authorities to oversee riparian lands contribute to their extensive exploitation by households and communities, disregarding environmental impacts. This underscores the prioritization of household interests over societal welfare (Matunda, 2015).

The literature emphasizes the imperative of safeguarding and nurturing riparian areas to ensure their optimal functionality (Matunda, 2015; Jeffrey *et al*., 2014; Muketha, 2020; Mugo *et al*., 2022). A multitude of studies underscores the importance of conserving environmental goods and services, supported by an extensive body of literature exploring economic valuation techniques, encompassing both stated and revealed preference methodologies (Welsh & Poe, 1998; Ichoku *et al*., 2009; Wang & Whittington, 2005). The utilization of a non-market valuation approach, particularly the CVM in this study is justified by the recognition that protecting RH holds equal

importance to other environmental goods, despite lacking a market price. Both revealed preference non-market valuation methods such as travel cost and hedonic pricing, and stated preference methods such as CVM and Choice Experiments (CE), have been extensively utilized in environmental valuation (Dikgang & Muchapondwa, 2013; Chanel *et al.*, 2016; Hung *et al.*, 2007). Revealed preference methods utilize surrogate markets to indirectly assign monetary values to environmental goods and services by correlating real market behavior with the proposed policy. However, revealed preference methods such as travel cost method and hedonic pricing have been criticized for their inability to effectively measure non-use values lacking market value (Neupane *et al*., 2017). Stated preference methods, on the other hand, directly attach monetary values to such goods and services by eliciting respondents' WTP or WTA (Carson *et al*., 2001; Ichoku *et al*., 2009; Ndambiri *et al.*, 2015; Ndambiri *et al.*, 2016; Neupane *et al*., 2017; Zhong *et al*., 2016; Barrena *et al*., 2014). Contingent valuation has been in use for over 35 years and has found extensive application in estimating welfare effects on various goods and services, including improved air and water quality, outdoor recreation, wetlands and wilderness restoration, conservation of cultural heritage sites, and enhancements in public education and utility reliability. While it is often associated with natural resource damage assessments such as oil spills, the majority of CVM applications have been aimed at assisting in policy evaluations (Carson, 2000). Studies done so far on economic valuation using CVM have focused on valuing non-marketed goods which range from agricultural extension services (Onoh, *et al*., 2014; Temesgen & Teferi, 2015), guidance and counselling services (Kim *et al*., 2018), food items and medicinal plants, forests, marine, coral reefs, recreational and agricultural heritage sites, improved water quality, social activities and dry land ecosystem services respectively (Zawadzki, 2016; Daly *et al*., 2015; Huhtala, 2004; Barrena *et al., 2014*; Konopka,

2013; Dikgang & Muchapondwa, 2013). Similarly, studies done on riparian lands range from: - riparian forests and vegetation conservation practices (Ryan *et al*., 2004), legislative framework for sustainable protection of riparian lands (Matunda, 2015; Muketha, 2020), potentiality to support ecotourism (Schismenos *et al*., 2018) and riparian management (Hughes, 2016; Ring *et al*., 2018). Wilcock *et al*. (2009) and Jeffrey *et al*., (2014), have focused on restoration of degraded riparian lands using WTP as a proxy for measuring CV estimates, and little information has accounted for valuation of RH protection especially in Kenya. CVM has also been used to examine public and publicly provided goods (Spindler *et al*., 2018; Neupane *et al*., 2017) however, these studies failed to account for household deviations between true and actual WTP using experimental design, a gap which this study intended to fill.

While CVM is a commonly employed valuation method, it is susceptible to its own set of challenges. These include respondents potentially struggling to comprehend the scenario being presented for evaluation, leading to varying responses based on question wording, and significant fluctuations in estimates. However, these challenges can be mitigated through rigorous survey design and application of robust statistical methodologies (Neupane *et al*., 2017).

2.2.2 Understanding WTP: Measurement and Determinants in Socio-economic, Institutional, and Physical Contexts.

WTP is the difference between the maximum amount a household is willing to spend on an item rather than do without it and the minimum amount above which he or she would refuse to pay. Computation of WTP as a proxy for CV estimates is common and the WTP estimate can be captured as a single value or as a random value (Wang &

Whittington, 2005). Studies such as Mwaura *et al*. (2010), Ozor *et al*., (2013), Onoh, *et al*., (2014) have used descriptive statistics and likert scale respectively to record a single WTP for a household. However, these methodologies failed to consider the fact that under experimental design one's true WTP can be stochastic in nature (Welsh & Poe, 1998; Wang & Jie, 2010; Ndambiri *et al*., 2015) and a households WTP value is inherent given the hypothetical nature in which the valuation is done (Wang & Whittington, 2005). Furthermore, certain households may express their WTP as a range rather than a single value, introducing deviation regarding their true WTP. Therefore, assuming that all households have a single valuation for their utilities would be impractical. Consequently, eliciting data on their true versus actual WTP towards RH protection would provide more informative insights. Additionally, comprehending the discrepancy between true and actual WTP values, as well as its determinants, would expand the scope of WTP valuation as earlier noted by Oduor *et al*., (2018). Moreover, establishment of the level of commitment of a household towards paying his or her stated WTP, would inform more on RH protection policies, given that few studies have endeveroued to do so. While some studies, like Ozor *et al*., (2013), acknowledge that households can be certain or uncertain in fulfilling their true stated WTP, Mwaura *et al*., (2010) and Onoh *et al*., (2014) do not. Understanding the certainty levels and associated probabilities for households who are certain of fulfilling their stated WTP would provide further insights into WTP studies. Additionally, considering the study was conducted during challenging economic times, it was expected that some households might be uncertain about their future incomes, thereby impacting their WTP (Whitehead *et al*., 2001). Therefore, comprehending individual household variations in WTP values from aggregated household WTP and the reasons behind those variations would be informative. Literature is rich on WTP and its determinants ranging from environmental

goods and services, food products both organic and inorganic, extension services, energy among others.

Empirical literature on consumer surveys reveal that consumers' socio-economic characteristics such as:- age, gender, level of education, income level, household size as well as the level of consumers' awareness and perceptions, product price, product attributes tend to influence consumers' WTP (Owusu &Anifori, 2013; Ozor, *et al*., 2013). Kumar *et al*. (2011) realized that factors like age, income, distance to service provider, tropical livestock units owned significantly influenced WTP. Neupane *et al.* (2017) and Owusu & Anifori, (2013), observed that factors such as: - age, gender, education level, occupation, household size, media exposure and income influenced WTP an observation similar that of (Temesgen & Teferi, 2015; Lamsal *et al*., 2015) variables which were investigated in this study. Verbeke *et al.* (2013) uniquely observed that apart from socio economic characteristics, household attitude, trust and importance attached to the valuation good influenced consumers WTP, variables which were equally considered in this study of RH protection. In the context of environmental goods and services, Amondo *et al*. (2013) highlighted that group membership, farm size, age, and time significantly influenced the variations in willingness to pay (WTP). Although their study focused on a different valuation good than this study on RH protection, age emerged as a significant variable affecting household valuation for RH protection. Ndambiri *et al*. (2015) noted that apart from socioeconomic variables, certainty about future income, bid amount, distance and knowledge on valuation good (Lewis *et al*., 2017; Fonta *et al.*, 2010) influenced WTP amounts. These variables were considered in this study as well, but unlike their application solely to WTP values in previous research, this study on RH protection expanded the scope to examine their effects on both WTP and its associated standard deviation. Since the RH protection

study was conducted during the COVID-19 pandemic, it was expected that most households would be uncertain about their future incomes. Despite this uncertainty, the study on RH protection employed a data generation approach similar to that used by Fonta *et al.,* (2010), but different from the approach of Lewis *et al*., (2017). As Barrena *et al.* (2014) observed, respondents such as housewives and retired people who had no permanent jobs were less likely to give true WTP as they don't earn any income, however those respondents who were temporarily unemployed but were in search of jobs were included in the analysis. This observation was also taken into account in this study. Lewis *et al*. (2017), using a logit model and data elicited from dichotomous choice (DC) format, valued public riparian areas and realized that monetary parameters such as bid amount, income and attitude toward WTP had significant influence on the residents' overall WTP. In this study of RH protection, various bid amounts and income levels were also considered and were found to affect the contingent valuation (CV) estimates. However, the analytical model and data generation formats used in this study differed from those used by Lewis *et al*., (2017).

From the collective findings of these studies, it can be inferred that various factors such as price, income, trust, education level, age, gender, distance, perception, household size, among others, have been identified as significant determinants of WTP. Therefore, these factors were taken into account to assess their respective contributions towards the valuation of RH protection. Few studies have expanded their approach to estimate WTP values by incorporating variance and standard deviation (SD) of WTP distributions into their analysis, thereby broadening the scope of WTP assessment. However, such studies are limited. The methodology, which examines WTP together with its SD under a aprobability likelihood matrix was initially introduced by Wang (1997), and in the same year, Wang & Whittington (1997) observed that the truncated mean WTP exceeded the

conventional WTP value. They identified variables such as age, gender, bid price, education level, certainty of future incomes, and income to influence both the mean and variance distribution of WTP values. Wang & Whittington (1997) found that men exhibited higher variance in WTP values compared to women, and income uncertainty led to increased variance in WTP values. Additionally, education level and income variables were associated with increased variance, while age was correlated with a reduction in variance distribution. Matunda (2015) and Muketha (2014) have demonstrated that institutional factors, such as clearly defined property rights and legal enforceability against those who destroy RH, significantly impact the valuation of environmental goods. Households tend to place higher values on goods and services which improve their well being and vice versa (Mckinnon *et al*., 2016) thus, effective legal enforcement and well-defined property rights enhance RH protection. These factors were considered in this study of RH protection and revealed varied household perceptions: some believed RH protection is solely the government's responsibility, making them more likely to contribute to its degradation, while others felt that if the government leased these habitats to the public, they would be better managed and protected, and legal enforcement would be easier to administer. Conversely, research by Colby & Orr (2005), Nicosia *et al*. (2014), and Pate & Loomis (1997) suggests that institutional factors, such as proximity, and physical characteristics, like the quality and quantity of the environmental good, also influence valuation. In this study of RH, distance and quality of environmental good influenced valuation. Interestingly, most households residing farther from the RH placed higher values on it, even though they perceived the RH to be of lower quality due to destruction. In a study by Wang & Whittington (2005), it was observed that stochastic payment card (SPC) WTP values were higher than referendum WTP values. Factors such as income, education level,

gender, and uncertainty regarding future incomes positively and significantly influenced WTP values, while age had a negative impact.

When these factors were regressed on the variance of WTP estimates, they exhibited similar effects to those observed for the WTP values themselves. This study of RH protection draws heavily from Wang & Whittington (2005) by examining the effects of similar factors on both WTP and its standard deviation (SD). Both studies used a similar analytical model and data generation format; however, Wang & Whittington (2005) employed SPC on referendum-generated data, whereas the RH study utilized both SPC and MBDC on open-ended generated data. Wang & Jie (2010) using MBDC format and two stage random valuation model (RVM) noted that second stage WTP was higher than First stage WTP value. The WTP values were positively influenced by income and negatively by income uncertainty. The variance increased with education level and income variables. The effect of similar explanatory variables was established on CV estimates and those factors proved significant however the SD reduced with attainment of higher education levels. Fonta *et al.*, (2010) using SPC, realized a higher WTP with Heckman two stage model compared to when the two stage RVM was used. WTP values were significantly and positively influenced by (income, certainty of future incomes, knowledge or awareness, gender, past experience in participation in a community development project, and confidence towards the hypothetical community trust fund) and declined with distance. Equally, the variance of WTP distributions were influenced positively by certainty of project implementation and negatively by distance. Similar results were observed in this study of RH. However, WTP values decreased when using the local trust fund as opposed to the tax fund, and the standard deviation (SD) increased with distance. Ichoku *et al.* (2009), using a two-stage RVM and data obtained from SPC, found that WTP was positively and significantly influenced by

female respondents, income, and perception/knowledge, while the variance increased with female gender. Although a similar analytical model was used for the valuation of RH in Kenya, it was noteworthy that WTP was positively influenced by income, and men had higher WTP compared to women, contrary to Ichoku's findings. However, the standard deviation (SD) increased with the female gender, a result consistent with Ichoku's study. The literature review underscores socio-economic, institutional, and physical factors as crucial determinants influencing households' WTP, an observation strongly corroborated by this study on RH protection as well. Understanding the socio-economic, institutional, and physical determinants of WTP is crucial, as they shape households' valuation of goods or services. Socio-economic factors include income level, education, occupation, household size, and demographic characteristics, while institutional factors encompass regulations, policies, property rights, and governance structures.

Physical factors relate to environmental or goods characteristics such as accessibility, quality, quantity, and spatial distribution. This understanding is vital for policymakers, economists, and environmental researchers to accurately assess the economic value of RH and formulate effective protection policies aligned with societal preferences and priorities. While various analytical models like logit, probit, and tobit have been applied to estimate WTP, the adoption of the two-stage random valuation model for valuing environmental goods and services, including RH protection, remains limited.

2.2.3 Review of Empirical Evidence on WTP data Elicitation Formats

The influence of socio-economic, institutional, and physical factors on WTP values has been thoroughly explored in numerous studies. While the impact of contingent valuation (CV) variables on WTP values is well-established in environmental and

natural resources literature, their precise effect on the valuation of RH remains ambiguous. Scholars like Carson (2000), Campos *et al.* (2007), and Zainudin *et al.* (2016) suggest that a comprehensive CV study should include factors such as elicitation format (EF), bid range (BR), payment vehicle (PV), and valuation good (VG). The term EF typically refers to the data generation method used to elicit preferences which can be either through a hypothetical scenario or a revealed preference mechanism (Svenningsen & Jacobsen, 2018; Ndambiri *et al*., 2016). The selection of EF is a critical component of stated preference surveys, influencing the quantity and quality of information collected on respondents' WTP, as well as the potential errors or biases that may hinder the observation of their true WTP (Chanel *et al*., 2016). The common data EF approaches include the open-ended approach, payment cards (PC), single-bound (SB) and double-bounded (DB) approaches, trichotomous approach, and payment ladder approach. For studies done on payment cards, the cards range from conventional cards, SPC, polychotomous cards (PPC) and circular cards (Vossler *et al*., 2004; Welsh & Poe, 1998; Campos *et al*., 2007). The conventional payment cards are popular given their simplicity and assumption that WTP is fixed (Ndambiri *et al*., 2016). Other cards such as SPC and Multiple bound discrete choice cards (MBDC) have gained popularity in the recent past given the assumption that a households WTP value is random (Wang, 1997; Wang & Jie, 2010), however the effect of data generated by these cards on valuation of RH for protection has not been empirically determined. This study of RH protection utilized the PC approach, a method also employed by (Ndambiri *et al*., 2016; Spindler *et al*., 2018) in eliciting WTP, because it fits most statistical models that allow one to obtain the parameters of the distribution of WTP, and to make prediction about a respondent's expected WTP amount. Other cards such as circular cards have gained popularity in health discipline because they make use of a visual pie-chart

representation without start or end points and households are only required to spin the circular card in any direction until they find the section that best matches their true WTP. As per the burgeoning literature on PC format, the cards have been modified to capture household preferences which can be classified as ordinal and cardinal (Wang & Jie, 2010; Welsh & Poe, 1998). The modification is pegged on the fact that the conventional PC is limiting on information and it insists on selecting of only one amount to reflect a household's maximum WTP, implying that it treats WTP amount as fixed (Vossler & Poe, 2005). These limitations led to the introduction of preference uncertainty capturing PC namely the SPC and the multiple bound discrete choice card (MBDC) as per (Welsh & Poe, 1998; Wang & Jie, 2010).

In SPC, a household is given the opportunity to state her WTP in step one. In step two, one is asked to state how good/certain she will make her promise and that is linked to a given level of probability ranging from zero to one, measured under ordinal uncertainty preference scale. This card elicits numerical likelihood besides verbal likelihood. In MBDC, a household selects his WTP and elicits his preference uncertainty using likelihood scale thus numerical values are assigned to verbal likelihood data (Wang & Jie, 2010; Ndambiri *et al*., 2016; Champ & Bishop, 2006). Both SPC and MBDC have the ability to evaluate a distribution for each household using household characteristics. MBDC offers a range of bids which can be useful to develop an optimal bid design, reduces the interval within which the latent variable lies and also reduces potential for respondents anchoring their response on bid amounts as with SB and DB formats (Wang & Jie, 2010; Alberini *et al*., 2003). CV studies have utilized various unceertainty EF, including SPC and MBDC formats. However, Ndambiri *et al*. (2016) suggest that the utilization of MBDC to elicit preferences for environmental goods, particularly in developing countries, remains largely unexplored. The application of these cards (SPC

and MBDC) is limited, indicating the necessity for further investigation, as addressed in this study. Furthermore, Wang & Whittington (2005) and Ichoku *et al*. (2009) have advocated for more comparative research utilizing split samples on EF to enhance the reliability and validity of CV studies, as earlier suggested by Alberini *et al*. (2003). Hung *et al*. (2007) acknowledge that the use of payment card (PC) allows for obtaining more information per respondent compared to single and double bound approaches. Additionally, PC usage is known to reduce item non-response rates compared to open-ended questions. PC serve as visual aids presenting a range of monetary amounts from 0 to a significant value, allowing respondents to indicate their maximum WTP, thus offering flexibility and a wider range of choices.

This contrasts with the limited options typically provided by the double bound approach. It is presumed that the range of amounts presented on the card affects WTP responses (Chanel *et al.*, 2016; Kim *et al*., 2018), a hypothesis examined in this study. Hung *et al*. (2007) also noted that with the use of PC, a respondent liking the programme but with a low WTP, can circle a low monetary amount that may reflect their true WTP with the PC rather than feeling compelled to answer yes to a monetary amount higher than they are able to pay in the DC. The PC format helps to avoid such misunderstanding that could happen in dichotomous CVM with multiple bid amounts and that is why it was chosen for this study. The limitations of PC include biases due to starting point and the range values. To deal with these limitations, the study adopted solutions offered by Channel *et al.,* (2016) such as asking the respondent to state his/her WTP before the card could be unleashed to him/her. This solved the starting point bias. Equally the bid ranges used were obtained from open ended (OE) approach, hence no range bias was expected. Despite the application of PC in valuation of CV estimates (Ndambiri *et al*., 2016; Ozor, *et al*., 2013; Daly, *et al*., 2015), the approach has not been

used to value RH protection. It is against this background that the study intended to fill these knowledge gaps, given that studies which tend to quantify and compare the CV estimates of RH protection across split samples using data elicited by SPC and MBDC approaches are very few as also observed by Welsh & Poe (1998) and Ndambiri *et al*., (2016).

2.2.3.1 Reviews on the Stochastic Payment Card (SPC)

Wang (1997) pioneered the development of the SPC methodology to estimate household valuation distributions. The SPC is an extension of the PC approach and is used to capture uncertainty as noted by (Wang & Jie, 2010). In the SPC approach, a household is presented with an array of prices or bid amounts represented in vertical axis whereas voting uncertainty levels accompanied by probabilistic values are represented on horizontal axis. The uncertainty ranges from ‘‘definitely yes or strongly agree,’’ ‘‘probably yes or agree,’’ ‘‘not sure,’’ ‘‘probably no or disagree,’’ and ‘‘definitely no or strongly disagree (Wang, 1997; Fonta *et al*., 2010, Ichoku *et al*., 2009, Vossler *et al*., 2004). From the respondent’s choice of bid amounts and preferred probability levels measured under uncertainty scale, a response likelihood matrix is formed comprising of both numerical and probabilistic component, that can be interpreted as a record of a household’s cumulative valuation distribution function (Ichoku *et al*., 2009). The matrix is assumed to be random and can be used to predict a household’s true WTP for a commodity under uncertainty conditions (Wang & Whittington, 2005). Unlike other approaches, this method incorporates uncertainty into the analysis by enabling respondents to express their level of certainty regarding their answers to each of the bid amounts presented. Subsequently, statistical analysis of the responses is conducted, considering the varying levels of certainty expressed by the respondents. Methods such as dichotomous choice (DC) and conventional PC assumes

that each respondent has a single point value for a good or service in question, whereas, SPC assumes that a household's valuation is best viewed as a random variable with an associated distribution (Wang & Jie, 2010). The major limitation of SPC method is that it assumes all respondents interpret the certainty levels in the same way, which is unrealistic. However with the introduction of the probabilistic component respondents are able to attach some value to their certainty levels hence moving away from a common and fixed interpretation of certainty. Moreover, there is a potential for the same type of range bias found in the PC application to arise, necessitating the use of ranges collected through an open-ended approach and the inclusion of zero as a bid amount on the card. In summary the SPC asks a household to indicate the probability that he will actually pay the stated bid amounts on the PC and this probabilities ranges from zero to one. The probabilities are distributed across uncertainty preferences ranging from definitely yes to definitely no.

2.2.3.2 The Multiple Bounded Discrete Choice (MBDC) format

This approach was developed by Welsh & Poe (1998). In this approach it is possible to provide respondents with a broad range of bids, like the PC method and a certainty range to allow respondents to express their uncertainty, similar to polychotomous choice models. The usage of MBDC format usually involves two stages, whereby in stage one a respondent is asked to choose his or her preferred bid amounts and in stage two, one is asked to express his level of voting certainty for each bid amount (Welsh & Poe 1998; Evans *et al*., 2003) and by so doing the method is capable of introducing respondents' uncertainty into the analysis. Just like SPC, MBDC method will lead to a two dimensional matrix where the first dimension (rows) provides the bid amounts and the second dimension (columns) allows respondents to express their level of certainty about each bid amount (Evans *et al*., 2003; Ndambiri *et al*., 2016; Neupane *et al*., 2017).

This is accomplished by substituting the yes/no choice given by the DC method with a range of five possibilities similar to that used in polychotomous choice: "definitely yes', "probably yes", "not sure", "probably no" and "definitely no"(Vossler, 2003; Vossler & Poe, 2005). The advantages of MBDC are as follows: - the method presents respondents with a range of bid values unlike in the conventional PC, the MBDC circumvents incentives for starting point bias and the difficulty inherent to the process of bid selection. MBDC method is slightly more efficient from a statistical point of view than the DC method (Alberini *et al*., 2003), hence it provides a higher level of precision of its estimated parameters and estimates of central tendency. The method is cheaper to implement than DC since it can be conducted with a mail survey, thus it avoids expensive personal or telephone interviews required by the DC approach (Welsh & Poe, 1998; Wang & Jie, 2010). Finally, the approach is applicable for policy purposes. For instance, the benefits of a policy can be gauged by respondents who unequivocally support it. If these benefits surpass the budgeted policy costs, then the policy is deemed feasible (Fonta *et al*., 2010). Wang & Jie (2010) underscore major weaknesses of the MBDC method, noting the potential for inducing range bias similar to that observed in PC and SPC applications. Furthermore, the method operates under the assumption that certainty levels are universally interpreted by all respondents, a premise considered impractical.

2.2.4 Payment Card (PC) design, Bid Range (BR) and CV estimates

CV studies rely on BR, which represents the discrepancy between the highest bid offered by a household willing to pay for a good or service and the lowest bid provided by a household willing to pay for the same good or service. This range usually has an influence on WTP values. Studies such as Roach *et al*., (2002) have shown that WTP increases with BR, whereas Fonta *et al*., (2008) and Vossler *et al*., (2003) have shown

that WTP increases with decline in BR. Nevertheless, studies assessing the change in BR by increasing and decreasing the ranges and the effect of that change on CV estimates are limited. According to Alberini *et al*., (2003), PC design entails the following: - BR, bid amounts, bid interval and bid presentation order, all which affect CV estimates (Welsh & Poe 1998; Spindler *et al*., 2018). BR determines the number of bid amount that will appear on the PC, and thus has an implication of the bid interval between which a household switch from Yes to Don't know and No responses (Roach *et al*., 2002; Wang & Jie, 2010). CV studies have been done with different numbers of bid amounts on PC, however few studies have come up to challenge the Roach *et al*., (2002) and Cameron & Huppert, (1989) standard ten bid amounts to be included in the PC, which affect bid intervals in preference uncertainty cards. BR is used to determine the mean, median, minimum and the maximum WTP values (Ndambiri *et al*., 2015). Studies done so far on card designs entails the bid presentation order by Alberini *et al*., (2003) in MBDC format where presentation of 13 bids (14 bid interval) in descending order resulted to larger WTP than when presented in ascending order, a finding similar to what was observed in this study of RH protection where MBDC lowered bid range format led to higher estimates when compared to MBDC raised bid range. Welsh & Poe (1998) using 13 bid (14 intervals) realized that MBDC led to higher CV estimates compared to DC and OE formats a finding which was similar to what was observed for RH protection even though the comparison was within the preference uncertainty formats. Huhtala (2004) using a tobit model with 10 bid amounts (11 intervals) payment card, realized a significant difference in CV estimates. The WTP differed between samples however, the contribution of the BR towards the obtained WTP was underestimated hence the need for this study. Ndambiri *et al*., (2016) using both interval regression and random effects models with 15 bid amounts (25 intervals) observed that

the SPC yielded a higher mean WTP welfare estimate towards improvement of air quality management in Nairobi city when compared PPC, a finding contrary to what was found in this study for RH protection where MBDC exhibited higher welfare estimates than SPC even though both studies were done in Nairobi using similar bid amounts. The divergence could be attributed to the analytical models and the valuation goods used. Svenningsen & Jacobsen (2018) emphasize the importance of BR in split samples, employing 8 bid amounts with a bid interval of 50. These ranges, classified as lower and upper bounds, were linked to payment vehicle.

The study revealed that an upper bound BR resulted in higher CV estimates. This hypothesis was tested within the study of RH, yielding similar findings, suggesting that households were inclined to pay more at higher bid amounts, possibly to enhance the likelihood of goods provision. Daly *et al*. (2015) using a 20 cell PC, observed a variation in the WTP, however the contribution of the BR towards the realized WTP was not understood thus the need for more similar studies. Chanel *et al*. (2016) employed three formats—Open-Ended (OE), standard PC, and the new circular PC with 14 bids—to elicit CV estimates. They found that OE and standard PC formats resulted in significantly lower WTP compared to the circular PC format. However, it remained unclear whether the variation in WTP stemmed from the BR used or the data EF used. This hypothesis was investigated in the present study of RH using a similar approach but focusing solely on uncertainty preference elicitation formats. Meanwhile, Ndambiri *et al*. (2016) utilized a 15-bid PC and observed that mean WTP values estimated varied significantly. Among the two PC addressing preference uncertainty, the PPC format generated the lowest mean WTP. However, the study exhibited bias by attributing the variations in WTP values solely to the EF rather than considering the BR chosen, a perspective also echoed in studies such as those by Alberini *et al*.. (2003) and Vossler *et*

al., (2004). Loomis (2006) employed a PC with 15 bid amounts (16 intervals) to establish WTP values using CVM and travel cost method (TCM) and the findings showed that CVM yielded lower mean WTP unlike TCM. Despite employing a different analytical model, Loomis's study focused on the number of trips made by visitors and overlooked the impact of the bid ranges used. Cristeche *et al.* (2015) used 7 bid amounts (8 intervals) and 10 bid amounts in a split sample approach. His WTP values were primarily influenced by socio-economic factors, without considering the effect of the bid ranges used. In contrast, this study on RH did take BR effects into account, though both studies utilized split samples. Wang & Jie (2010) used a bid amount of 13 (14 intervals) to collect valuation data. Their findings showed that the one-stage valuation method, employing the multiple-bounded discrete choice (MBDC) format, led to higher mean WTP and variances compared to the two-stage model. While this study of RH protection utilized a similar valuation model, Wang & Jie's study did not compare the effect of changes in bid ranges on WTP and its associated standard deviation (SD). Additionally, they did not compare the SPC and MBDC formats within the same study context, an expansion in scope that this studyof RH aimed to address. Through a review of these studies conducted in diverse locations, circumstances, and using different PC formats including conventional PC, SPC and MBDC, alongside various bid ranges, it became evident that the effect of BR on valuation estimates remains a significant concern. Some studies have compared MBDC with other formats like OE and DC. Ndambiri *et al*. (2016) have compared polychotomous payment card (PPC) and SPC against conventional PC with constant bid intervals across the split samples, contrary to the hypothesis which was tested in this study. Wang & Whittington (2005), compared SPC approach to traditional referendum EF using 2 SPC split samples and 5 referendum split samples. The referendum split sample used a constant 5 bid

amount (6 interval) whereas the 2 SPC split samples used varied bid amounts of 8 and 5 respectively. The sample mean WTP was higher in referendum format compared to SPC, and the mean variation was attributed only to EF used forgetting the bid intervals used. The comparison between means in the SPC samples revealed that the truncated SPC mean WTP was higher than that of the standard SPC. However, a limitation of their study was that it combined preference uncertainty EF and referendum format, which could be considered unfair or biased. Additionally, the study had a limited scope in EF, highlighting the need for comparison with the MBDC format. Similar to the study by Wang & Whittington (2005), this research on RH ensured homogeneity between sample BR and bid intervals but heterogeneity within the SPC and MBDC samples to introduce randomness in comparison and eliminate sample comparison bias, as advised by Welsh & Poe (1998). The bid intervals utilized by Roach *et al*. (2002) were considered biased as they lacked an interval below the lowest bid interval, necessitating truncation. Therefore, this study on RH protection aimed to rectify the bias in Roach *et al.*'s (2002) WTP values by introducing 0 as a bid amount on both the SPC and (MBDC) cards. To the best of the researchers' knowledge, few studies have been conducted to determine, quantify, and compare the effect of varying BR, bid amounts, and bid intervals on CV estimates, as noted by Alberini *et al*. (2003), Broberg & Brannlund (2008), Cameron & Huppert (1989), and Hung *et al*., (2007). Moreover, using SPC and MBDC preference uncertainty EF in the same study context, as suggested by Broberg & Brannlund (2008), further adds to the novelty of this research. However, as Welsh & Poe (1998) postulate, failure to demonstrate consistency across value EF forms a basis for rejecting the validity of CV studies. Hence, this study opted to use identical BR across samples with varied bid intervals.

2.2.5 Payment Vehicle (PV) and its effect on CV estimates

Approximation of welfare values using CV is not new. Campos *et al.* (2007) and Zainudin *et al*., (2016) opines that a good CV study should comprise of PV, data EF, VG (Public or Private), survey instruments, valuation scenario and elicited welfare measure (WTP or WTA) besides valuation format. The validity of CV studies relies on the PV since it provides the context for payment (Champ & Bishop, 2006). PV is the mode of payment for the environmental good or service in question. Studies done so far on PV range from the use of donations, payments in kind, cash, use of amenity bills, taxes, trust, fees and fines (Champ & Bishop, 2006; Svenningsen & Jacobsen, 2018, Ndambiri *et al*., 2016; Neupane *et al*., 2017; Spindler *et al*., 2018). Out of these vehicles, some are regarded as monetary whereas others are non -monetary such as labour hours and payments in kind (Cheryll *et al*., 2011). Monetary PV include: - taxes, entrance fees, amenity bills, trip expenditures, donations among others (Campos *et al*., 2007; Champ & Bishop, 2001). Literature has shown that care should be exercised when choosing the PV to be used as some vehicles can raise objections and protest responses among survey participants and hence bias the survey results (Fonta *et al.,* 2010; Ndambiri *et al*., 2015). The payments can be one-time lump sum or recurrent payment depending on the nature of the good in question (Cook *et al*., 2018). As a general rule, a capital investment, such as setting aside a wilderness area, should use a fixed lump sum payment mechanism while other goods and services which could become extinct if there were no continued payments, should consider using a recurring payment (Cook *et al*., 2018). Svenningsen & Jacobsen (2018) observed that the use of taxes in valuation of public moral good is more coercive and likely to lead to higher WTP than voluntary mechanisms such as donations. He further argues that other PV which forms part of people's utility function but not directly related to the good and are

not subject to any budget constraint will inflate WTP values, a hypothesis which proved that Trust elicited lower WTP unlike Tax for RH protection.

This study on RH protection shared similarities with Svenningsen & Jacobsen (2018); however, it distinguished itself by comparing the use of taxes and trust as PV in the valuation of both public and private moral goods, an aspect that has been overlooked in previous studies. Musharaf *et al*. (2018) noted that the use of implicit PV such as travel costs, tended to underestimate CV estimates compared to the usage of explicit vehicles like entrance fees contrary to Christeche *et al*., (2015). However, in the study on RH protection, explicit vehicles recorded both higher WTP and SD values, contrary to their observations. Barrena *et al*. (2014) suggest that although taxes are frequently utilized in valuing environmental goods and services, their centralized structure may present difficulties in distributing funds to meet regional needs compared to voluntary donations and contributions. However, this study of RH protection decided to compare the use of Trust and Tax funds. This choice was made because Nairobi County, being the capital city of Kenya with a large population, was assumed to have a majority of working households willing to contribute to protection efforts through taxes. Additionally, with the devolution and delocalization of services to county levels, it was presumed that the taxes collected would specifically be allocated for RH protection within the city of Nairobi. Qureshi & Harrison (2002) observed that RH protection on private lands can be influenced by economic instruments and regulatory approaches. Price-based instruments, such as taxes collected from taxable incomes, fines, fees, and environmental bonds, could help protect environmental goods. Subsidies for habitat protection and penalties for destruction are forms of rewards that can be utilized. Taxes were chosen in this study as they were expected to result in higher estimates of WTP compared to donations. Moreover, taxes are subject to budget constraints and are

considered objective. There is evidence of payments by farmers for environmental goods and services. Kumar *et al*., (2011), have exploited on the use of cash as a PV, whereas Messerk *et al*., (2008) and Svenningsen & Jacobsen (2018) used tax as a PV and it was realized that for a coercive tax setting, households are willing to incur costs in the form of higher taxes that provide benefits or transfer income to others when a public good is considered (Lewis *et al*., 2017), an observation very close to the findings of this study where tax elicited higher WTP for RH protection. Hung *et al*. (2007) compared the use of money and labour payments, and it was realized that payment in money was less acceptable. Payment in working days was flexible and acceptable, however these findings are limited in application where samples are split and where data is elicited using different uncertainty preference EF, hence the use of SPC and MBDC. Similarly, Huhtala (2004), realized that the intensity of preferences measured in monetary terms (or in total WTP) differed according to the PV used, a hypothesis which proved true in this study of RH. Wiser (2007), noted that the manner in which collections towards and spending from a trust fund for the purpose of environmental projects are done can easily influence WTP values. Some of the PV tend to be inseparable from their collection points and the manner in which they are administered, for example taxes are set and can only be collected by the government unlike by local project implementers. However, with devolution it could be easier to set policies which favor exclusive collection of environmental taxes at county levels. The effects of changing PV on CV estimates have been felt far and wide and it has often been applied in several studies ranging from recreational forests, beach management, conservation of marine fishery reserve and conservation of wetlands (Campos *et al*., 2007; Daly *et al*., 2015). Scholars have divided these PV into two categories: implicit, which involve indirect costs, and explicit, which entail direct costs. In discrete choice experiment

studies, both direct and indirect PV have been employed. For instance, travel costs are typically considered implicit payment vehicles, while entrance fees are regarded as explicit option (Musharaf *et al*., 2018; Campos *et al*., 2007), and it has been observed that they do affect household's preferences and WTP across split samples. However, there is limited evidence of similar application on RH protection in Nairobi county hence the need for this study.

2.2.6 Reviews on Valuation Good (VG) and CV estimates

A VG refers to an environmental good or service under consideration for valuation, which may or may not have an established market value. Carson (2000) emphasizes the necessity of including a VG in a comprehensive CV study. Therefore, the nature of the good, whether public or private, significantly impacts CV estimates (Fonta *et al*., 2010; Ichoku *et al*., 2009). Svenningsen & Jacobsen (2018) conducted a comparative analysis of stated and revealed preferences concerning public goods with strong moral components. They observed that changes in the VG influenced the observed disparities in WTP and recommended further investigation, especially for environmental goods with significant non-use values such as conservation and protection. However, there is a dearth of literature on the effects of change in VG on CV estimates especially on RH protection using CVM, hence the design of this study. Cook *et al.* (2018) expressed concerns regarding the delicate balance between environmental conservation and industrial development, particularly in urban areas with RH that provide multiple ecosystem services. These habitats often possess public goods characteristics, making their valuation challenging using CVM. However, such valuation exercises are crucial for informing decision-makers about the merits of RH protection, especially as rapid urbanization threatens these habitat. In Kenya, many RH are considered public goods according to the (GOK, 2010*)*, leading to a "free access mentality" that has contributed

to the destruction of riparian services such as water quality and scenic beauty. Changes in land use patterns have exacerbated issues such as increased flooding during the rainy season and reduced runoff during dry periods (Mugo *et al*., 2022). Muketha (2014) observed better water quality in streams adjacent to vegetated riparian buffer strips compared to those without vegetation. However, there has been a recent shift away from viewing RH solely as public goods, with efforts to involve the private sector and local communities in their protection. Private investors are leasing public RH and implementing sustainable projects, promoting ecotourism, and generating profits (Schismenos, *et al*., 2018). Despite this positive trend, such investors remain scarce in Kenya. Conversely, some Kenyan RH, particularly those near lakes and rivers, are overseen by village elders and chiefs who might lack the capability to adequately supervise and govern their utilization. This often results in the exploitation and mismanagement of riparian resources by the local community, highlighting the need for clearer guidelines on the moral duty of care for RH (Matunda, 2015). In this study, the VG encompassed both public and private RH characterized by strong moral obligations or duty of care from both public and private households. However, considering the prevalent scenario where private investors have invested in public riparian areas with the objective of sustainable utilization, they not only derive private benefits but also contribute to public benefits that extend to other households and even counties. Hence, these goods were regarded and analyzed as private goods in this study. Previous researches have examined various types of goods, including pure public goods, private goods, and quasi-goods. Some private goods and services are provided publicly by the government to address market failures or for political motives. Consequently, these goods acquire public goods features such as non-excludability and non-rivalry, rendering them susceptible to free-riding (Spindler *et al*., 2018). The real costs of

providing these goods are easily underestimated because people lose the market price as an indicator, and that impedes on their valuation. Zawadzki (2016) investigated public perceptions of intangible benefits and costs associated with valuing mega sports events through the CVM. The study's findings raised concerns about the feasibility of depending solely on public funds to finance such events. This aspect serves as a foundational premise for the current study on RH, which aims to explore households' involvement and their potential opportunities for funding RH protection efforts. Spindler *et al.* (2018) investigated the value of a publicly provided bike-sharing service, primarily financed by a private entity, and observed a higher WTA compared to WTP, especially when substitute goods were available. However, the examined good displayed quasi-good characteristics, and their results echoed previous findings indicating higher WTA when goods are considered public. This conventional understanding was challenged in the context of the current study on RH protection in Kenya, where households exhibited a higher WTP for publicly provided goods. As a result, further research is recommended to assess households' WTA for RH protection in the same region. Messerk *et al*. (2008) employed hypothetical CV and coercive tax PV, uncovering a lower WTP value in a heterogeneous public setting compared to a private setting, contrasting with the findings of this study on RH protection. Conversely, their results suggested that households who derive fewer benefits from a public good tend to exhibit a higher WTP in a public voting setting than in private decision-making. This implies that households are willing to bear costs, such as higher taxes, to provide benefits or transfer income to others, a trend consistent with the findings of this study on RH protection, where households interviewed under increased BR demonstrated a greater WTP for enhanced public provision of the good. Khanna *et al*., 1994 using a two stage least square method, evaluated agricultural research expenditures from a public

goods perspective, where one of the good was a pure public good whereas the other was considered a joint product. The joint-product exhibited the specific feature of agricultural research conducted in the states where some benefits were private, in the sense that they are state-specific, while others are public and spill over to other states. The findings indicated that the government demand for public agricultural research is unusually price elastic but is full income inelastic. Of importance is the fact that the study considered two goods: - pure public versus joint product from public perspective. In this study on RH, where the existing arrangement required private investors to invest in riparian zones with the aim of using them sustainably and derive private benefits but also in the process their conservation efforts yield public benefits which spilled over to other people and even counties, those goods/investments were considered private.

2.2.7 Reviews on methodological valuation of WTP

The utilization of WTP as a measure for estimating welfare in assessing the economic value of non-market goods and services is widely practiced. This approach has found application across various fields and disciplines, extending beyond agricultural extension services (Whitehead *et al.*, 2001; Onoh, *et al*., 2014; Temesgen & Teferi, 2015) to encompass areas such as the valuation of community-based conservation activities (Lamsal *et al*., 2015) and environmental commodities (Ndambiri *et al*., 2015; Welsh & Poe, 1998). However, there is concern regarding the methodology used to measure WTP, especially within the realm of agricultural extension services. Studies such as Mwaura *et al*. (2010), Ozor *et al*. (2013), and Onoh, *et al*. (2014) have utilized descriptive statistics and Likert scales respectively, often capturing WTP at a single point, in contrast to approaches adopted by others (Alberini, 1995; Whitehead *et al.*, 2001; Ndambiri *et al.*, 2015; Wang & Jie, 2010). In the valuation of environmental goods and services, diverse models have been employed to ascertain WTP. Commonly

used models include the ordinary least squares method (OLS), the Tobit model, frequently employed when the dependent variable is censored (Wang & Whittington, 2005), as well as logit and probit models, particularly suitable for data elicited using various formats like open-ended, dichotomous choice, and scale-based methods, or when the dependent variable is binary (Cook *et al*., 2018; Lamsal *et al*., 2015). These models are regarded as classical models in the sense that they work well when normality assumption is upheld and when a household's maximum WTP value is assumed to be single and fixed. As literature evolves, models have evolved over time from the Welsh & Poe (1998), interval switching regression model which is also popular when the true WTP is assumed to lie between an interval (Cook *et al.,* 2018; Ndambiri *et al*., 2015) to Wang & Jie (2010) Random Valuation Model (RVM) which captures preference uncertainties elicited from using uncertainty EF. RVM is based on the assumption that a household's WTP is a random variable with a distribution rather than a single point. The randomness of WTP has also led to the use of random effects probit model used whenever the likelihood thresholds are collapsed to zero and one, changing the format from multiple to dichotomous nature(Christeche *et al*., 2015). The 0 and 1 dependent outcomes can be assumed to follow a given probability distribution and hence they can be treated independently (Alberini *et al*., 2003). There is a possibility of ordering the likelihood thresholds responses by collapsing the likelihood likert scale into say three, that is responses such as definitely yes and probably yes can be treated as yes responses hence coded 1, probably yes and probably no can be treated as don't know responses and coded say 2, and definitely no and probably no responses can be treated as no responses and coded say 3. This coding paves way for the use of ordered probit and logit models (Wang & Whittington, 2005). Other studies have used maximum likelihood functions to measure WTP elicited by uncertainty preference

methods, simply because the respondents answer a series of questions including stating the maximum WTP and indicating the degree to which a household is sure of making the payment measured against likelihood threshold which later forms a likelihood matrix and can be estimated using maximum likelihood functions (Wang & Whittington, 2005; Vossler & Poe, 2005). Cameron & Huppert (1989) posits that whenever the dependent variable is measured on intervals of a continuous scale, the maximum likelihood estimation function works so well. On statistical comparison of parametric variables such as sample mean WTP amounts, t tests have been commonly used (Wang & Whittington, 2005; Fonta *et al*., 2008) whereas for non- parametric variables such as socio economic characteristics, Kruskal-Wallis test, Mann-Whitney test and chi square test have been used (Ndambiri *et al*., 2016; Ndambiri *et al*., 2015). When the sample comparison is limited to only two samples, then Mann-Whitney test has proved to be the best, whereas when the split samples are more than two, Kruskal-Wallis test can be used (Ndambiri *et al*., 2015; Ndambiri *et al*., 2016). According to neo classical literature, two independent samples can be compared in terms of means and deviations or variances, as evidenced by (Wang & Jie, 2010; Ichoku *et al*., 2009). In this study of RH the Wang & Jie (2010), two stage random valuation model (RVM) was adopted to elicit WTP values and Mann –Whitney test, Kruskal-Wallis test were used to compare the mean WTP across samples whereas F test was used to determine the joint effect of the CV estimate determinants.

2.3 Conceptual Framework

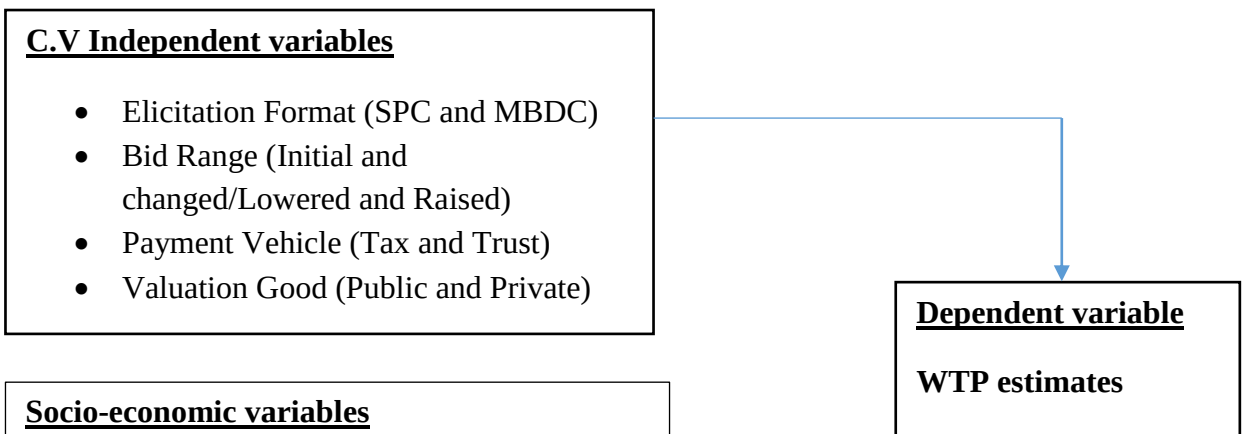
Figure 2.1 outlines the conceptualized interrelationships in the study, the key variables involved and how they are interrelated. In the framework, the dependent variables were WTP and SD of WTP estimates. Both WTP and SD were regarded as contingent valuation estimates (CVE), which were tested against all the stated independent

variables. The CVE were influenced by changes in: - CV variables (PV, BR, EF and VG), socio-economic variables (Age, Gender, Income, Household size, Education) and physical and institutional factors (Distance, Certainty of future incomes, Necessity to protect RH, Land ownership within the riparian area). For example, the EF used to elicit CV data may influence the respondents' CVE and in this study the formats considered were SPC and MBDC. As much as limited studies have compared different data elicitation formats, a few have compared SPC and MBDC formats. It was hypothesized that the change in EF could either increase or decrease WTP values and its SD. Few studies have shown that MBDC format understates the WTP values, but in this study of RH, MBDC format overstated the WTP values and its SD. BR usually influence the valuation estimates. The effect of Lowering and Raising the BR on CVE was investigated in this study. From both literature and theoretical perspective, lowering the bid ranges leads to higher WTP values and lesser deviations. Hence it was hypothesized that lowering the BR could lead to more WTP. However, in this study of RH protection, it was interesting to note that households expressed lower WTP for lower bid amounts contrary to the expectations. An indication that households were willing to pay more for RH protection probably because they suffered more from the effects of unprotected RH. The type of PV used could also affect the CVE. From literature, PV could be implicit or explicit and depending on their nature they can affect WTP values. Two PV were considered in this study namely Tax and Trust. Some studies have shown that Tax overstates WTP whereas Trust understates WTP values. A hypothesis which proved to be true in this study. Lastly the VG used has proved to affect CVE. In this study the view of RH as a public good by some respondents and as a private good by others were evaluated and their effects on the estimates established. Studies have shown that when the VG is public, WTP is overstated and vice versa. In this study of RH

protection, the view of the good as public elicited higher WTP than when the good was viewed as private. Socio-economic characteristics have been realized to equally influence CVE. Age as a variable has shown a positive relationship to the estimates in some studies, whereas in others the influence has been negative. Gender which refers to the sex of the household head could influence the estimates positively or negatively as shown from the literature. Income variable equally is thought to influence the estimates given that from both theoretical and economic perspectives, WTP increases with income and conversely affect household deviations in WTP. Education level has shown a positive correlation with CVE. With attainment of a higher level of education, households acquire more knowledge and become receptive of new ideas which helps them make better decisions. Household size which is usually used to measure the number of family members has equally shown correlations with valuation estimates. For some time now the issue of family size has aroused debate globally. Family size could either be the size of nuclear family or extended family. In this study the family size considered was the number of adults and children feeding from the same source as at the time of interview. It was anticipated that this variable could decrease WTP values and increase household dispersions in this study. Other factors such as distance has had a negative effect on WTP estimates. As distance increases, WTP declines. Some studies have shown that distance increases with dispersion, whereas others have shown no correlation between distance and CVE. Ownership of land within the riparian area could also affect the estimates positively or negatively as observed in other studies, hence it was hypothesized that ownership of land within riparian could negatively influence CVE. Necessity to protect RH was hypothesized to increase WTP values and reduce SD. Lastly Certainty of future incomes is known to increase WTP values and reduce dispersions of household WTP estimates as per the literature reviewed. It is worth

noting that literature on CV variables considered in this study was limiting especially when the effect of these variables on the estimates were compared across the samples. There are limited studies which compare: SPC and MBDC formats, Lowered and Raised BR, Tax and Trust, Public good and Private good within the same study context. Moreover, studies assessing the combined effect of socio-economic, physical and institutional factors variables on welfare estimates using the RVM are scanty. While many studies have focused solely on analyzing the impact of socio-economic variables on WTP, others have examined a combination of socio-economic and institutional factors. However, within the realm of environmental studies, the emphasis has largely been on CV variables for welfare estimates, with minimal attention given to RH protection. Consequently, gaining insights into the collective influence of these variables on valuation estimates for RH protection within Nairobi city could provide more comprehensive and informative findings.

Figure 2.1: Conceptual framework



Source: Own conceptualization (202

Source: Own conceptualization, (2020).

2.4 Synopsis of the literature review

The literature review in this chapter comprehensively explored previous studies encompassing theoretical frameworks, CV, WTP and its determinants, uncertainty preferences, data elicitation formats, empirical studies utilizing EF, BR, PV and VG alongside identified gaps and conceptual issues. The adoption of welfare economics theory was justified due to the hypothetical nature of the study and the non-marketable aspect of RH. Furthermore, the utility maximization theory was employed for its capability to derive both Marshallian and Hicksian demands. The CV method was favored for its ability to capture both use and non-use values of a good or service through hypothetical markets, contrasting with revealed preference methods that solely focus on eliciting use values.

Reviews on the measurement of WTP revealed that some scholars assessed it as a single fixed value, while others treated it as a stochastic variable capable of encompassing a range of values. This necessitated the utilization of various analytical models, including

logistic regression, probit regression, interval regression, maximum likelihood estimation, and random valuation models, to analyze WTP values. In the context of this study on RH protection, where SPC and MBDC data elicitation formats were employed to capture both ordinal and verbal data, the use of a random valuation model was deemed necessary due to its ability to analyze such matrix data effectively. Various factors have been identified as influencing WTP and its SD, including socio-economic, institutional, physical (such as distance), and environmental factors (EF, BR, PF, VG), as well as the valuation scenario itself. While many studies have highlighted socio-demographic factors and income as common influencers of WTP, others have underscored the significance of environmental factors. However, there is limited evidence regarding the collective impact of all these factors on WTP for RH protection and its associated SD. Reviews on data elicitation formats indicated that, despite the various approaches used, the utilization of PC, particularly SPC and MBDC cards across split samples, was infrequent. This is noteworthy given that these cards have the capability to generate both numerical and verbal data, which can offer more informative insights. Moreover, the selection of the PC format is known to influence the quantity and quality of information collected on respondents' WTP, as well as the potential errors or biases that may hinder the observation of their true WTP. Payment cards (PC) are commonly linked with biases such as range and starting point biases. The surveyed literature primarily associates the influence of variations in BR on WTP with alterations in the EF employed, analytical models utilized, bid amounts, and sample sizes, alongside demographic, institutional, and physical characteristics. Nevertheless, there has been limited exploration regarding split samples, and there is scarce evidence concerning the impact of BR on WTP for split samples using preference uncertainty data elicitation formats specifically, SPC and MBDC formats. Various PV were

assessed, and common vehicles used for valuation included donations, taxes, entrance fees, fines, payments in kind, payments through local trust funds, and cash. Studies reviewed indicated that certain PV such as taxes, may provoke protest responses, while others, such as trust funds, are commonly employed and preferred for local-level provision of public goods. Moreover, some researchers illustrated that donations could artificially inflate WTP values due to their lack of objectivity and absence of budget constraints, thereby advocating for the utilization of Tax funds for valuation in this RH protection study. However, there remains limited understanding regarding the impact of Tax and Trust PV on WTP for RH protection based on the literature. Utility derived from a good or service is a function of perception. Perceiving the good as public has been linked with low WTP, whereas for some households, viewing the good as private resulted in higher valuation estimates. However, the perception of RH by Kenyan households and their corresponding valuation remained poorly understood, prompting the design of this study area.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Description of the study area

The study was conducted in Nairobi County. The county covers approximately 696 square kilometers with a population of 4.4 million people and a population density of 6,300 persons per square kilometer (KNBS, 2020). The county is located at the south-eastern end of Kenya's agricultural heartland, at approximate longitude of 1° 9'S, 1° 28'S and latitude 36° 4'E, 37° 10'E. It has an altitude of between 1,600 meters and 1850 meters above sea level. Nairobi County boasts on a bimodal rainfall pattern, the long rains occur between March and April and short rains occur between November and December. The average annual rainfall ranges between 850 and 1050 mm while the mean annual temperatures range between 12°C and 26°C (Ndambiri *et al*., 2015; Ndambiri *et al*., 2016). The study area is usually dry and cold between the months of July and August, but hot and dry in the month of January and March. The average monthly relative humidity varies between 36 and 55 per cent. Mean daily sunshine hours vary between 3.4 and 9.5 hours. After the first rainy season the county tends to be very cloudy up to September when conditions are usually overcast with drizzle (KNBS, 2020; Brewer, 2021; Ndambiri *et al*., 2016). Urbanization, population growth coupled with industrialization are putting enormous pressure on the Nairobi rivers mainly Nairobi river and Mathare river which are the main source of water supply for the city. These rivers are heavily polluted as a result of domestic and industrial wastes which are directly discharged to these rivers without being treated hence impacting negatively on the water quality (Matunda, 2015) and causing diseases such as cholera. Most land in Nairobi, including the central business district is publicly owned and leased for 99 year

periods to private owners (Nthiiri, 2022). Government leasehold covers most of the legalized residential areas, and corporate ownership of land in these areas is becoming more common. Freehold land is privately owned either by households or by groups of households and can be sold without limits to the period of ownership, however this kind of ownership covers a small portion of land particularly for lands which border rivers. Over 50 per cent of land in Nairobi is estimated to be under private ownership (ADB, 2017). The high population growth in Nairobi is attributed to frequent migration of people from rural areas to the city. The forces motivating rural-urban migration to Nairobi include: - better economic prospects, opportunities for higher education and higher wage employment, besides ready market for goods and services (GOK, 2021b). Rural urban migration has led to unprecedented sprawl of informal settlements, increased urban agriculture, settlement in riparian lands and huge amount of wastes.

The county is endowed with well-drained, rich and fertile arable land which supports agricultural production. Nairobi hosts about 8 per cent of the Kenya's total population and 25 per cent of Kenya's urban population (KNBS, 2001), despite the fact that it only covers 0.1 per cent of Kenya's total surface area. The increased population growth in the county is viewed as the main driver of environmental change and major determinant of land-use patterns and settlement, consumption patterns and environmental quality (Muketha, 2014; Ndambiri *et al*., 2016; Matunda, 2015). Solid waste management is a big challenge in Nairobi County. Increased urbanization, rural-urban migration and rapid development associated with population growth have resulted in increased generation of solid wastes. However, this increase in solid wastes has not been accompanied by a relative growth in the capacity to address the problem of waste disposal. Tracing back to the year 1992, tons of solid wastes generated in Nairobi City increased from 800 to 1,000 tons per day, of which less than ten per cent was collected.

In the year 2002, the amount of solid wastes increased to 1,530 tons per day of which 40 per cent was either uncollected, or disposed of by burning or illegal dumping (ADB, 2017). In the year 2020/2021 Nairobi city produced 1,971,000 tons of solid wastes (KNBS, 2021). Improper management of solid wastes has thus become one of the most challenging and pressing environmental problems in the city. Wastes in Nairobi comes from different sources including household, service and industrial processes. Domestic sources contribute almost 68 percent of the solid wastes, industrial activities accounts for 14 percent; roads contribute about 8 percent; hospitals account for 2 percent; markets such as the famous Gikombaa market account for 1 per cent and 7 per cent from other sources (GOK, 2021; ADB, 2017). Most common forms of solid wastes in Nairobi City include food wastes, plastic and paper which are disposed indiscriminately along the rivers as observed by (ADB, 2017). The supply and access of clean water in Nairobi county is constrained by high water costs. In all informal settlements, only 24% of households have access to piped water in form of public water taps (Karisa, 2010). Contamination of piped water due to infiltration of foul waters through the broken pipes is common. Sanitation challenges in the informal settlements are popular pausing a hinge on supply of clean environment. The Main economic activities in the study area include small businesses, farming, informal and formal employment, as well as Juakali activities (Mugo *et al*., 2022) which contribute towards RH destruction. The expenses associated with recreation and sporting endeavors in Nairobi fluctuate based on the particular activity, location, and available amenities. While certain activities may be budget-friendly, others might incur higher costs, particularly those demanding specialized equipment or facilities. Among the widely embraced recreational options in Nairobi are visits to public parks and green areas like Uhuru Park or Karura Forest. These parks usually entail entrance fees but offer a serene environment, often enhanced

by the proximity to RH making them favored choices for outdoor leisure pursuits such as picnics, jogging, or nature walks (Matunda, 2015, Nairobi Club, 2023). In 2017, Nairobi witnessed a significant cholera outbreak, as reported by Kariuki *et al.* (2018), with 3,967 documented cases and 77 fatalities. The outbreak was primarily linked to contaminated water sources, substandard sanitation practices, and insufficient hygiene measures prevalent in informal settlements and densely populated areas of the city. Masresha *et al.* (2019) further underscored the persistent threat of cholera transmission, particularly among low and middle-income households in Nairobi. Contributing factors include unreliable water supply, inadequate waste management, and unhygienic living conditions. Despite efforts to combat cholera, including improved infrastructure and public health campaigns, the involvement of RH and households' appreciation of these habitats' value could offer a potential solution to mitigate the recurring cholera outbreaks in Nairobi.

3.1.1 Map of the study area

Figure 3.1 below presents a map of the study area showing locations of interest. The sampled areas lied along Nairobi and Mathare rivers.

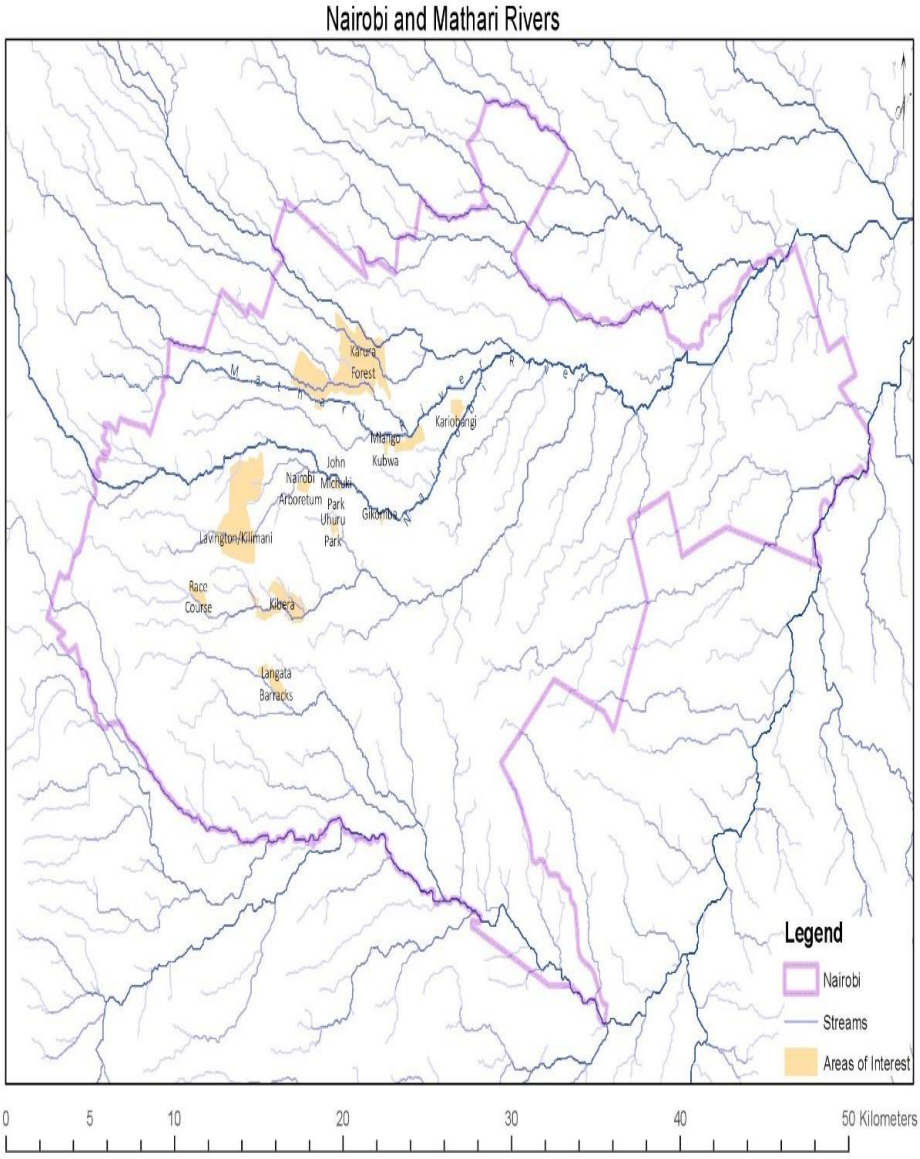


Figure 3.1: Map of study area
Source: Author (2020).

3.2 Contingent survey research design for the study

This research utilized a combination of survey and experimental methodologies. The survey method is frequently employed in numerous studies due to its interactive nature, allowing the researcher to directly engage with the study subjects, thereby enhancing

objectivity. Nonetheless, this approach has its disadvantages, such as being time-intensive, costly, and unsuitable for issues that demand a historical perspective. Despite these limitations, the survey method was adopted in this study to collect data on the socio-economic traits of households, their overall awareness of RH, the challenges linked to unprotected RH, and the physical and institutional elements related to RH protection. This is primarily because these variables are effectively captured through surveys. Conversely, considering the hypothetical nature of the study and the need for eliciting WTP values through valuation inquiries, the implementation of an experimental design was deemed necessary for obtaining such data.

3.2.1 Environmental good valued

RH were valued in Nairobi County using contingent survey design. In Kenyan scenario, RH have been presumed to be a public good which exhibit the characteristics of any environmental public good such as poorly defined property rights, externality and free riding problems. However, there is no empirical evidence to support that assumption. Moreover, the good is non- rivalrous and non-excludable besides being non- marketable hence the use of CVM to elicit WTP for their protection (Carson *et al*., 2001).

3.2.2 PV for the environmental good valued

This study used both a special Trust and Tax funds as PV. In this fund, the respondents were required to make a one-time monthly contribution specifically for the purpose of RH protection. The use of Trust as a vehicle was considered given that in other studies it has been regarded as a neutral PV which minimizes emotional reaction and protests and its ability to enhance the plausibility of the hypothetical scenario compared to alternative PV such as fees and donations (Cameron & Huppert, 1998; Ndambiri *et al*.,

2016). Equally, Tax fund was used as a PV given that in studies such as (Bateman *et al*., 1995; Svenningsen & Jacobsen, 2018; Barrena *et al*., 2004) the vehicle had realized higher WTP and was prone to protest responses. This study on RH protection examined the Tax vehicle to determine whether it would yield higher or lower WTP values compared to the Trust vehicle. It was found that the Tax vehicle was preferred by the majority of households surveyed.

3.2.3 Data Elicitation Format

Both SPC and MBDC payment cards were used for data elicitation (Carson *et al*., 2001; Wang & Whittington, 2005). These two formats elicited both numerical and verbal data for valuation of RH protection in the city of Nairobi. These formats were adopted in this study given their ability to elicit both households stated WTP values besides the level of surety of the households paying the stated WTP amounts (Ndambiri *et al*., 2016). The use of these two cards led to the creation of split samples for RH protection: SPC Public and SPC Private, which were further divided into SPC Tax, SPC Trust, SPC Private Good, SPC Public Good, SPC Lowered Bid Range, and SPC Increased Bid Range, resulting in 12 subsamples for the SPC format. The split samples were replicated in the same manner for the MBDC format. These split samples were essential for addressing several biases, including strategic bias (where respondents answer strategically to influence the provision of a good), respondent behavior bias (where respondents consistently behave differently, potentially contaminating the results), and restricted answering due to fear of contradiction in subsequent questions. Moreover, employing split samples ensured consistency and construct validity for this study.

3.2.4 Experimental research design

Experimental designs have been used widely in several disciplines ranging from marketing, health and environmental economics. This type of design requires a systematic and logical method for answering the questions. Due to the absence of an existing valuation good, the hypothetical nature of the valuation scenario, and the open-ended format of the valuation question, conducting an experiment was deemed necessary as advised by (Tassie & Endalew, 2020). Experiments are usually classified into three namely: - lab experiments, field experiments and auctions where the good is sold to the highest bidder (Breidert *et al*., 2006). Lab experiments are conducted under controlled environment or in an artificial set up and some subjects are varied as the researcher observes their effect on one or more dependent variables. This type of experiments is associated with quick results unlike in field experiments. Lab experiments are limited in the sense that the subjects are aware of the experimental situation hence subjects can change their behavior when they are under observation in comparison to their normal behavior leading to low external validity (Breidert *et al*., 2006). Field experiments are conducted in the real world environment and hence they do not suffer from the problem of artificial set ups. In this type of experiments, bid prices are varied and household responses are analyzed. The respondents could be aware of participating in the experiments or not. Field experiments are costly when compared to lab experiments and they may take longer time before results can be obtained (Broadhead, 2000).

In environmental literature different field experiments have been used such as choice experiments. In a stated choice experiment, a respondent is asked to choose from several available options, each of which is associated with a number of characteristics and a certain bid price. A series of experiments is presented to each respondent, varying

attributes across respondents to provide the necessary variation for estimation (Devicient *et al.*, 2004). The choice experiments are useful when the options in question are characterized by multiple attributes and the policy objective is to choose the optimal combination of the attributes to predict behavior (Devicient *et al.*, 2004; Svedsater, 2001). In field experiments data can be elicited using either open ended approach or closed ended. In this study, a field experiment was conducted through open ended approach to value RH within Nairobi County. The bid amounts were collected from the pretest exercise and a final questionnaire was prepared for data collection. The respondents were contacted through interview schedules done with the help of a questionnaire. The respondents were divided into two sample groups namely SPC and MBDC, and asked to state their WTP before the card was shown to them hence revealing their true WTP. Later on the card was shown to them and they were asked to choose their maximum WTP from the amounts indicated in the card. Thereafter a follow up question was asked for them to indicate their level of certainty/uncertainty regarding the selected amount and the subsequent amounts. Certainty levels were either represented by probabilities or in ordinal representation depending on the card one was interviewed under. The voting went on for each amount until a respondent reached a point where he could switch from yes to no. If the respondent selected zero as the amount, he was asked the reasons why he preferred that amount i,e (It is not my business to protect the RH, let those who destroy those habitats pay for their protection, it's the government duty to protect those habitats, i have more financial obligations, because RH protection have no value to me). Finally, the zero answers were analyzed and true protestors dropped from the analysis as advised by (Fonta *et al*., 2010; Barrena *et al*., 2014; Cameron & Huppert, 1989; Vossler *et al*., 2003; Fonta *et al*., 2008).

3.2.5 Philosophy of the study

Several philosophical approaches have been used in research (Backhaus, 2012). These approaches include: - interpretivism approach which is based on the assumption that reality is subjective, multiple and socially constructed. Interpretive approaches rely on questioning and observation in order to discover or generate a rich and deep understanding of the phenomenon being investigated. The approach is closely associated with qualitative methods of data collection. Positivism approach is also commonly used. This approach relies on measurement and reasoning. Moreover, it is based on the assumption that knowledge is revealed from a neutral and measurable (quantifiable) observation of activity, action or reaction. Besides, the method assumes that there is a single objective reality to any research phenomenon or situation regardless of the researcher's perspective or belief, thus researchers take a controlled and structural approach in conducting research by identifying a clear research topic, constructing appropriate hypotheses and by adopting a suitable research methodology. Positivism states that if something is not measurable in this way it cannot be known for certain. Scientific knowledge is derived from the accumulation of data obtained from observation.

This suggests that anything that cannot be observed and in some way measured or quantified, is of little or no importance. Positivism is closely associated with quantitative methods of data collection. Another approach commonly used in business is the pragmatic approach which is geared towards solving problems in a sensible way that suits the conditions that really exist now, rather than obeying fixed theories, ideas, or rules. The institutional approach has also been widely used. This approach which was developed by institutionalists, attaches much importance to psychological factors

unlike other factors. Neoclassical approach is also another philosophical approach usually adopted by researchers. This approach aims at improving the classical ideas by modifying them. The neo-classical approach was first adopted by Alfred Marshall in 1986. The approach believed that induction and deduction are necessary for the science of economics and they are regarded as complements rather substitutes. Keynesian approach first developed by John Maynard Keynes has also been used by other researchers. The approach takes into consideration the operation of business cycles that affect the entire economic policies and hence deals with the problem of the economy as a whole. Deductive and inductive reasoning approaches have also gained fame in the recent past. Deductive approach starts with the assertion of a general rule and proceeds from there to a guaranteed specific conclusion (Backhaus, 2012). Deductive reasoning moves from the general rule to the specific application and is based on the assumption that if the original assertions are true, then the conclusion must also be true. Inductive reasoning initiates with specific and constrained observations, then advances towards a generalized conclusion, which, although probable, isn't absolute, considering the amassed evidence. It progresses from particular instances to broader generalizations.

Much scientific inquiry employs the inductive method, entailing the collection of evidence, identification of patterns, and formulation of hypotheses or theories to elucidate observed phenomena. However, a limitation of this approach is that the conclusions it yields are not logical necessities, as no amount of inductive evidence guarantees the conclusion. This stems from the uncertainty regarding whether all possible evidence has been collected, and the potential existence of unobserved evidence that could challenge the hypothesis. Finally, some researchers have employed the abductive reasoning approach (Roncaglia, 2005). Abductive reasoning is a type of logical inference that begins with an observation or set of observations and aims to

identify the simplest and most plausible explanation. It starts with an incomplete set of observations and moves towards the most probable explanation for the observed phenomena. One advantage of abductive reasoning is that it facilitates daily decision-making, making the best use of available information, even when it's incomplete. Additionally, the process is creative and intuitive, making it particularly favored in the medical field (Roncaglia, 2005). In this study, both interpretivism and positivism philosophical approaches were used given that the study required both qualitative and quantitative data sets coupled with the hypothetical nature of the study which necessitated the use of quasi experiment.

3.3 Sampling

3.3.1 Target population

The target population of interest included both riparian households (land owners, residents/tenants and business men who stay close to the RH) and non-riparian households (non-land owners, non-residents/tenants and business men who stay far from RH) but available within the RH during the interview period. This population was estimated at 289,898 people (KNBS, 2020). The composition of this population was heterogeneous due to their diverse socio economic and demographic characteristics besides their perceptions towards RH protection. The unit of analysis was households. Households form an important population to consider because of the economic outflows experienced as a result of the effects of unprotected RH within the city. Moreover, if households feel that their welfare would be improved with the introduction of the RH protection policy, they would be the ones paying towards funding the implementation of such a policy.

3.3.2 Sample Size determination

The needed sample size was calculated from the approach of Anderson *et al*. (2007):

$$n = \frac{(Z_{\alpha/2})^2 p * q}{E^2} \quad \text{..... (3.1)}$$

Where; n = Sample size, Z= confidence level (95% in this case)

$z_{\alpha/2} = 1.96$

P = proportion of the population,

q = 1- *p*

E= allowable error

$$n = 0.5 * 0.5 * \left[\frac{1.96}{0.05}\right]^2 = 384$$

From the formula, 384 is the minimum sample size of the households for reliable results as suggested by Tassie & Endalew (2020). Literature has also shown that larger sample sizes are known to correct for data problems in split samples (Denscombe, 2010). In the realm of contingent valuation (CV) studies, a comprehensive set of guidelines and recommendations was crafted by the 'Blue Ribbon Panel (NOAA, 1992) to assist practitioners of contingent valuation methodology (CVM). The panel proposed that a minimum recommended sample size for CVM studies which involve split samples should be 1,000 respondents (Bateman *et al*., 1995; Fonta *et al*., 2008; Svedsater, 2001). In addition, due to the need for data reliability and accuracy, the sample size was increased to 1,000 households. Lastly with the availability of funds from German Academic exchange service (DAAD) and African Economic Research Consortium (AERC), there was need to increase the sample size.

3.3.3 Sampling procedure

Multistage sampling procedure was used to arrive at appropriate sample size as follows. First Nairobi County was purposively selected out of 47 counties in Kenya because it hosts major RH in the country such as Nairobi dam and Nairobi river. Moreover, the county experiences frequent cases of flooding coupled with high rates of demolition of structures within the riparian areas (Matunda, 2015). In addition, it hosts many people inhabiting riparian areas, majority whom are presumed to be working. Within Nairobi county, purposive sampling was done based on the fact that RH perform many functions but only eight were chosen as they form the subject of study. These eight include; - control of soil erosion, acting as buffer zones, habitat use for recreation and sporting, improvement of water quality, spiritual function and reflection of life, bird watching and research function, aesthetic beauty and provision of riparian resources such as fish.

The control of soil erosion function led to purposive sampling of two locations where RH had been degredated due to urban agriculture thus causing soil erosion. Buffer zone function led to selection of other two locations which border dams and springs and where frequent flooding cases were experienced. Habitat use for recreation informed the selection of some two more sites along riparian homes which benefited from recreation opportunities and facilities. Improvement of water quality led to selection of two rivers where the water quality was poor due to RH degradation, and two locations bordering each river were purposively selected for consideration. Based on rivers, Nairobi and Mathare were purposively selected because there has been observed high concentration of land use units in the 30 Meters distance from the existing river bank (Muketha, 2014). Moreover, along these rivers there has been observed a mixture of urban land uses ranging from urban agriculture, formal and informal residential settlements,

informal businesses, garages and urban open recreational ground, hence areas along these rivers were suitable for sampling.

Along Mathare river in Mathare constituency, Mathare area and Mlango Kubwa were purposively chosen due to informal settlements. Along Nairobi river, Kamkunji constituency was selected for hosting the famous Gikombaa market which was purposively chosen to represent informal businesses and its strategic situation along Nairobi river. Grogan area was purposively selected for its vehicle garages. Based on urban agriculture, Embakasi constituency was purposively chosen due to rampant agricultural activities and within that constituency, two locations namely Mukuru kwa Njenga and Mukuru kwa Reuben were selected based on the fact that they represent areas where urban agriculture and quarry mining is dominant and hence this contributes to RH destruction. Moreover, they lie along Nairobi river thus contributing to poor water quality in that river. Based on buffer zoning, Langata constituency was chosen given that it hosts the famous Nairobi dam which is a public good. In this constituency Kibera and Langata locations were selected since they border the dam which is considered as a wetland. Based on aesthetic beauty, Westlands and Kilimani constituencies were purposively sampled since they lie along Nairobi river and they host the famous scenic sites. Based on spiritual functions and reflection of life, John Michuki Memorial Park and Nairobi Arboretum were selected to represent rehabilitated riparian sites.

Based on recreation, Green park and Tall area were purposively selected because of their recreational facilities besides the fact that they possess the public private good characteristics. Based on sports, bird watching and research functions, Karura forest and Museum to Racecourse road were chosen for their sporting grounds and facilities.

Lastly based on provision of riparian resources, Kariobangi and Mlango Kubwa areas were chosen given the unplanned informal settlements in those areas which have impacted negatively on availability of fodder, fish and firewood. Stratified two stage proportionate simple random sampling was employed to get the required sample size as follows. During the initial phase, the sixteen locations were stratified into two distinct subpopulations, or strata, comprising eight locations each. These two strata were delineated based on the two preference EF utilized in this study, namely: SPC and MBDC In the second stage, the 8 locations in each EF were stratified into two non-overlapping categories namely private (To represent riparian and non-riparian land owners, business owners, residents who stayed and conducted their activities near/within the RH) and public to represent (Respondents who had come from other locations outside the riparian, and were found within the RH during the time of interview, deriving utility from the RH). This stratification resulted in two samples for each category, yielding a total of four samples: MBDC Public versus MBDC Private, and SPC Public versus SPC Private. Each of these samples was further stratified into six strata: Trust, Tax, Bid Raised, Bid Lowered, Public Good, and Private Good. This led to six sub-samples under MBDC Public and six sub-samples under MBDC Private, totaling 12 sub-samples for the MBDC format. The same stratification was applied to the SPC format, resulting in a total of 24 sub-samples utilized for this study based on specific objectives. Lastly, proportionate stratified simple random sampling was used to obtain the required sample size from each strata. The required proportionate sample in a location was computed from households in a location divided by the sum of all households in sixteen locations them multiplied by the needed sample estimate of 1000 households, as illustrated in Table 3. 1.

Table 3.1: Distribution of questionnaires among respondents

Basis/Function	Locations	Households (N)	Sample proportion obtained (n)	Stage one (n/2)	Stage two(n/12)
Buffer zone	Mathare	23,922	83	41	4
	Langata	25,770	89	44	4
Urban agriculture	Mukuru kwa Njenga	6,210	22	11	1
	Mukuru kwa Reuben	8, 410	29	14	1
Aesthetic	Lavington	12,472	43	22	2
beauty	Kilimani	10,000	34	17	1
Recreation	Uhuru Park	30,000	103	52	4
	Ever Green park	7806	27	13	1
Sporting	Karura forest	4,000	14	7	1
	Racecourse	3,720	14	7	1
Reflection of	Aboretum	4,000	14	7	1
life/spiritual	Michuki Memorial Park	2,800	10	5	1
Water quality	Gikombaa	51,288	176	88	7
	Grogan	12,560	43	22	2
Riparian	Mlango Kubwa	41,100	141	71	5
resources	Kariobangi	45, 840	158	79	7
	Total	**289, 898**	**1000**	**500**	**42**

Source: KNBS, 2020

However, after data collection it was realized that out of 1,000 proposed sample, 100 questionnaires from SPC format indicated protest responses (Refer to Appendix B1), whereas 16 questionnaires were not properly filled as expected and some were incomplete. This meant that the protest responses accounted for 10% of the total responses and 1.6% of the responses accounted for incomplete responses for SPC format. In total 11.6% of SPC responses were invalid. From MBDC format, 90 questionnaires indicated protest responses (Refer to Appendix B1) whereas 20 questionnaires were incomplete. This meant that the protest responses accounted for 9% of the total responses and 2% of the responses accounted for incomplete responses for

MBDC format, thus 11% of MBDC responses were invalid (Refer to Appendix B3). Therefore, 226 questionnaires were dropped from the analysis. This gave rise to a sample of 774 respondents whose data were used in the analysis of RH protection within Nairobi county. Environmental literature often refers to protest responses as those indicating a zero WTP. These responses are typically excluded from analysis (Barrena *et al*., 2014; Ndambiri *et al*., 2016), as they can reflect a disingenuous valuation of the goods or services in question and potentially introduce self-selection bias into the study (Ryan *et al*., 2004). As per the current body of research, the origins of these protest responses can be traced back to factors such as free-riding, a general negative reaction to the interview process, or a particular aversion to the payment method employed (Fonta *et al*., 2010; Ndambiri *et al*., 2015). In this particular study, it was observed that 19% of the households demonstrated protest responses towards the protection of RH, attributing their unwillingness to pay to the belief that they were not responsible for habitat destruction. Some respondents further insisted that the onus of RH protection rests with the government, not with them as households (Refer to Appendix C2 for results). Studies like Amigues *et al*., (2002) suggest that when the proportion of protest responses exceeds the remaining sample by 46%, it becomes necessary to adjust the remaining sample for protest responses using alternative models such as the spike model.

However, in this study, the remaining sample was significantly larger (81%) than the proportion of protest responses (19%) hence no need for sample adjustment. Several studies have examined the impact of protest responses on WTP values (Fonta *et al*., 2010; Ndambiri *et al*., 2016; Barrena *et al*., 2014). Some have found that excluding protest responses from the analysis results in lower WTP values (Fonta *et al*., 2010; Ndambiri *et al*., 2016; Barrena *et al*., 2014) as compared to when these responses are

included. Others argue that excluding zero bid responses from the analysis leads to the loss of valuable insights (Fonta *et al*., 2008). It's been suggested that such exclusion could potentially inject sample selection bias into the analytical model, thereby resulting in inconsistent parameter estimates (Fonta *et al*., 2010). In this study on RH protection, careful consideration was given to the advice provided by Fonta *et al*., (2008) to avoid indiscriminately dismissing protest responses. Figure 3.2 below illustrates the distribution of the remaining 774 questionnaires utilized for analysis after excluding true zero WTP responses or true protests (refer to Appendix B2), in addition to incomplete responses.

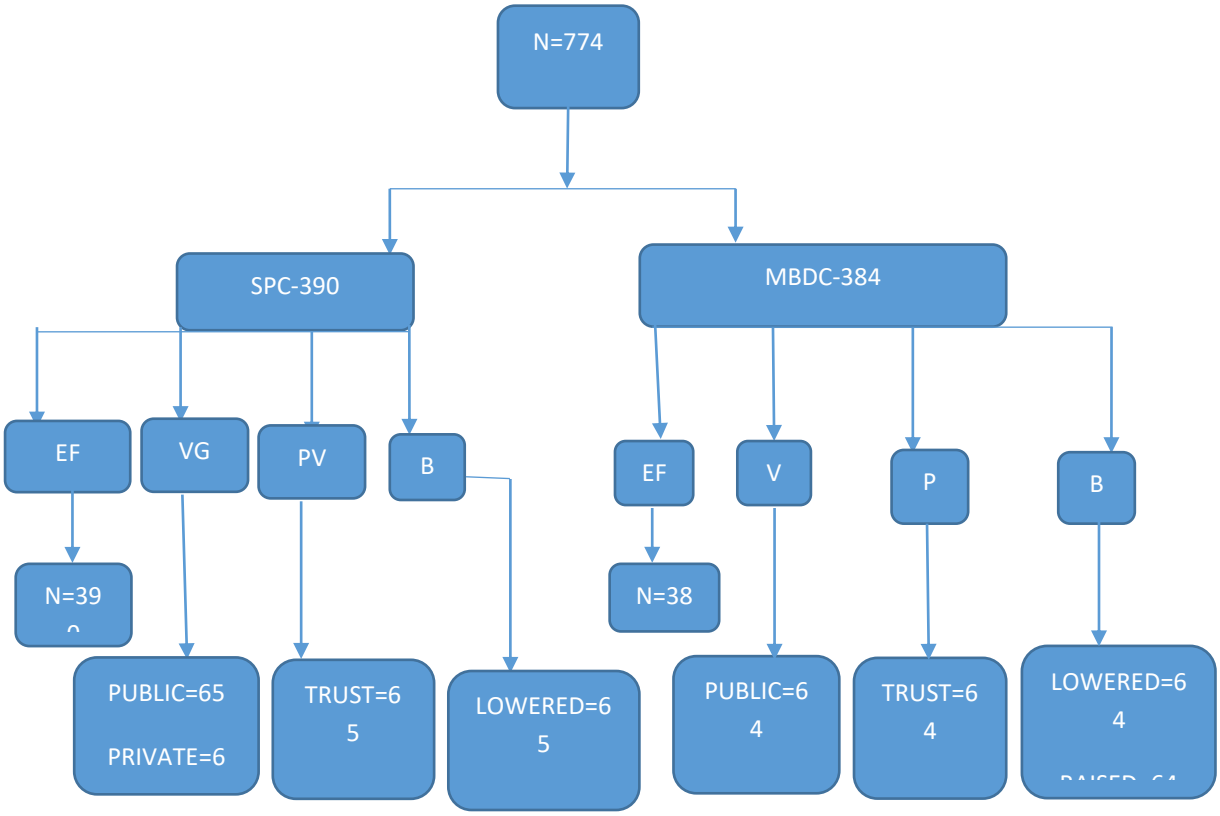


Figure 3.2: Sample distribution of questionnaires for data analysis
Source: Own conceptualization (2020).

3.4 The survey technique

This study employed interview method since it allows the researcher to probe for more information from the respondent, it also leads to a high response rate, and the interviews can be scheduled at a convenient time unlike other methods. In CV studies, interviews can either be personal, mail or telephone interviews (Carson, 2000). This study used personal interviews just as used in CVM studies (Carson, 2000; Ryan *et al*., 20003; Braun *et al*., 2016). In personal interviews, the interviewer can motivate the respondents to participate completely in an interview and even probe for more information under unclear responses (Mugenda & Mugenda, 2003). Personal interviews can be accompanied with the use of visual aids that can help convey complex ideas or information to the respondents. Also they can minimize high cases of don't know responses (Cook *et al*., 2018). Furthermore, in Kenya, there is a lack of compiled data regarding household telephone books and numbers, email addresses, and even postal addresses (Ndambiri *et al*., 2016; Wang, 1997) hence the study opted to use personal interviews.

3.4.1 Data sources and collection

Both primary and secondary data sources were used. Primary data were obtained from the respondents using an interview schedule coupled with direct observation. Face to face interviews were conducted given their ability to reduce sample selection bias as pointed out by Carson (2000). For all the objectives, data on socio economic characteristics (Age, Household size, Gender, Education level, Income level, Certainty of future incomes, bid amounts) were collected. In addition, data on other aspects such as Distance, Knowledge on current state of RH, Necessity to protect RH and perception towards RH protection were equally collected. Objective one focused on determining the changes in WTP before and after presenting the SPC and MBDC formats to respondents and its associated variations, household level of certainty regarding

payments and their numerical and ordinal probabilistic components. Objective two aimed to assess respondents' sensitivity to variations in bid amounts and ranges. Data on WTP values were collected when bid ranges were both lowered and raised. Objective three placed emphasis on household preferences regarding Tax fund and Trust fund as payment vehicles, along with other socio-economic characteristics. For objective four, the major concern was on respondent’s perception and view towards RH, whether public or private good. Additionally, secondary data sources were utilized, including data from publications by the KNBS, various Kenyan government institutions and academic journals. These secondary sources provided information such as: the number of households in the study area, population statistics, population density, rainfall patterns, temperature records, and soil characteristics,which were used to provide a general description of the study area. Data collected from Kenyan government publications such as (GOK, 2019) include city charges for domestic solid waste collection and disposal upon which the elicited WTP values in objective one were compared. Journal articles like Nthiiri (2022) provided the entrance fees charged by Karura forest which was used in estimation and comparison of WTP estimates elicited from objective three.

3.4.2 The contingent survey instrument

The survey instrument used in this study was a questionnaire, which comprised of six distinct sections. These sections included an inquiry into respondents' general awareness of the current state of RH in Nairobi, an overview of the RH protection plan, an examination of the plan's effects, an assessment of associated costs, a segment featuring valuation questions, and finally, inquiries regarding respondents' socioeconomic, environmental, and demographic characteristics, aligned with existing environmental valuation literature (Ndambiri *et al*., 2017; Neupane *et al*., 2017). The questionnaire

included a mix of closed-ended, open-ended, and fill-in-the-blank questions. These questions were clearly stated, simplified, and structured to eliminate any ambiguity and avoid technical details.

3.4.2.1 Training of research assistants

Due to wide geographical and variable scope of the study, the participation of the lead researcher was supplemented by more personnel to collect the data. The research assistants were initially engaged to collect and correct data from the pilot study site. The training was done so as to check consistency amongst the assistants and their understanding of the research questions.

3.4.2.2 Preliminary assessment of survey instruments

In any research, it is crucial to conduct a preliminary questionnaire test to rectify any potential ambiguities, as suggested by Mugenda & Mugenda (2003). Perneger *et al*. (2015) have indicated an ideal pretest size for identifying the challenges and misconceptions respondents may face while utilizing questionnaires. The necessary sample size required to identify an issue with a specific level of certainty in at least one participant was calculated using the Blair & Conrad (2011) formula. As a result, a pre-test sample comprising of 32 respondents was determined as follows.

$$n = \frac{\ln(1-Power)}{\ln(1-p)} \quad \text{.....(3.2)}$$

Where n=pretest sample size

Power= desired level or proportion of problems to be detected in the questionnaire (which in this study was set to be at least more than 80%).

P=prevalence of the problem often taken as the margin of error (which in this study of RH was represented by 0.05), and ln=natural log

Therefore n = ln (1-0.8)/ln (1-0.05)=31.37.

The pretest sample size was determined according to the calculation and rounded up to the nearest whole number, resulting in a sample of thirty-two participants, following guidance from Perneger *et al.* (2015). Subsequently, this study entailed conducting a preliminary trial of the survey tool (questionnaire). The pretest exercise was conducted within Nairobi county among the public and private RH owners. The respondents were requested to complete the survey questionnaire, as recommended by Chanel *et al*. (2016) and Ndambiri *et al*. (2017). In the pretesting, the respondents were asked to comment on the suitability of the questions posed, paying close attention to wording, clarity, relevance and interpretation of each question in the questionaire and other anomalies as pointed out in (Braun *et al*., 2016, Hung *et al*., 2007). The BR used for the study were equally established or collected from the pre-test exercise and they were used to determine the minimum, maximum and mean WTP values. Based on the responses and comments provided by the respondents during the pre-test, a final draft of the survey questionnaire was prepared.

3.4.2.3 The data collection period

The study was conducted in the months of October 2020 – April 2021. The implementation process was in twenty four phases corresponding to different samples as per the sampling procedure. An introductory cover letter explaining the significance of the study was also attached to the questionnaire as a way of encouraging responses. Furthermore, a confidentiality statement was included in the letter to convey an ethical commitment to the respondents that the information provided was to be used for sole purpose of research.

3.4.2.4. Validity of the research instruments

The effectiveness of any research tool depends on its relevance, comprehensiveness, and the arrangement of items in relation to the variables being studied. Validity is crucial and comes in three forms. First, construct validity entails determining the appropriate operational measures for the concepts being investigated. Second, internal validity is relevant primarily to explanatory and causal studies, establishing a cause-and-effect relationship to demonstrate that certain conditions lead to specific outcomes. It is not applicable to descriptive or exploratory studies. External validity is used to delineate the scope within which the study's results can be extrapolated. If there is potential for misinterpretation of a question, the information is considered to have low validity. To avoid this, the questionnaires were subjected to a pilot test. Furthermore, a session was organized with the participants in a semi-structured interview setting, where the questionnaires were handed to them directly, allowing for clarification of any uncertainties. This enhanced the validity of the study. Consequently, the study's results can be generalized with 95 percent confidence level and a 5 percent margin of error.

3.4.2.5. Reliability of the research instruments

The concept of reliability in research refers to the consistency and dependability of the outcomes of an investigation. A study is considered reliable if it can replicate the same results under unchanged conditions within a population. This can be viewed deductively, where consistent results are achieved on separate occasions, or inductively, where diverse researchers can reach similar conclusions under differing circumstances. Kothari (2009) suggests that reliability may be compromised by four potential threats:

a) Subject error: This pertains to the timing of the interview. It is crucial to pick a neutral time and date to ensure unbiased results.

b) Subject bias: This issue is particularly pronounced in organizations with authoritarian management. The interviewees may provide responses that they believe the intervewer wants to hear, rather than their genuine thoughts and feelings.

c) Observer error: This error can be minimized by structuring the interview schedule rigorously.

d) Observer bias: This bias revolves around the interviewer's interpretation of the collected data.

The reliability of the questionnaire used in this study was evaluated using the Cronbach Coefficient Alpha, which measures the internal consistency of the items. This method estimates the reliability of test scores from a single test administration. As a result, it provided robust reliability measures, as the more consistent the test content and administration conditions are, the higher the internal consistency and reliability (Mugenda & Mugenda, 2003). The Cronbach Coefficient Alpha value for the research instrument used in this study of RH was 0.84, surpassing the recommended 0.7 suggested by Mugenda & Mugenda (2003).

3.5 Research authorization

The researcher proceeded to collect data after receiving permission from the School of Agriculture and Natural Resource Management of Moi University (Refer to Appendix D). In pursuant to research authorization and ethics as required by the Laws of Kenya, the researcher also made an application for authority to conduct the research in Kenya from the National Commission for Science, Technology and Innovation (NACOSTI) in Nairobi. The research permit was granted by NACOSTI which paved way for data collection (Refer to Appendix E). Moreover, given that the validity and authenticity of the license runs only for one year from the date of issuance as per the NACOSTI regulations, the researcher had to renew the license.

3.5.1 Ethical consideration

The study upheld the principle of voluntary participation that required that people are not coerced into participating in research (Kothari, 2008; Muketha, 2014). The study sought the involvement of participants through informed consent, whereby prospective respondents were fully informed of the procedures involved in the research and allowed to give their consent to participate. To protect the privacy of the respondents, the researcher guaranteed the participants their confidentiality by assuring them that information collected would not be made available to anyone who has not been directly involved in the study. Furthermore, the researcher ensured that participants remained anonymous throughout the study. Moreover in accordance with the research ethics, a plagiarism test was conducted after the final write up of the dissertation by Moi University through the Centre of Excellence for Educational Research Methodologies and Management (CERM-ESA) and the dissertation passed the test with a word count of 54194 (See Appendix F).

3.6 Variable descriptions and expected relationships

The variables considered in this study of RH protection are detailed in Table 3.2 below.

Table 3.2: Description and measurement of variables and their expected signs

Variable	Full definition	Description of the variables	Expected Sign
WTP	Willingness to pay (Monetary	Dependent variable (Continuous)	+/-
SD	Measurement) Standard deviation of WTP estimates	Dependent variable (Continuous)	+/-
Bid	Bid amount offered	Bid amount in the payment card	+/-
Age	Age in years	Age of household head in years (continuous)	+/-
Gender	Gender of household	Sex of the household head (1=male, 0= Otherwise)	+/-
Income	Income level of household per month	Household income measured in Kenya shillings (continuous)	+
Own	land ownership	Whether household head owns land within riparian area (1=Yes, 0=No)	+
Necess	Necessity	Necessity to protect RH (1=Necessary 0=Unnecessary)	+
Dist	Distance	Distance from business/ farming activity/ place of residence to the nearest riparian habitat measured in Metres (continuous variable)	-
Cert	Certainty	Certainty about future incomes for the next one year (1=Certain, 0=Uncertain)	+
Educ	Education level	Households level of education (0=No formal education, 1=Primary, =Secondary, 3=College, 4=University)	+/-
RH protection	Riparian habitat protection level	Scope test for protection, (0=None, 1=25%, 2=50%, 3=75%)	+
Hhsize	Household size	Number of adults and children feeding from the same source(continuous)	+/ - +/-
PV	Payment vehicle used	Preferred payment vehicle (0=Tax fund, 1=Trust fund)	+/- +/-
VG	Valuation good	View on valuation on the good (0=Public, 1=Private)	+/-
BR	Bid range	Type of range one is interviewed under (0=Base range, 1=changed bid range).	+/-
EF	Elicitation Format	Data generation format (0=SPC, 1=MBDC)	

Source: Survey data, 2020.

3.7 Data analysis

The study used both qualitative and quantitative data. Data in scale measurements with normal distribution were subjected to descriptive statistics. Nominal and count data was tested for statistical differences using Man-Whitney test, Kruskal-Wallis test and F test

(Ndambiri *et al*., 2015; Ndambiri *et al*., 2016). Data were analyzed using various descriptive and econometric procedures found in STATA. Quantitative and qualitative data summaries and findings are presented in inform of tables and graphs based on the objectives addressed.

3.7.1 Analytical framework

The Wang & Jie (2010) two stage random valuation model (RVM) was used to analyze SPC and MBDC data. The model assumes that one's WTP denoted say by letter $\mathbf{Z_j}$, is a random variable which takes a cumulative distribution function say $\boldsymbol{\lambda}(\mathbf{L})$ and the mean value of $\mathbf{Z_j}$, is $\boldsymbol{\mu_j}$, and the standard variance is $\boldsymbol{\sigma_j}$, then the WTP model can be formulated as:

$$Z_{j,} = \mu_{j,} + \varepsilon_j \quad \text{.....(3.3)}$$

where ε_j is a stochastic term. Presupposing that the respondent j knows her valuation distribution when given a bid price L_{ji}, then the probability of household j saying 'yes' to the offer L_{ji} will only be possible, if the WTP is greater than the bid price, or 1 minus the probability distribution of the bid price as shown below.

$$P_{ji} = \text{Prob}(Z_{j,} > L_{ji}) \quad \text{..... (3.4)}$$

$$= 1 - \lambda(L_{ji}) \quad \text{..... (3.5)}$$

Suppose the probability of the j^{th} person saying yes to the bid price L_{ji} is known either through assigning numerical values to the verbal MBDC likelihood data or through asking the household to state his/her numerical probabilistic data as with the SPC format, then equation (3.5) can be estimated for every household using the following estimation model.

$$P_{ji} = 1 - \lambda(L_{ji}) + e_j \quad \text{..... (3.6)}$$

where e_j is the random term which is normally distributed with zero mean and constant variance(δ^2) for respondent j, but different for different respondents. P_{ji} is the probabilistic dependent and continuous variable which can take any value between 0 and 1. On the other hand L_{ji} is a continuous explanatory variable representing bid price for household j. Assuming the probability P_{ji} takes a normal cumulative density distribution function of the form $\lambda_j(.)$, with a mean μ_i and a standard variance σ_i, such that , $\lambda(L_{ji}) = \boldsymbol{\phi}\left(\frac{\mathbf{L_{ji}-\mu_j}}{\boldsymbol{\sigma_j}}\right)$, then the model (3.6) becomes:

$$P_{ji} = 1 - \phi\left(\frac{L_{ji}-\mu_j}{\sigma_j}\right) + e_j \;\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(3.7)}$$

From equation 3.4 to 3.7, it can be deduced that WTP is a random variable normally distributed with a mean of zero and constant variance. The bid offer is also assumed to follow a normal random distribution with bid prices distributed around its mean and variance for each household, such that the probability of paying is a function of the distribution of bid prices around its mean and variance plus the error term. Given that the main aim is to estimate and analyze μ_i and σ_i, which are functions of personal characteristics and uncertainties among others, equation (3.7) can be estimated for each household j using random valuation two stage model approach. In stage one assuming that e_j takes a normal distribution, then equation (3.7) can be transformed as follows:-

$$\frac{P_{ji}-1+\phi\left(\frac{L_{ji}-\mu_j}{\sigma_j}\right)}{\delta} \sim N(0,1) \;\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(3.8)}$$

The standardized log function would give rise to:

$$\text{Log}\,(L_i) = \sum_{j=1}^{i} \text{Log}\,\Omega\left\{\frac{P_{ji}-1+\phi\left(\frac{L_{ji}-\mu_j}{\sigma_j}\right)}{\delta}\right\} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(3.9)}$$

where $\boldsymbol{\Omega}(.)$ represents a standard normal distribution probability density function. The intuition is similar to that of a least square nonlinear estimation function where δ has no

effect on the estimation as long as it is a normal distribution. In stage two, μ_j and σ_j can be estimated for each household. For example from equation (3.9), μ_j and σ_j can be estimated for each household j, and models can be constructed and used to estimate their determinants as follows.

$$\text{Log}\,\mu_j = z_0 + q_j'z + e_1 \quad \text{(3.10)}$$

$$\text{Log}\,\sigma_j = \alpha_0 + y_j'\alpha + e_2 \quad \text{(3.11)}$$

where q_j' and y_j' are determinants of the mean and SD respectively. z_0 and α_0 are parameter estimates to be estimated. e_1 and e_2 are random errors which reflect inherent behavior of the respondent. Two stage approach was chosen because it provides a less biased estimation of the mean, variance and standard deviation of household valuation distributions since no econometric models are introduced at the first stage. Moreover, given the transformations, the data is normalized unlike in Wang & Jie, (2010) one stage model. Moreover, the results of the mean values and variances together with SD can easily be modelled and compared to other contingent valuation approaches (Wang & Jie, 2010), hence its adoption to estimate mean and SD of SPC and MBDC distributions in this study. Equations (3.10) and (3.11) respectively were used as models to establish the mean WTP and SD of mean WTP distributions, together with their determinants for each objective in this study. Equations 3.10 and 3.11 can be simplified as follows:-

$$\text{Log}\,\mu_{iEF} = \beta_0 + \beta_1\text{agehh} + \beta_2\text{inc} + \beta_3\text{dst} + \beta_4\text{Hhsize} + \beta_5\text{gen} + \beta_6\text{educ} + \beta_7\text{cert} + \beta_8\text{Necess} + \beta_9\text{own} + \beta_{10}\text{EF} + \varepsilon_i \quad \text{(3.12)}$$

$$\text{Log}\,\sigma_i\,\text{EF} = \alpha_0 + \alpha_1\text{agehh} + \alpha_2\text{inc} + \alpha_3\text{dst} + \alpha_4\text{Hhsize} + \alpha_5\text{gen} + \alpha_6\text{educ} + \alpha_7\text{cert} + \alpha_8\text{Necess} + \alpha_9\text{own} + \alpha_{10}\text{EF} + \varepsilon_i \quad \text{(3.13)}$$

In this study, the Wang & Jie (2010) RVM was employed to elicit WTP due to its robust statistical foundations, ensuring reliability in estimating WTP values. Additionally, the model offers flexibility in accommodating various data formats commonly encountered in environmental valuation studies, such as open-ended, dichotomous choice, and scale-based methods. Moreover, it utilizes efficient estimation techniques, allowing researchers to obtain precise parameter estimates even with complex split sample data structures commonly found in environmental valuation research. Previous studies that have utilized the RVM have demonstrated its empirical validity and effectiveness in accurately estimating WTP for various environmental goods and services (Wang, 1997; Wang & Whittington, 2005), thus justifying its adoption for this study. The statistical differences in mean WTP and SD estimates between and within two samples were tested using Mann-Whitney test (Ndambiri *et al*., 2016), while for more than two samples, such statistical differences were tested using Kruskal-Wallis test statistic (Ndambiri *et al*., 2015). The Mann-Whitney and Kruskal-Wallis tests were selected because they do not require normally distributed data, making them suitable for analyzing WTP data, which may not follow a normal distribution. These tests are robust against outliers and skewness and are appropriate for ordinal response formats. Additionally, they facilitate comparisons of WTP across different demographic groups or conditions and offer straightforward interpretation, benefiting policymakers and practitioners in environmental decision-making (Ndambiri *et al*., 2015).

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Chapter Overview

This chapter presents the findings from an assessment of how changes in EF, BR, PV, and VG impact household economic valuation estimates (WTP and its associated SD) for RH protection in Kenya. The analysis utilized CV uncertainty data elicitation payment cards, with valuation estimates converted to dollars at an exchange rate of 1 USD =152.43 KES.

4.2 Diagnostic Tests Performed

The data were subjected to various tests before being analyzed. Multicollinearity test was done using Variance Inflation Factor (VIF) and the results gave a mean VIF of 1.22 against the recommended VIF of 10, an indication of negligible collinearity among the independent variables. Heteroscedasticity test was also done to test for constant variance using white test. The following hypothesis was tested.

H_0: Presence of homoscedasticity

H_A: Presence of heteroscedasticity

The findings showed a chi2 (1) =1.61 and Prob > chi2 = 0.2042. The probability Prob > chi2 = 0.2042 is more than 0.05, hence failure to reject the null hypothesis implying presence of homoscedasticity. Normality test was equally done to test if the data were normal, using Shapiro –Wilk test and the following hypothesis was tested.

H_0: The data follows a normal distribution.

H_A: The data does not follow a normal distribution

The findings showed a W test statistic of 0.99352 and a prob>Z value of 0.09641. The prob>Z value of 0.09641 was greater than 0.05, leading to failure to reject the null hypothesis, thus the data was normally distributed. Besides the data were tested for

sample selection bias by comparing the means of independent variables for respondents who had indicated positive WTP to those who had indicated zero WTP amounts both in SPC and MBDC formats. The t test was used to test for any significant difference for continuous data variables such as income, whereas Chi-square test was used for categorical data variables. The results showed no significant variances in the independent variables between the protest and non-protest responses for both the SPC and MBDC groups (Refer to Appendix B3 for details).

4.3 Descriptive Results not utilized in the welfare estimate functions.

This section provides descriptive findings regarding households' perceived benefits of safeguarded RH, challenges linked to unprotected RH, primary sources of RH destruction along with empirical evidence highlighting RH related issues in Nairobi. It also explores the categorization of compromised RH and the associated problems, the level of gravity and attention given to unprotected RH, proposed protective measures and the preferred mode of payment for RH protection policies by households. Figure 4.1, presented below, illustrates the descriptive outcomes concerning the benefits attributed to protected RH, as articulated by both SPC and MBDC households.

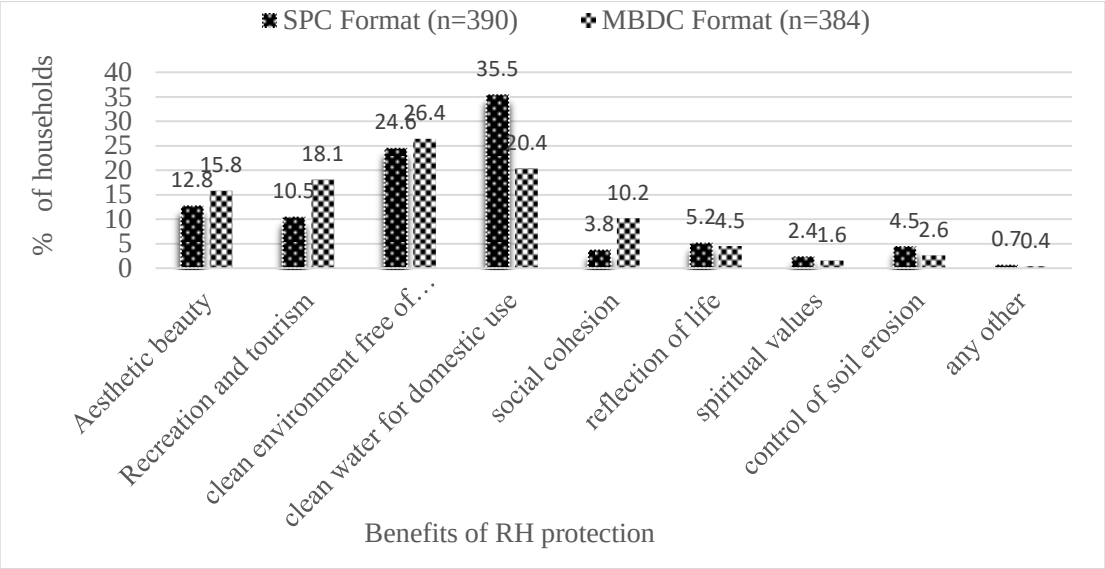


Figure 4.1: Benefits associated with protected RH
Source: Author's Survey Data, 2021

When households were asked to specify the benefits associated with protected RH, a notable divergence in preferences emerged between SPC and MBDC respondents. Among SPC respondents, the majority (35.5%) anticipated obtaining clean water for domestic use, while only 2.4% expressed an expectation of spiritual functions. Additional preferences included 24.6% prioritizing a clean environment free of diseases, 12.8% valuing aesthetic beauty, and 10.5% enjoying recreation and tourism benefits. On the contrary, MBDC respondents exhibited a distinct set of preferences, with the highest percentage (26.4%) favoring a clean environment free of diseases. A minimal 2.6% expressed expectations of benefiting from controlled soil erosion, while 20.4% envisioned clean water for domestic use, and 18.1% looked forward to recreation opportunities. These findings align with previous observations made by researchers such as Mckinnon *et al*. (2016), Nel (2020) and the NAS (2002). The implications of these results suggest that, with these perceived benefits in mind, households are likely inclined to support and protect RH. Research, including studies by Jeffrey *et al*. (2014) and Lewis *et al*., (2017) have established a positive correlation between perceived

benefits and conservation efforts. Hence, a compelling case exists for promoting active household involvement in safeguarding RH in Kenya, considering the myriad of benefits they link to such protective endeavors. When survey participants in both SPC and MBDC formats were asked about the issues connected to destructed RH, the findings are presented in Figure 4.2 below.

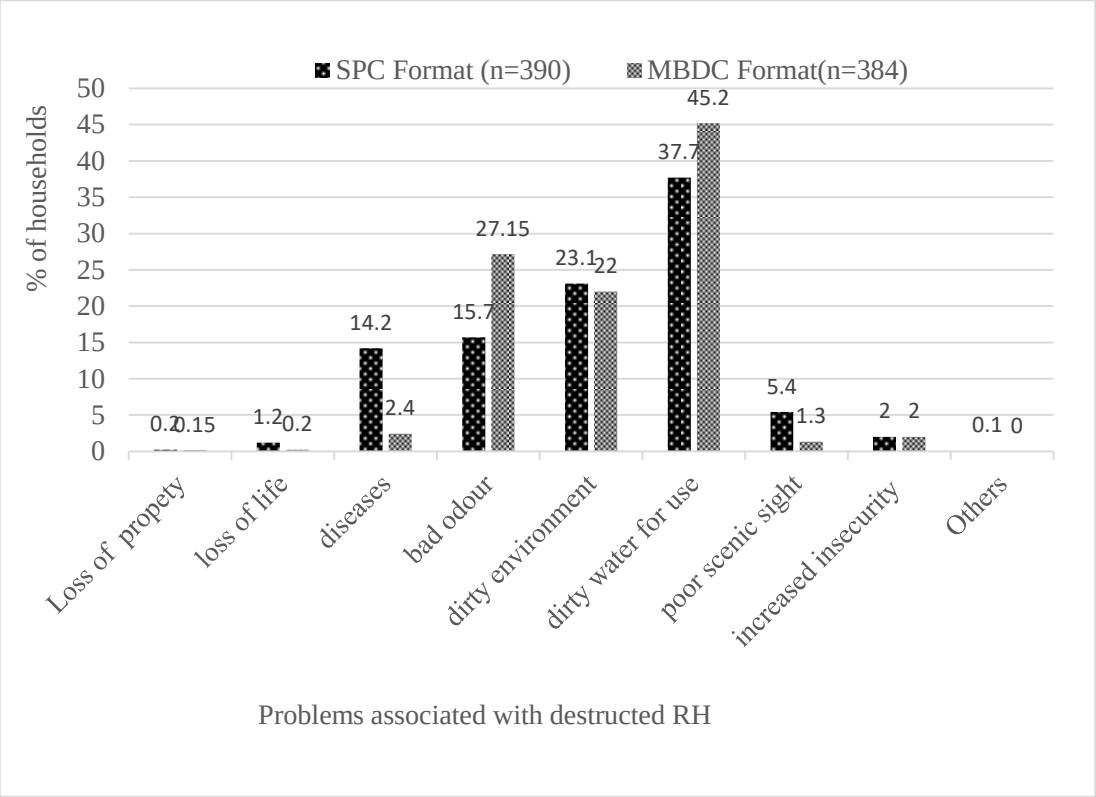


Figure 4.2: Challenges linked to compromised RH.
Source: Author's Survey Data, 2021.

The analysis of the issues related to destructed RH conditions reveals that a significant portion of households in the SPC category (37.7%) experienced heightened challenges due to contaminated water (37.7%) and unpleasant odour (15.7%), both associated with unsanitary environments (23.1%) and resulting illnesses (14.2%). Comparatively, only 1.2% were linked to loss of life, and 0.2% were associated with property loss. Poor scenic views accounted for 5.4%, insecurity accounted for 2% with other issues contributing to 0.1%. Conversely, the majority of MBDC households (45.2%) faced

difficulties arising from polluted water and unpleasant odors (27.15%) originating from unclean surroundings (22%). A smaller percentage suffered from diseases (2.4%), loss of life (0.2%), and property loss (0.15%). Poor scenic views affected 1.3%, insecurity impacted 2%, and 0% resulted from other problems. These findings underscore the urgency of protecting RH, given the challenges encountered by households. The results align with previous studies, such as those by Karangi (2017), and Muketha, (2014) suggesting that Nairobi residents have experienced various problems as a result of unprotected RH. Initiatives toward RH protection would likely be well-received, considering the documented challenges. When households were asked about Nairobi's RH destruction-associated problems, a significant proportion acknowledged the issue. Specifically, 85% of SPC households and 89% of MBDC households (Refer to Appendix C1) recognized the city's challenges, reinforcing the importance of RH protection.

This aligns with the findings of Karangi (2017) and Matunda (2015), indicating widespread awareness of the problem. The survey delved into the causes of RH destruction, with human encroachment identified as a major concern. The results in Appendix C1 reveal that 79.5% of SPC households and 93.8% of MBDC households perceive human encroachment as a menace. Conflicting laws and Acts were cited by 12.8% of SPC and 2.6% of MBDC households, while 5.1% (SPC) and 0.5% (MBDC) pointed to inadequate legal enforcement. Additionally, 2.6% (SPC) and 2.3% (MBDC) attributed RH destruction to climate change. These findings echo previous studies by Karisa (2010), Karangi *et al*. (2017) and Mugo *et al*. (2022). The implications of these results are significant, suggesting that without interposition, Kenyan habitats may face extinction due to ongoing destruction, particularly from human encroachment. Therefore, understanding the economic value households place on RH could serve as a

driving force for protection efforts. In Appendix C1, it is evident that 93.8% of MBDC households recognize the necessity of safeguarding RH, surpassing the 81.2% acknowledgment from SPC respondents. This finding indicates a higher willingness among MBDC households to contribute financially to RH policies, given their perceived importance in protecting these habitats. When participants were tasked with categorizing issues linked to destroyed RH, 60% of SPC households identified it as an environmental problem, contrasting with 26% of MBDC households. Social concerns were raised by 20.5% of SPC respondents compared to 2.6% of MBDC participants.

For economic problems, 11.8% of SPC households mentioned it, while a substantial 62.5% of MBDC households considered it an economic issue. Individual concerns were expressed by 6.4% of SPC and 8.3% of MBDC households. Interestingly, only 1.3% of SPC households associated the problem with politics, whereas 0.5% of MBDC households did so, as outlined in Appendix C2. This finding suggests that issues related to deteriorated and destructed RH are perceived as primarily an environmental concern for SPC households (60%) and predominantly an economic problem for MBDC households (62.5%) as shown in Appendix C2.

Therefore, gaining insight into the environmental and economic values placed on this habitat by each household would be informative for further analysis. Furthermore, when these households were surveyed to express their opinion on issues arising from destructed RH concerns who? 38.5% of SPC households indicated government concern, while 52.1% of MBDC households shared the same view. Only 0.8% of SPC households felt NGOs were affected, in contrast to 0.3% of MBDC households. Business community concerns were expressed by 1.5 % of SPC households and 3.6% of MBDC households. A notable difference emerged, with a larger proportion of SPC

households (51.2%) feeling that the issue concerned households, compared to 3.9% of MBDC respondents. Interestingly, 0.3% of the SPC respondents considered it a problem for everyone, whereas 3.4% of MBDC households felt it concerned everyone. Additionally, 0.5% of SPC households believed it concerned the church, as opposed to 0.3% in MBDC. 0.3% of the SPC respondents indicated concern for others, while 1.3% of MBDC households felt it concerned others, as outlined in Appendix C2. These findings underscore the shared responsibility of both the government and households in the protection of RH as previously indicated by Holmes *et al*., (2008). Appendix C3 provides insights into the households' seriousness regarding issues related to destructed habitats, the attention authorities allocate to RH protection and proposed measures for RH safeguarding. Among the 390 surveyed SPC respondents, only 1.3 % perceived the problem as very serious, while 14.1% of MBDC respondents shared this view. The majority of SPC households (92.3%) considered the issue serious, in contrast to 65.1% of MBDC households. Additionally, 6.4 % of SPC households perceived the problem as less serious, compared to 20.8% of MBDC households. These results indicate a general consensus among households that the issue of destructed RH is indeed serious and warrants attention (Holmes *et al*., 2002). Furthermore, the findings revealed that 12.8% of SPC households believed RH received a significant amount of attention, while 20.8% of MBDC respondents held this view. About 51.3% of SPC households felt they received some attention, whereas only 8.9% of MBDC households felt the same. In contrast, 30.8% of SPC households believed they received not too much attention, while 70.3% of MBDC households shared this sentiment.

Additionally, 10.3% of SPC households expressed the belief that the habitats had not received any attention at all, compared to 5.2% of MBDC households. These findings suggest that while some attention has been directed towards habitats as also observed

earlier by Singh *et al*., (2021), there is room for improvement in addressing the potential for destruction. When households were surveyed about protective measures for RH, a significant majority expressed a preference for intensified educational campaigns, with 71.8% of SPC households and 57.3% of MBDC households advocating for this approach. Fencing emerged as a perceived necessity, with 10.3% of SPC households endorsing it, compared to 5.2% of MBDC respondents. Additionally, 7.2% of SPC and 7% of MBDC households believed that the payment of non-protection taxes could contribute to RH preservation, while 3.1% of SPC and 2.6% of MBDC households believed in the protection subsidy. Almost 1.3% of SPC respondents favored life imprisonment for those causing destruction compared to 1% of MBDC respondents. A distinction appeared regarding the endorsement of demolishing structures erected on RH, with 3.8% of SPC households supporting it compared to 10.4% of MBDC households.

Furthermore, 2.1% of SPC households considered the discharge of treated effluents as beneficial, while 15.6% of MBDC households shared this perspective. Minority proportion of SPC and MBDC households (0.5% and 0.8%) respectively preferred other measures. These findings from Appendix C3 suggest that, despite the existence of educational campaigns, households place a significant emphasis on the need for intensified efforts in this area. This inclination is noteworthy, particularly as earlier indicated in Appendix C2 that a majority of SPC households (51.2%) view RH destruction as a personal problem while 52.1% of MBDC households view it as a government problem. The desire for increased educational campaigns indicates a potential shift in households' perceptions and values concerning the importance of RH protection. Appendix C4 presents results indicating households' familiarity with the WTP scenario, their interest in the involvement of the hypothesized kitty fund, and their

inclination to contribute funds regularly to the established kitty. The findings revealed that 48% of SPC households found the WTP scenario to be entirely new, compared to 39% of MBDC respondents. Additionally, 26% of SPC respondents perceived it as somewhat new, contrasting with the 8% of MBDC households. A minority, representing 0.1% of SPC and 1% of MBDC households, reported familiarity with the WTP scenario. Furthermore, 18% of SPC households and 52% of MBDC households stated that they had never heard of it, aligning with common observations in CV studies (Barrena *et al*., 2014; Welsh & Poe, 1989). These results indicate that a significant number of households were not familiar with this valuation method, which could potentially introduce hypothetical bias into the study. To address this issue, a correction factor of one-third was applied to the WTP estimates, following the recommendation of Barrena *et al.,* (2014).

This adjustment was deemed necessary upon acknowledging the limited awareness among participants. The majority of households, comprising 89.7% of SPC and 75.5% of MBDC households, expressed interest in the established fund. Conversely, 2.6% of SPC and 23.4% of MBDC households indicated that their participation would hinge on the nature of the policy, while 7.7% of SPC and 1% of MBDC households displayed no interest in getting involved. Notably, the predominant interest in the yet-to-be-established fund suggests overall receptiveness to such initiatives, signaling support if implemented. In a parallel vein, 77.4% of SPC households and 85.2% of MBDC households affirmed their willingness and interest in making monthly contributions to the established kitty. Among SPC households, 14.4% specified that their contributions would be contingent on the nature of the established kitty. In contrast, a minority (3.1%) of MBDC households confirmed that they would contribute only if convinced by the kitty's operation. A smaller proportion of SPC households (8.2%) expressed a refusal to

contribute, whereas 11.7% of MBDC households shared this sentiment. These results suggest that a majority of households were inclined to contribute to the proposed fund, demonstrating support for RH protection. Households indicating a refusal to contribute were considered protestors and were subsequently excluded from the analysis to maintain sample integrity. Appendix C5 illustrates the households' preferred mode of payment for the protection policy. A significant majority, comprising 64.2% of SPC and 66.5% of MBDC households, favored paying through a tax deducted from their incomes or settled at the point of purchasing local items. A minority, constituting 0.5% of SPC and 0% of MBDC households, indicated a preference for other payment methods. Additionally, 24% of SPC and 27.3% of MBDC households expressed a willingness to contribute directly to the local TRUST fund, while 1.3% of SPC and 2.3% of MBDC households were comfortable paying through donations. Some households, including 4.6% of SPC and 2.1% of MBDC, felt at ease paying alongside their insurance premiums, while 4.9% of SPC and 0.5% of MBDC households were comfortable combining their payments with amenity bills. Only 0.5% of SPC and 1.3% of MBDC households expressed comfort in paying contributions alongside fees. These findings align closely with other documented payment methods (Ndambiri *et al*., 2016; Nicosia *et al*., 2014; Zawadzki, 2016). In this study, the prevalent preference for paying for RH protection alongside other taxes suggests a familiarity with payment systems such as Pay as You Earn (PAYE) and Value Added Tax (VAT) as per the (GOK, 2021a). This mode of payment was deemed familiar to households, leading to a perceived lower impact, as the funds were deducted at the source.

4.4 Results of the variables utilized in evaluating welfare estimation functions.

Table 4.1 presents the results of descriptive statistics for the variables utilized in the valuation of welfare estimation functions, encompassing both SPC and MBDC formats.

Table 4.1: Descriptive statistics of variables used in valuation estimate function

Characteristics	SPC Model (n=390)				MBDC Model (n=384)			
	Mean/ Proportion	**Std error**	**Min.**	**Max**	**Mean/proportion**	**Std error**	**Min.**	**Max.**
Age (Years)	36.692	0.433	20	61	38.153	0.488	18	62
Income (KES)	32,092	25,305	2,718	134,700	50,444	44,222	2,580	144,094
Distance (Metres)	3.009	1.576	1	11.906	3.949	2.576	1	27
Household size	3.862	0.078	1	10	3.896	0.088	1	10
Gender (1=Male)	0.644	0.024	0	1	0.622	0.025	0	1
Education			0	4			0	4
0=Informal	0.092	0.036			0.010	0.005		
educ	0.138	0.043			0.135	0.017		
1= Primary	0.169	0.047			0.284	0.023		
2=Secondary	0.231	0.053			0.349	0.024		
3=College	0.369	0.060			0.221	0.021		
4=University								
Certainty of future incomes (1=Yes)	0.479	0.025	0	1	0.479	0.026	0	1
Necessity to protect RH (1=Necessary)	0.944	0.012	0	1	0.945	0.011	0	1
Ownership of land in riparian land (1=Yes)	0.218	0.021	0	1	0.258	0.022	0	1

Notes: Gender: 1=Male, 0=Female. Ownership of land in riparian land: 1=Yes 0=No. Necessity to protect RH: 1=Necessary, 0=Otherwise. Certainty of future incomes: 1=Certainty, 0=Otherwise.
Source: Author's Survey Data, 2021.

Based on the findings presented in Table 4.1, it is evident that the mean household size for most families in both formats was 4, a figure slightly below the national average family size of 4.4 (KNBS, 2020). The observed range varied from a minimum of 1 household to a maximum of 10 households. This trend aligns with a study by Ndambiri *et al*. (2015) conducted in the same city. Interestingly, this study of RH indicates a

modest deviation of 4 households fewer when compared to Fonta *et al.,* (2010) findings using the SPC format. This divergence might be attributed to the increased access to education, which has led to delayed marriages and childbearing as households prioritize their careers and personal development. This trend contributes to smaller family sizes as couples opt to have fewer children (KNBS, 2021).

The mean household size in Nairobi suggests that, if the RH protection policy were to be implemented, it could encounter comparatively less resistance. Studies have consistently shown that families with fewer members might exhibit a greater willingness to contribute financially to environmental conservation due to reduced financial obligations (Tassie & Endalew, 2020; Wiser, 2007) in contrast to larger family sizes. This alignment may be indicative of a more favorable climate for the acceptance and support of the proposed RH protection policy. The mean age of respondents was nearly identical in the two formats, with the MBDC format recording an average age of 38 years for a sample of 384 respondents and the SPC format having a mean age of 37 years for a sample of 390 respondents.

This small difference suggests a subtle distinction in the age composition of the two groups. It's noteworthy that the average age of respondents exceeded the youthful age ceiling limit of 35 years set by the (GOK, 2010). This finding prompts consideration of potential implications of age for RH protection, as households in this age bracket are commonly assumed to be raising families and may be more vulnerable to risks associated with disrupted RH (Colby & Orr, 2005). In terms of gender distribution, it is noteworthy that a majority of respondents in both SPC and MBDC formats were men, constituting 64% and 62%, respectively.

A result similar to (Wang & Jie, 2010; Ndambiri *et al*., 2015; Ndambiri *et al*., 2016) but contrary to that of Wiser (2007). This finding in this study of RH suggests a pronounced inclination among men towards supporting RH protection policies compared to their female counterparts. Consequently, it is imperative to target men in policy implementation, given their predominant representation (over 62% of the respondents) and their role in controlling household resources. The influence of men in determining budgets related to RH protection policy implementation is significant. To ensure effective policy outcomes, sensitization efforts should be tailored to enlighten women about the crucial importance of RH protection in Kenya.

Additionally, future research endeavors should delve into the factors limiting women's active participation in RH protection initiatives. Analyzing educational levels using the SPC format reveals intricate patterns. Notably, 36.9% of SPC households had completed a university education, in contrast to 22.1% of MBDC households. This suggests that the majority of SPC households had acquired a university education, indicating a potentially higher awareness and knowledge of the risks associated with unprotected RH as observed in studies like Holmes *et al*., (2004), where households with a bachelor's degree and above demonstrated heightened awareness. While 13.8% of SPC households had only completed primary education, a comparable 13.5% of MBDC households had similarly finished primary education. This finding implies a slight difference between the two groups, yet both were presumed to possess some level of information concerning RH. Furthermore, 28.4% of MBDC households had attained secondary education level compared to 16.9% of SPC households, suggesting that MBDC households were more aware of the necessity to protect these habitats. Additionally, the number of MBDC households with a college education level was 1.5 times that of SPC households, indicating that a majority of MBDC households had

attained a college education level, presuming a higher level of awareness. In contrast, 90.7% of SPC households had education up to the university level, differing from 98.9% of MBDC respondents. This discovery indicates that despite households being educated and presumed to prioritize RH protection, the reality diverged, as evidenced by the high incidence of RH destruction in the city, suggesting otherwise. Illiteracy rates were 9.2% for SPC respondents and 1% for MBDC respondents, both lower than the mean illiteracy rate of 10% for Nairobi County. This observation implies that possessing information and awareness about RH is crucial, but alone, it is not enough to ensure protection. Instead, comprehending the significance attributed to these habitats might be key to translating awareness into effective RH protection.

The positive correlation between WTP for RH protection and the level of education underscores the pivotal role of education in enhancing access to information and fostering a willingness to contribute to RH protection, as emphasized in other studies such as Wiser (2007). Therefore, sustained government efforts to educate households, emphasizing both tangible and intangible benefits derived from RH habitats, are imperative for maintaining a committed approach to RH protection. Regardless of the educational background of households, a significant majority of survey participants (52.1%) in both formats expressed uncertainty about their future incomes. This uncertainty is closely tied to the economic challenges prevailing during the study, exacerbated by the widespread impact of the Covid-19 pandemic. Respondents, grappling with the pandemic's effects, exercised caution in projecting their future expenditures due to ongoing income uncertainties, a phenomenon acknowledged by the International Monetary Fund in 2020. However, the 48% of respondents who exhibited certainty about their future incomes suggest that the WTP for RH protection was not severely impacted. Existing literature, as highlighted by Wang & Whittington (2005)

and Wang & Jie (2010), underscores the pivotal role of income certainty in shaping CV estimates. Despite economic challenges, this level of certainty provides a relatively stable foundation for valuing RH protection. Looking ahead, as economies recover from the shocks induced by the pandemic, conducting follow-up studies becomes imperative to assess changes in levels of income certainty. Such investigations could illuminate evolving dynamics and their potential implications for the valuation of RH. Recommendations for future research should be guided by specific questions, such as exploring the factors influencing shifts in income certainty post-economic recovery and their consequential effects on RH protection valuation.

The mean monthly income for the SPC format was KES 32,092 ($210.56 at an exchange rate of 1 USD = KES 152.43), whereas the MBDC format had a higher mean income of KES 50,444 ($330.97 at the same exchange rate). Significantly, these average incomes align with the range documented for Nairobi County as per KNBS (2021), ranging from KES. 23,671 ($155.31) to KES. 119,199 ($782.07). In contrast to prior studies conducted in the same city by Ndambiri *et al,*. (2015; 2016), this study reveals a mean monthly income for RH protection that exceeds their findings by more than 60%, despite variations in the valuation goods under consideration. Additionally, when comparing our results with similar RH studies, such as the research conducted by Colby & Orr (2005), the registered mean income for this study on RH protection represents only 0.1% of what was observed in 2005 by Colby & Orr and merely 0.7% of the figures reported by Kline *et al*. (2000). Although the incomes reported in this study of RH indicate a higher WTP, they do not reach the levels observed in these earlier investigations. This suggests that Kenyans are notably more inclined to allocate resources for RH protection, likely attributed to the perceived benefits from these habitats. Consequently, it implies that the implementation of an RH protection policy

may not encounter significant resistance. Furthermore, if garnering support for the RH protection policy is a goal, it is prudent to target middle-income earners. The observed income levels, especially in the MBDC format, indicate a potential reservoir of financial support within this demographic. A higher percentage (95%) of respondents in the MBDC format expressed the need to protect RH compared to 94% in the SPC format. This observation is attributed to the education levels of the respondents. Advancements in education expose households to new ideas, information, and knowledge (Holmes *at al*., 2004; Ndambiri *et al*., 2015). Within the city, respondents with higher levels of education were more likely to recognize the importance of protecting RH, consistent with findings from studies like Neupane *et al*., (2017) and Fonta *et al.,* (2007). Majority of the respondents found it necessay to protect RH, and it is reasonable to presume that their WTP towards protection is equally high.

However, further empirical investigation could provide deeper insights into the relationship between perceived necessity and actual WTP. Additionally, the results indicate that a significant majority of respondents in both formats reside and conduct their businesses in close proximity to RH, within a distance of less than 4 meters. This observation underscores the potential risk of increased degradation and destruction of RH due to human activities in the future.

Therefore, it becomes imperative to emphasize the need for their protection to ensure their continued proper functioning. Considering the high population density within the city, there is a pressing need to engage in awareness campaigns targeting households residing and conducting businesses near RH, besides promoting sustainable practices to mitigate potential harm. Studies, such as Schismenos *et al*., (2018), highlight that RH can serve as valuable assets for ecotourism, recreation, spiritual activities, research, and

even as venues for weddings. These diverse functions not only contribute to the conservation of RH but also offer economic opportunities. Sensitizing households about these potential benefits can foster a greater understanding of the importance of RH protection. Moreover, the findings in Table 4.1 highlight a distinct disparity in land ownership among these environments, where a smaller percentage of SPC respondents (22%) possess land compared to MBDC respondents (26%). For those households who own land within the riparian area, 76.7% of SPC and 95% of MBDC respondents hold land under leasehold ownership. In contrast, only 23.3% of SPC and 5% of MBDC households hold land under freehold ownership (Refer to Appendix C6). This finding suggests that a considerable portion of RH is under government ownership, despite facing significant destruction.

This observation underscores the potential for safeguarding these lands through careful planning and facilitation, in accordance with environmental laws. The government could explore the possibility of promoting public-private partnerships, mirroring successful initiatives in other regions such as Kisumu city. By leasing these lands to private entrepreneurs under conditions that encourage sustainable use, the government can generate revenue, while entrepreneurs can earn income through their conservation efforts. Additionally, Appendix C3 highlights the crucial need to raise awareness among landowners within the RH about the importance of protecting these areas. Household responses in the appendix underscore the necessity for intensified educational campaigns within their localities.

4.5 Effects of value EF on CV estimates of RH protection in Kenya

Two elicitation formats, specifically SPC and MBDC, were juxtaposed, and their means were subjected to a Mann-Whitney test to detect any significant differences. The results of this analysis are detailed in Table 4.2 below.

Table 4.2: Evaluating differences in mean WTP estimates for different value EF

Descriptions	**SPC (n=390)**	**MBDC (n=384)**
Mean WTP (μ) in KES/Month	925.51	1167.60
Standard error of the mean	48.31	78.04
Coefficient of variation(σ/μ)	1.03	1.31
MWT-value (MWTP)	2.717	
P-value (MWTP)	0.007***	

Explanatory notes: MWT implies Mann Whitney Test; * p < 0.1; ** p < 0.05; *** p < 0.01.

Source: Author's Survey Data, 2021.

The findings in Table 4.2 indicate that the MBDC format exhibited a higher mean WTP at KES 1167.60±78.04 (equivalent to $7.66±$0.51, at the exchange rate of 1 dollar = KES. 152.43), compared to the SPC format with a mean WTP of KES 925.51±48.31 (equivalent to $6.07±$0.32 at the same exchange rate).To mitigate potential overstatements in values, a corrective measure was implemented for all subsequent objectives involving WTP and Standard Deviation (SD) of WTP results. This involved dividing the actual WTP values by 1/3. This adjustment accounts for overstated values typical in cross-sectional data and addresses hypothetical bias, as recommended by Barrena *et al*., (2014).

The observed WTP values for the SPC format in Table 4.2 were slightly lower than those reported by Wang & Jie (2010) and Wang & Whittington (2005), who used a similar analytical model just like the one used in this study of RH, and the differences could be attributed to varying sample sizes and different valuation goods used. In contrast, the WTP values in Table 4.2 differ from those observed by Ndambiri *et al.,*

(2016), where the MBDC format had lower WTP values than SPC format in the same study area. This divergence in WTP values could be associated with differences in elicitation formats considered. The SD usually measures the magnitude of dispersion or variability of household data values from the sample mean, while the standard error of the mean (SEM) measures how far the sample mean of the data is likely to be from the true population mean (Stock & Watson, 2019). Upon analyzing the SPC and MBDC formats to detect significant variations in the SD of WTP values using the Mann-Whitney test, the findings revealed noteworthy differences. Specifically, the coefficient of variation (COEFV) usually derived from the SD, showed that the mean WTP estimates within the MBDC format exhibited a substantial dispersion of 131%, contrasting with the SPC format, where the COEFV was calculated at 103%. This pattern aligns with the conclusions drawn by Wang & Whittington (2005), suggesting that MBDC household WTP estimates were considerably more variable from the mean estimate compared to those in the SPC format.

This finding implies that if the RH protection policy was to be implemented, respondents from the SPC format would be a more targeted group due to their more homogeneous WTP values. The Mann-Whitney test statistic demonstrated a significant difference in mean WTP values (KES. 242.09 or $1.59) at a 1% significance level (MWT $\boldsymbol{\alpha}$=2.717; $p<0.01$). This observation is consistent with the findings of Champ & Bishop (2006). Furthermore, the results revealed that the standard deviation (SD) in the SPC format (KES. 953.28 or $6.25) was lower compared to that of the MBDC format (KES. 1,529.56 or $10.03) at a 1% significance level. Given that between sample statistical differences were realized at 1 % in both WTP values and its SD, the null hypothesis (H_O) was rejected in favor of the alternative hypothesis (H_A), which states that changing the EF does significantly affect households' CV estimates towards RH

protection in Kenya. The positive values expressed by households for both WTP and its SD in Table 4.2 underscore the favorable perception of households towards RH protection. Additionally, these WTP and SD values reveal that, despite previous limitations in the application of these two data formats for RH valuation, they have proven to be desirable. This aligns with expectations from CV literature, as these formats not only demonstrate WTP values but also indicate the consistency and commitment of households towards paying the stated amounts associated with their positive WTP values. This consistency is crucial for informed decision-making. Interestingly, SPC households exhibited greater consistency in fulfilling their stated WTP values compared to MBDC households. Research in CV literature has indicated a preference for economic forms that underestimate WTP values (Svedsater, 2001; Bateman *et al*., 1995).

Consequently, in this study, the SPC format is recommended for future valuations of RH protection. For practical applicability of the WTP estimates, determination of total WTP/Year was necessary. Multiplication of Mean WTP by the number of households amounted to total WTP value (KES 925.51*12*289898 households). During the 2020/2021 period, Nairobi city generated around 1,971,000 tonnes of solid waste, according to the (KNBS, 2021). Out of this total, 40% were illegally disposed of, leaving approximately 788,400 tonnes uncollected. According to the (GOK,2021c) the fee for refuse collection for a middle-income class household was set at KES 300 or $3. Multiplying the tonnes of uncollected and illegally dumped solid wastes by the collection fee of KES 300 gave a total amount of 237 million, which was lost by the Nairobi County. If the proposed WTP values would be properly collected and utilized, 0.7% of the total collections (KES 3.22 Billion from SPC format and KES 4.1 billion from MBDC format) can be used for proper solid waste disposal and the rest of the

money can be used to foster development projects within the study area. Table 4.3 displays the outcomes of average WTP estimates and their determinants for both the SPC and MBDC data elicitation formats.

Table 4.3: Mean WTP estimates and the determinant factors for different EF

Characteristics	**SPC Model** DV=Log(μ_i)		**MBDC Model** DV=Log(μ_i)		**SPC-MBDC Model** DV=Log(μ_i)	
	Coefficient	**Std error**	**Coefficient**	**Std error**	**Coefficient**	**Std error**
Age (Years)	0.030**(0.031)	0.003	0.007***(0.002)	0.001	0.003***(0.001)	0.002
Gender (1=Male)	0.093*(0.092)	0.050	0.056**(0.049)	0.024	0.074**(0.028)	0.032
Income (KES)	0.119*(0.052)	0.068	0.085**(0.043)	0.033	0.087**(0.011)	0.043
Distance (Metres)	0.267**(0.047)	0.067	0.093***(0.000)	0.029	0.089**(0.033)	0.040
Informal educ	-.166(0.568)	0.185	-0.028(0.152)	0.017	-0.026 (0.816)	0.111
Primary educ	.054(0.668)	0.060	0.047(0.595)	0.069	0.141 (0.609)	0.276
Secondary educ	.050(0.569)	0.031	0.016(0.622)	0.033	0.011(0.644)	0.024
College educ	.055(0.631)	0.046	0.014(0.528)	0.022	0.009** (0.031)	0.008
University educ	0.006(0.891)	0.050	0.205(0.504)	0.031	0.037***(0.001)	0.011
Household size (No. of persons)	-0.098*(0.081)	0.050	-0.032(0.420)	0.022	-.078***(0.001)	0.030
Necessity to protect RH (1=Yes, 0=No)	0.189*(0.085)	0.107	0.098*(0.066)	0.051	0.116*(0.056)	0.068
Certainty of future income (1=Yes)	0.075(0.230)	0.049	0.098***(0.001)	0.024	0.061*(0.071)	0.031
Owning land within riparian area (1=Yes)	-0.111*(0.089)	0.062	-.051**(0.041)	0.028	-0.077*(0.085)	0.038
EF(1=MBDC)	-	-	-	-	0.067**(0.043)	0.032
Constant	0.912***(0.001)	0.287	1.276***(0.001)	0.146	0.407**(0.020)	0.183
Summary statistics						
F-statistic	22.681		56.234		32.150	
Prob > F	0.000		0.000		0.000	
Adjusted R-squared	0.671		0.695		0.687	
Number of observations	390		384		774	

Explanatory notes: the character 'μ_i ' refers to the mean WTP values of the ith household; * p<0.1; ** p<0.05; *** p<0.01. In parentheses are the p-Values.
Source: Author's Survey Data, 2021.

The results indicate that factors such as Age, Gender, Income, perceived Necessity to protect RH, and Distance significantly and positively impacted mean WTP estimates across the models. Conversely, Land ownership within the riparian area significantly and negatively influenced mean WTP values. The household-level effects of these determinants are elucidated as follows:

In terms of Age variable, older households demonstrated a higher WTP towards RH protection compared to younger counterparts. This could be attributed to the fact that older households may have fewer financial obligations, allowing them to allocate some funds for RH protection. Additionally, older respondents might derive more value and benefit from RH services, such as sightseeing, recreation, and bird watching, as a means of alleviating boredom and enhancing their quality of life (Gobbens & Van Assen, 2018). This finding aligns with observations by Fonta *et al*., (2010) in studies using SPC format for valuation but differs from the findings of Kreye *et al*., (2016) and Ndambiri *et al*., (2015). Notably, Bateman *et al*., (1995) found that age had no significant influence on WTP in their valuation of changes in EF. Regarding the Gender variable, male headed households exhibited higher WTP compared to female headed households, a discovery consistent with the findings of Ndambiri *et al*., (2015) but in contrast to the observations of Laroche *et al*., (2001) and Fonta *et al*., (2008). A plausible explanation for this positive influence is that men often make decisions on financial matters at the household level, control essential resources, and have quicker access to information compared to women (Tuan & Navrud, 2007; Ndambiri *et al*., 2015). Income emerged as a significant variable with a positive sign, aligning with expectations from economic theory. This finding is consistent with studies by Neupane *et al*. (2017), Kreye *et al*. (2016), and Fonta *et al*. (2008), suggesting that respondents are more inclined to protect RH when their incomes are higher (Ndambiri *et al*., 2015; Ndambiri *et al*., 2016; Wang

& Jie, 2010). The positive coefficient of the Income variable supports the anticipated relationship, validating the outcomes of this study. Distance significantly and positively influenced WTP estimates, a finding similar to that observed by Nyongesa *et al*., (2016) and Fonta *et al*., (2007) but contrary to what was observed by (Pate &Loomis, 1997; Ndambiri *et al*., 2015; Barrena *et al*., 2014). Other studies such as Nicosia *et al*., (2014) observed no correlation between distance and WTP.

In this study, households who resided far from RH (More than 4 Metres from the RH) had higher WTP unlike those who resided near. A simple explanation for the observed behavior could be that residents who resided near gained less benefits from RH protection and benefited more from alternative land use practices, hence they were less willing to protect RH. Necessity to protect RH positively and significantly influenced WTP values across the three models. A finding consistent with that noted by (Daly *et al*., 2015; Carson *et al*., 2001). Respondents who found it necessary to protect RH had higher WTP compared to their counterparts. The reason could be that such households were cautious with their health and social challenges associated with unprotected RH such as diseases and insecurity, hence their WTP was higher (Remoundou & Koundouri, 2009; Ndambiri *et al*., 2015). Ownership of land within riparian areas significantly and negatively influenced WTP values across the models. Contrary findings have been reported by Zhong *et al*., (2016) where implementation of best management practices for water quality program increased with land ownership.

The negative land ownership coefficient realized in this study contrasts the positive sign observed by Endalew & Wondimagegnhu (2019) for the same variable. In this study the negative coefficient of land ownership implies that WTP estimates for RH protection declined with land ownership. A plausible explanation could be that respondents who

owned land in riparian areas found less need of protecting those lands for environmental gains (Nyongesa *et al*., 2016), instead they found pleasure in using them for alternative uses such as farming, building residential and commercial houses besides brick making. This confirms the need to sensitize land owners within the riparian areas that they can still make more profits through riparian ecotourism which is an opportunity for developing countries (Schismenos *et al*., 2018). Household size was significant with a negative sign for only SPC and SPC-MBDC models, a result similar to that reported by Oduor *et al*., (2018) but contrary to what was observed by Fonta *et al*., (2005; 2007). Studies such as Lamsal *et al*., (2015) have shown no correlation between household size and WTP.

In this study, WTP for protection of RH declined with increase in family sizes. A plausible explanation could be that larger family sizes were associated with more financial obligations such as paying school fees and family upkeep unlike smaller families (Ndambiri *et al*., 2015). While the certainty of future incomes positively and significantly influenced the mean WTP in both the MBDC and pooled models, the education level variable also had a similar positive effect in the pooled model. This observation is consistent with the findings of Wang & Whittington (2005), Wang & Jie (2010), Ndambiri *et al.*, (2015), and Daly *et al*., (2015), but contrasts with the results reported by Neupane *et al*., (2017). Specifically, households with College and University education exhibited higher WTP compared to their less-educated counterparts.

This is attributed to the fact that residents with post-college education have better access to information and a greater ability to understand the severity of unprotected RH problems and the feasible solutions to these problems (Neupane *et al.*, 2017; Daly et *al.*,

2015), resulting in higher levels of awareness. WTP decreased with uncertainty of future incomes. because households are more likely to pay more when they are confident about their future earnings. Of importance is the effect of change in EF on WTP values. When EF was included in the pooled model as one of the explanatory variables, the results showed that change in EF from SPC to MBDC increased mean WTP values by 6.7%. This finding suggests that, in addition to other independent variables, the change in EF significantly influenced WTP values. However, research findings comparing these two formats in the same study are limited. It was realized that determinants (Age, Gender, Distance, Necessity to protect RH, Land ownership in riparian land, EF, Income, Household size, Certainty of future incomes and Education level) significantly and differently influenced average WTP values across the three models at 1% level as shown by their respective F tests ($p<0.01$, F=22.68; $p<0.01$, F=56.23; $p<0.0$, F=32.15). The models were fit at 1% level with adjusted R^2 of about 0.70 across the three models an observation slightly above that observed by Tuan & Navrud, (2007) for split samples and the variation attributed to different methodological and data elicitation approaches used. From the pooled model, it was observed that older and male headed households who had attained post college education and whose data were generated using MBDC format, resided far from RH and found it necessary to protect RH even though they didn't own land near the habitats hence they had higher mean WTP estimates. Moreover, their income levels were high and they were more certain of their future incomes thus higher WTP for RH protection. Table 4.4 below illustrates how the combination of explanatory variables influences the SD of WTP values across various data elicitation formats.

Table 4.4: Dispersion in the WTP estimates and the determinant factors for different EF

Characteristics	SPC Model DV=Log(σ_i)		MBDC Model DV=Log(σ_i)		SPC-MBDC Model DV=Log(σ_i)	
	Coefficient	Std error	Coefficient	Std error	Coefficient	Std error
Age (Years)	0.003 (0.208)	0.002	0.004**(0.03)	0.001	0.003*(0.086)	0.001
Gender (1=Male)	-.061*(0.051)	0.034	-.021(0.124)	0.017	-.046**(0.025)	0.022
Income (KES)	-.081*(0.066)	0.046	-.035 (0.180)	0.024	-0.056 (0.114)	0.029
Distance (Metres)	0.099**(0.021)	0.045	.077***(0.000)	0.021	0.441***(.001)	0.027
Informal educ	0.052 (0.757)	0.169	0.002 (0.529)	0.004	0.065 (0.584)	0.118
Primary educ	-.183 (0.562)	0.249	-0.056 (0.567)	0.098	-0.085 (0.560)	0.115
Secondary educ	-0.043 (0.718)	0.120	-0.020 (0.661)	0.047	-0.044 (0.723)	0.124
College educ	-0.060 (0.577)	0.081	-0.016 (0.610)	0.317	-0.046 (0.696)	0.118
University educ	-0.061(0.701)	0.063	-0.002 (0.935)	0.024	-0.027 (0.649)	0.061
Household size (No. of persons)	0.065*(0.052)	0.034	0.022 (0.108)	0.016	0.005 (0.122)	0.021
Necessity to Protect RH (1=Yes)	-0.073 (0.805)	0.072	-0.046 (0.881)	0.037	-0.082*(0.051)	0.046
Certainty of future income (1=Yes)	0.070**(0.001)	0.033	0.033*(0.184)	0.017	0.002 (0.144)	0.021
Owning land within riparian area (1=Yes)	0.067 (0.755)	0.042	0.036*(0.086)	0.020	0.046*(0.094)	0.026
EF (1=MBDC)	-	-	-	-	0.098***(.001)	0.022
Constant	1.391***(0.000)	0.194	0.754***(.000)	0.104	0.076 (0.319)	0.125
Summary statistics						
F-statistic	19.67		44.78		31.32	
Prob > F	0.000		0.000		0.000	
Adjusted R-squared	0.650		0.699		0.683	
Number of observations	390		384		774	

Explanatory notes: the character 'σ_i refers to the SD of the mean WTP values of the ith household; *p<0.1; ** p<0.05; *** p<0.01. In parentheses are the p-Values. Source: Author's Survey Data, 2021.

The findings indicate that, across the three models (SPC, MBDC, SPC-MBDC), Distance had a significant and positive impact on deviations. This contrasts with the

observations made by Fonta *et al*., (2010) and Fonta *et al*., (2008), suggesting that an increase in distance resulted in a higher dispersion of WTP estimates for RH protection. Conversely, studies such as Fonta *et al*., (2007) and Ndambiri *et al*., (2015) have linked distance to travel expenditures, where greater distances covered were associated with higher travel costs. In the context of this study on RH, dispersions increased with Distance. This outcome could be attributed to the notion that the utility derived from using RH was constrained by elevated transport costs and other travel expenditures reducing travels to the RH by households who stayed far.

Additionally, the high levels of economic uncertainty during the study period led respondents to be cautious in their spending,in order to save for immediate family needs. These observations contributed to greater dispersion. The Certainty of future incomes emerged as a significant factor positively influencing dispersions in both the SPC and MBDC models. This implies that variations in WTP estimates increased with the certainty of future incomes. This finding aligns with the results reported by Wang & Whittington (2005).

However, it contradicts the findings of Wang & Whittington (1997b) and Wang & Jie (2010), where uncertainty regarding future incomes was associated with higher variances in valuation distributions. Descriptive statistics in Table 4.1 reveal that a significant proportion (52%) of respondents expressed uncertainty about their incomes. Among the households who were certain about their future incomes (48%), it is likely that upon receiving their incomes, they allocated funds among competing family needs, leading to inconsistencies in their valuation distribution. This pattern is consistent with observations made by Ndambiri *et al*. (2016). Gender exhibited a significant and negative impact on dispersion in both the SPC and SPC-MBDC models, indicating that

female-headed households had larger dispersion in their valuation distributions compared to male-headed households. This finding aligns with the results reported by Fonta *et al*., (2007, 2010), but contrasts with the findings from Wang & Whittington (1997, 2005) and Ichoku *et al.* (2009). This observation may be linked to the limited access women in developing countries have to crucial family resources, coupled with their often-restricted decision-making authority within households, resulting in limited financial access Fonta *et al*., (2005; 2010). Such limitations could contribute to higher dispersion in their estimates.

Additionally, within the traditional African context, women are known to engage in haggling for prices in markets more frequently than men, potentially amplifying their WTP dispersions. Furthermore, as indicated in Table 4.1, the majority of households comprised men, who appeared to have higher levels of education compared to women. This observation may suggest that women were relatively less educated and thus less informed about matters concerning RH protection. This could be attributed to their traditional roles, which often involve tending to children and domestic chores, potentially resulting in a higher variability in their valuation distributions. Both Age and Land ownership within the riparian area demonstrated a positive and significant influence on dispersions in both the MBDC and pooled models.

The Age variable exhibited a positive correlation with SD, a result congruent with the findings of Holmes *et al*. (2002). Conversely, studies such as Wang & Whittington (1997) have shown a negative relationship between Age and SD. In the context of this study on RH protection, despite older respondents having previously expressed higher WTP values for protection, their WTP dispersions were greater compared to those of younger respondents. One plausible explanation for the positive correlation observed

between Age and dispersion is that older respondents tend to allocate more funds for retirement and precautionary needs as they age, potentially leaving less money for RH protection.

This allocation pattern could contribute to higher deviations in their WTP valuation distributions, a phenomenon also noted by Colby & Orr (2005). Ownership of land within the riparian area had a significant and positive impact on household WTP deviations, aligning with the findings of Holmes *et al*. (2002). This suggests that respondents who owned land within the riparian area exhibited higher inconsistencies in their WTP valuation distributions. The rationale behind this observation could be linked to their lower WTP for RH protection, as they might prefer alternative land use practices that offer more benefits, unlike the perceived benefits from protection (Nyongesa *et al*., 2016). Conversely, the Income variable exhibited a negative impact on dispersions across the models, significantly affecting dispersions only in the SPC model. A finding which implies that increase in the monthly aggregate income of households say by 1 % led to a decrease in the SD of WTP values by 8.1%. The inverse relationship between income and SD aligns with the findings reported by Wang & Jie (2010) but diverges from those of Wang & Whittington (1997).

This result suggests that respondents with higher incomes were more willing and confident to allocate greater amounts towards RH protection, in accordance with economic theory, thereby reducing inconsistencies in their payments. This observation is consistent with the findings of Tassie & Endalew (2020). On the other hand, it is plausible that SPC respondents had relatively lower incomes (as shown in Table 4.1) thus they faced financial constraints and had diverse and pressing needs such as food, rent, and medication, requiring more urgent financial allocations. Consequently, less

money might have been available for RH Protection, leading to larger dispersions in their WTP values compared to their counterparts with higher incomes. Furthermore, given that the study was conducted during the Covid-19 pandemic, coupled with significant uncertainties, a majority of households adopted cautious spending habits for the future (International Monetary Fund, 2020). Household size significantly and positively influenced dispersion in SPC model. Increase in Household size say by 1%, led to an increase in SD by 6.5% in the SPC model.

This observation implies that as family size increased, dispersions also increased, an observation attributed to the possibility that a larger family size could be associated with more financial obligations (Ndambiri *et al*., 2015) leaving little monies left for RH protection, i.e during school opening days more money could be required to pay fees, and when schools are closed, much money goes towards the purchase of food hence higher inconsistencies are expected during such time periods leading to higher dispersion. The perceived necessity to protect RH had a significant and negative impact on dispersions in the pooled model, a finding akin to that of Wang & Whittington (1997).

This suggests that households considering it essential to safeguard RH exhibited lower dispersions in their valuation distributions. The majority of respondents (94.4% of SPC and 94.5% of MBDC, as illustrated in Table 4.1) who considered it necessary to protect RH demonstrated less dispersed WTP values by 8.2% compared to their counterparts. The variable of necessity to protect RH has consistently been associated with educational attainment, as emphasized in studies like Ichoku *et al*. (2009) and Fonta *et al*. (2010). These studies highlight that educational attainment enhances a household's knowledge and awareness of environmental conservation, leading to a perceived

necessity to protect RH and resulting in less dispersion in valuation distributions. In this context, educated respondents had lower dispersions in their WTP values. However, a paradox emerged in this study: although the majority of households (90.7% of SPC and 98.9% of MBDC households) had attained education levels beyond primary education, the destruction of RH continued. This discrepancy between expected and actual outcomes may have contributed to the observed RH destruction, largely due to human encroachment, which was identified as a major cause of the problem (Refer to the results in Appendix C1). Understanding the significance that each household attaches to RH protection could potentially unveil the underlying causes of this paradox. Therefore, it is not prudent to assume that educated households automatically contribute to environmental conservation, particularly in the case of RH protection.

While households may appear educated, understanding how they value RH becomes crucial. They might possess education but lack comprehension of the consumptive and non-consumptive benefits associated with RH. Moreover, they might have theoretical knowledge that has not been translated into actions for RH protection. Hence, intensified educational campaigns focusing on these crucial aspects could enhance their understanding and motivation towards protecting RH. Conversely, the Change in EF variable showed a positive and significant impact in the pooled model. This implies that transitioning from SPC to MBDC increased dispersion in the pooled model by 9.8%. A plausible reason for this finding is that, as shown in Table 4.2, the MBDC format exhibited a higher coefficient of variation (COEFV) of 131% and a higher SD compared to the SPC format, thereby contributing to greater variability in the MBDC sample distributions. Additionally, results from Table 4.1 revealed that 26% of MBDC households owned land in the riparian area and preferred alternative land uses, which might have also contributed to higher dispersions in their WTP values. It was realized

that significant determinants influenced SD of WTP at 1% level (*p<0.01,* F=19.67; *p<0.01,* F=44.78; *p<0.01,* F=31.32) respectively across the SPC, MBDC and SPC-MBDC models. The models were fit and significant at the 1% level, with adjusted R^2 values of approximately 0.70 across all three models. This observation is three times higher than that reported by Wang & Whittington (2005) for the SPC format, despite using similar analytical models.

The divergence could be attributed to differences in sample sizes, independent variables and different elicitation formats used. Since the results showed that there was a significant difference at 1% level in mean WTP and SD of WTP values between SPC and MBDC formats shown by Mann-Whitney test statistic (*p<0.01,* α=2.717), that led to the rejection of H_0. Moreover, when EF was treated as an independent variable and regressed on both pooled WTP and SD estimates, the results were significant and positive, as change of EF from SPC towards MBDC increased CV estimates, leading to the rejection of the null hypothesis.

4.6 Effect of changing the Bid Range (BR) on CV estimates for RH protection

Table 4.5 displays the results concerning differences in the sample mean of households' estimated mean WTP and its SD for various Bid Ranges (Lowered range, Base range, Raised range) in both SPC and MBDC data elicitation formats. The bid ranges considered in this analysis were obtained through an open-ended approach and were specified on both the SPC and MBDC cards. It is essential to note that both SPC and MBDC cards presented similar bid amounts (15 bids each), with a maximum bid amount of KES 2,000 and a minimum bid amount of KES 0. These bid range design specifications align with the guidelines outlined by Vossler *et al*. (2004) for CV studies.

Table 4.5: Evaluating differences in mean WTP estimates for different BR

Descriptions	SPC			MBDC		
	Lowered range	**Base range**	**Raised range**	**Lowered range**	**Base range**	**Raised range**
Mean WTP (μ) in KES/Month	581.08	846.37	1127.77	1485.31	997.23	1205.39
Standard error of the mean (σ)	86.30	74.09	97.32	124.21	109.25	113.91
Coefficient of variation (σ/μ)	1.20	1.03	0.96	1.19	0.99	0.76
Number of observations	65	65	65	64	64	64
KWT value ($\chi 2$)		97.746***			78.27***	
P-value		0.000			0.000	

Explanatory notes: KWT implies Kruska Wallis Test; * p<0.1; ** p<0.05; *** p<0.01.
Source: Author's Survey Data, 2021.

The mean WTP estimates for lowered and raised BR were pegged on changes in BR presented by (Base ranges ±KES.50 or Base ranges ± $0.44). The results show that MBDC Lowered BR mean WTP was 2.6 times that of SPC Lowered BR mean WTP, whereas MBDC Raised BR mean WTP was 1.1 times that of SPC Raised BR mean WTP. MBDC Base range mean WTP was 1.2 times that of SPC Base range mean. SPC Lowered BR variation was higher by 1% when compared to that of MBDC Lowered BR variation as shown by their respective coefficient of variation (COEFV). On the other hand, SPC Raised BR variation was 20% higher than that of MBDC Raised BR range variation even though the number of observations differed by 1 unit. For within sample comparisons, under SPC format, when the BR was lowered, the mean WTP declined by a margin of KES. 265.29 from the Base range, whereas when the BR was raised, a positive divergence of KES. 281.4 from the Base range was realized, leading to a total divergence limit in Kenya Shillings of (-265.29 to +281.40). Implying that when

the SPC range was Raised, the mean WTP increased at an increasing rate of change of 33.2% compared to when the range was Lowered where mean WTP value decreased at a rate of change of 31.3%, an observation contrary to Wang & Whittington, (2005) where shorter version of SPC exhibited higher WTP compared to longer version. This finding is contrary to the consumer economic theory where by less quantities of a good is consumed at higher prices. In this study of RH protection, households were willing to pay more for higher bid amounts a result that diverges from the findings of Fonta *et al*., (2008). One straightforward explanation for this observed phenomenon is that households within Nairobi County had slightly higher incomes compared to those observed in the same study area by Ndambiri *et al*., (2015) thus resulting in their higher WTP. In addition, from the descriptive results in Table 4.1, majority of the households (60% of SPC and 57% of MBDC households) had attained College and University education levels hence they were presumed to be aware of the problems, effects and potential solutions to unpro tected RH and they understood the cost implications which probably could be more thus leading to higher WTP (Neupane *et al*., 2017; Remoundou & Koundouri, 2009). For MBDC format within sample comparison, when the BR was Lowered, the mean WTP increased by a margin of KES. 488.08 from the Base range, whereas when the BR was Raised, a positive divergence of KES. 208.16 from the Base range was realized, leading to a total divergence limit in Kenya Shillings of (+488.08 to +208.16). The implication is that when the MBDC range was Raised, the mean WTP increased at a decreasing rate of change of 21.3% compared to when the range was Lowered where mean WTP value increased at an increasing rate of change of 48.94%. In reference to the Base range, respondents were willing to pay more at Lower bid amounts than at higher bid amounts, an observation in line with economic theory and Fonta *et al*., (2008) observations. The current observation in this study of habitat

protection meant that for those respondents who were interviewed using MBDC format, they were sensitive to changes in BR such that any slight increase in bid amount decreased their WTP, a finding recommendable in the welfare economics literature since WTP declines with increase in bid price and vice versa (Nicosia *et al*., 2014; Vossler *et al*., 2003). However, this finding is contrary to what was found out by Roach *et al*., (2002) where MBDC Raised BR led to higher WTP values when compared to Lowered BR. In this study it was expected that increasing the BR could lead to lower WTP values than those observed under the Base range. However, the result depicted that raising the BR led to a higher mean WTP when compared to that of MBDC reference category. It was counter intuitive to note that respondents interviewed under SPC and MBDC formats had higher WTP when the bid ranges were raised, given a high future income uncertainty coupled with hard economic times experienced in the country during the study period.

Despite contradicting economic theory, this observation can be attributed to households having slightly higher incomes compared to those observed previously by Ndambiri *et al.,* (2015), along with their strong preference for RH protection, resulting in higher WTP. Generally, the mean WTP values for MBDC ranges were higher and closer to their mean WTP values unlike those of SPC ranges. Significant differences at 1% level in the various bid ranges based on SPC and MBDC formats were realized as shown by their respective Kruskal-Wallis tests ($p<0.01$, $\chi 2 = 97.746$; $p<0.01$, $\chi 2 = 78.27$), leading to the rejection of H_0 in favor of the H_A (Changing the BR does significantly affect households' CV estimates towards RH protection in Kenya). The findings also show that SPC format SD increased as one moved from Lowered range to Base range to Raised range respectively as shown by their respective deviations (KES. 697.30, KES. 871.76, KES. 1082.66). On the other hand, MBDC deviations decreased as one moved

from Lowered range to Base range to Raised range respectively as shown by their respective deviations (KES. 1767.52, KES 987.26, KES.916.10). Significant differences in SD at 1% level in the various ranges based on SPC and MBDC formats were realized as shown by their respective Kruskal-Wallis tests ($p<0.01$, $\chi2 = 97.746$; $p<0.01$, $\chi2 = 78.27$), leading to the rejection of H_0. The results also indicate that employing Lowered BR values in future valuations is advisable as they tend to underestimate valuation. This observation aligns with economic theory and is therefore recommended. When comparing the anticipated total WTP linked with Lowered BR to the recreation value of a habitat such as Karura Forest in 2016, which was assessed at KES 6.4 million (Nthiiri, 2016), the significant protection potential becomes evident.

If the proposed collections of KES. 2 billion from SPC Lowered BR households and KES. 5.2 billion from MBDC Lowered BR households are efficiently collected and utilized, they would cover only 0.1% of the costs associated with recreation and sporting in the forest. This leaves management of Karura forest with a considerable profit margin of 99% associated with RH protection, while households would still enjoy sporting services within the forest at a more affordable cost of (KES. 100 or $0.7 per visit) compared to private grounds like the Nairobi Club which charges KES 465,000 or $3051 as full membership entrance fees (Nairobi Club, 2023) for sporting. Table 4.6 show the findings when the Base ranges were dropped and comparisons of mean WTP values made based on disjointed and pooled Lowered and Raised bid ranges.

Table 4.6: Evaluating differences in mean WTP estimates for the different ranges based on the value EF and pooled samples

Descriptions	Lowered bid range		Raised bid range	
	SPC	**MBDC**	**SPC**	**MBDC**
Mean WTP (μ) in KES/Month	581.08	1485.31	1127.77	1205.39
Standard error of the mean(**σ**)	86.30	124.21	97.32	113.91
Coefficient of variation (σ/μ)	1.20	1.19	0.96	0.76
Number of observations	65	64	65	64
MWT value(**α**)	6.059***		0.520	
P-value	0.000		0.604	

Descriptions	**SPC-MBDC Lowered bid range (n=129)**	**SPC-MBDC Raised bid range (n=129)**
Mean WTP (μ) in KES/Month	1033.20	1166.58
Standard error of the mean (σ)	105.26	105.61
Coefficient of variation (σ/μ)	1.20	0.86
MWT-value	0.895	
P-value	0.372	

Pooled samples

Explanatory notes: MWT implies Mann Whitney Test; * p < 0.1; ** p < 0.05; *** p < 0.01.
Source: Author's Survey Data, 2021.

The results show that when the BR was Lowered, MBDC sample elicited a mean WTP value which was about two and a half times that of SPC sample, even though the dispersion coefficients were almost similar (120%). This finding is similar to the observations made by Roach *et al.*, (2002). However, it may not be entirely applicable to the current scenario since the elicitation formats compared in their study differ from those used in this study. These COEFV in the Lowered BR sample were more than the threshold (100%) and that shows that Lowered BR samples had huge variance in their distributions thus larger SD from the mean WTP (Jalilibal *et al.*, 2021). A significant difference in mean WTP values (KES. 904.23 or $5.9) at 1% level was realized within

the Lowered BR samples as shown by the Mann-Whitney test statistic value ($p<0.01$, α=6.059) leading to the rejection of H_0. Conversely, with the BR raised, the MBDC sample exhibited a less dispersed distribution at 76%, accompanied by a higher mean WTP value of KES 1205.39±113.91. In contrast, the SPC sample registered a mean WTP value of KES 1127.77±97.32, with a higher dispersion of 96%. This observation aligns with the findings of Svenningsen & Jacobsen (2018).

However, there was no significant difference in mean WTP values between the Raised BR samples, indicated by the Mann-Whitney test statistic value ($p>0.1$, α= 0.52). This implies that respondents interviewed under the Raised BR provided their true valuations for RH protection without overstatement or understatement of their WTP values. Overall, the MBDC sample consistently recorded higher mean WTP values with stable valuation distributions, both when the ranges were Lowered and Raised, unlike the SPC sample. This finding could be attributed to the slightly higher incomes of households using the MBDC format, as indicated in the descriptive results of Table 4.1. This observation aligns with the studies of Fonta *et al*., (2005; 2010) and Ichoku *et al*., (2009), where a household's WTP tends to increase with income. Additionally, this finding implies that the MBDC sample may have overstated its valuation for RH protection, while the SPC sample may have understated its valuation. It was noteworthy that while the MBDC format generally resulted in higher WTP values, the increase in WTP was more pronounced when the BR was Lowered, in contrast to when it was Raised. However, the difference in mean WTP values between the Lowered and Raised BR was not statistically significant.

This observation suggested that at higher bid ranges, the MBDC WTP tended to decline, a trend akin to findings observed by Vossler *et al*., (2003) and Fonta *et al*.,

(2008). Regarding the SD, the findings showed that when the BR were Lowered, SPC format exhibited a lower deviation of (KES. 697.30 or $4.6) compared to the MBDC format which had a higher deviation of KES 1767.52 or $11.6. However, there are limited studies available for such comparisons. A significant difference in SD of (KES.1070.22 or $7.02) at 1% significance level was realized within the Lowered BR samples leading to rejection H_0. When the ranges were Raised, SPC format exhibited a higher deviation of (KES. 1082.66 or $7.10) compared to that of MBDC format (KES. 916.10 or $6), however, no significant difference at 10% significance level was realized between the Raised BR samples. When the samples were combined based on Lowered BR and Raised BR, the results revealed a higher mean WTP value for the Raised BR model (KES 1166.58 ±105.61) compared to that of the Lowered BR model (KES 1033.20±105.26). This finding suggests that households were still willing to pay more at higher bid amounts, contrary to economic theory. This deviation may be attributed to the higher incomes recorded by the households in this study, coupled with the potential desire to influence the provision of the good.

Some studies, such as Tassie & Endalew (2020) and Ichoku *et al*., (2009), have illustrated that education plays a crucial role in the protection of environmental goods and services. As respondents acquire more knowledge about the risks associated with unprotected habitats, their WTP increases even at higher bid amounts to prevent potential damages. Notably, in this study, the majority of respondents had attained formal education, as indicated in Table 4.1. This educational background was presumed to have a positive influence on their WTP, leading to higher values at elevated bid amount. The findings also indicated that the Raised BR model exhibited less dispersion, with a COEFV of 86%, compared to the highly dispersed Lowered BR model at 120%. This suggests that increasing the BR led to higher and more consistent WTP values,

although no significant difference was observed at the 10% level in the mean WTP values of the pooled samples as shown by the Mann-Whitney test statistic ($p>0.1$, $\alpha = 0.895$). Further the results show that Lowered BR deviation (KES. 1239.84 or $8.13) was higher compared to that of Raised BR deviation (KES. 1003.26 or $6.58) despite the fact that there was no significant difference at 10% significance level observed between the two samples. When the mean WTP values were multiplied by the number of households to calculate total WTP values for practical applicability, the SPC and MBDC Lowered BR WTP values were KES 2.2 Billion (KES 581.08*12*289,898) and KES 5.2 Billion (KES 1,485.31*12*289,898) respectively.

In the year 2020/2021, the cost for Nairobi arboretum entrance fees was KES 65 or $0.43 per household per visit. Assuming a household would visit the arboretum once per month per year, the total annual revenue collected by the arboretum management would be KES 226 Million (65*12* 289,898). With the hypothesized collections from SPC and MBDC Lowered BR estimates of 2.2 Billion and 5.2 Billion, the arboretum would have surplus collections ranging from about 1.8 billion to 4.9 billion. If the proposed WTP values would be properly collected and utilized, 0.9% of the total collections could be used to upgrade the status of the arboretum and the rest be used for other developments within the arboretum, given that households expressed a positive WTP towards the protection of these habitats.

Additionally, households would receive value for their money and continue enjoying more utility due to improved service provision from the arboretum. If the arboretum's management decides to lower the entrance fees by say KES 5or $0.03, the total revenue collected would be KES 209 Million. Alternatively, if the management considers raising charges by a similar amount from the current rates (KES 65 or $0.43), the total revenue

collected would be 244 Million. Comparing these reviewed revenues to the actual amount collected (226 Million), the arboretum would be better off with a slight increase in entrance charges compared to a slight reduction. Therefore, the management of the arboretum should consider revising their entrance charges slightly upwards, considering the higher WTP values expressed by households. Table 4.7 presents findings of BR and its determinants. The joint effect of independent variables on average WTP values for SPC-MBDC Lowered BR, SPC-MBDC Raised BR and SPC-MBDC Lowered-Raised BR were tested using F test.

Table 4.7: Mean WTP estimates and the determinant factors for the different BR

Characteristics	SPC-MBDC Lowered bid range DV=Log(μ_i)		SPC-MBDC Raised bid range DV=Log(μ_i)		SPC-MBDC Lowered-Raised DV=Log(μ_i)	
	Coefficient	**Std error**	**Coefficient**	**Std error**	**Coefficient**	**Std error**
Age (Years)	0.010**(0.047)	0.005	0.005*(0.062)	0.003	0.006**(0.016)	0.003
Gender (1=Male)	0.105 (0.501)	0.091	0.087 (0.456)	0.052	0.081 (0.898)	0.057
Income (KES)	0.191 (0.943)	0.116	0.159**(.046)	0.067	0.074 (0.437)	0.070
Distance (Metres)	0.155**(0.038)	0.077	0.209***(.001)	0.067	0.092***(.001)	0.017
Informal educ	-.002 (0.005)	0.763	-0.002 (0.005)	0.763	-0.189 (0.528)	0.157
Primary educ	0.827 (0.255)	0.584	0.037 (0.776)	0.132	0.048 (0.255)	0.584
Secondary educ	0.416 (0.569)	0.126	0.069 (0.588)	0.625	0.416 (0.569)	0.126
College educ	0.250 (0.531)	0.073	0.035**(.033)	0.042	0.250* (0.061)	0.073
University educ	0.273 (0.791)	0.074	0.036***(.001)	0.033	0.100***(.001)	0.416
Household size (No. of persons)	-0.045(0.943)	0.060	-0.049(0.210)	0.043	-0.015(0.316)	0.043
Necessary to protect RH (1=Yes)	0.311**(0.022)	0.125	0.210**(.196)	0.085	0.240***(.001)	0.086
Certainty of future income (1=Yes)	0.001 (0.565)	0.088	0.059 (0.943)	0.063	0.057 (0.539)	0.061
Owning land with riparian area (1=Yes)	-.191*(0.074)	0.099	-0.110*(0.076)	0.057	-0.002 (0.534)	0.062
Elicitation Format (1=MBDC)	0.828*(.086)	0.484	0.108**(.041)	0.052	0.143*(0.054)	0.076
Bid Range (1=Raised)	-	-	-	-	0.237***(.000)	0.076
Constant	0.725*(.087)	0.370	0.599** (0.029)	0.348	0.448***(.000)	0.174
Summary statistics						
F-statistic	9.30		16.05		12.16	
Prob > F	0.0000		0.0000		0.0000	
Adjusted R-squared	0.6407		0.6351		0.6571	
Number of observations	129		129		258	

Explanatory notes: the character 'μ_i ' refers to the mean WTP for the ith household;* p<0.1; ** p<0.05; *** p<0.01. In parentheses are the p values.
Source: Author's Survey Data, 2021.

The results in Table 4.7 indicate that several factors, including Age, Distance, Necessity to protect RH, and EF, significantly and positively influenced mean WTP values across the three models. Notably, older households displayed a greater willingness to contribute to RH protection compared to their younger counterparts, even when BR were altered. This aligns with findings from Holmes *et al*., (2002) and Kline *et al*., (2000) regarding RH restoration. However, this result contrasts with the observations of Ndambiri *et al*., (2015) and Ndambiri *et al*,. (2016) within the same study area. A potential explanation for this behavior is that older households prioritize their quality of life (Gobbens & Van Assen, 2018) and perceive themselves as more vulnerable to the effects associated with unprotected RH (Colby & Orr, 2005; Ndambiri *et al*., 2016; Remoundou & Koundouri, 2009).

The variable Distance was found to be significant and positive, which contradicts previous studies such as Pate & Loomis (1997), Barrena *et al.*, (2014), Ndambiri *et al*., (2015), and Fonta *et al.,* (2008), but is consistent with the findings of Nyongesa *et al*., (2016) and Fonta *et al.,* (2007). In this study, households residing farther from RH expressed a greater WTP compared to those living nearby. One possible explanation is that households living farther away may have acknowledged the long-term advantages of conserving these areas, even if they didn't experience direct benefits in their daily lives. They might have regarded their support for RH protection as an investment in the future sustainability and resilience of ecosystems, which ultimately benefits society as a whole.

This perspective could lead to higher WTP values (Alam, 2013). The significance of the Necessity to protect RH variable was consistent and positive across all models, aligning with expectations. This observation implies that respondents who perceived it as

necessary to safeguard RH exhibited higher WTP compared to their counterparts. This finding corresponds to similar outcomes reported by researchers such as Holmes *et al*., (2004), Daly *et al*., (2015), and Carson *et al*., (2001), where respondents with at least a College education level considered it necessary to protect the habitats, leading to higher WTP values. The descriptive statistics in Table 4.1 of this study had earlier indicated that a majority of respondents had attained post-college education levels and expressed the belief in the necessity to protect RH. Literature also suggests that households who are more informed or knowledgeable about a good or service tend to have higher WTP (Ichoku *et al*., 2009; Tuan & Navrud, 2007; Daly *et al*., 2015).

However, contrasting results have been found by some researchers like Nicosia *et al*., (2014), who observed no correlation between awareness levels and WTP. In the specific context of RH protection within this study, it is plausible that respondents who perceived it as imperative to safeguard RH might have encountered more adverse effects associated with unprotected RH, such as heightened risks of diseases and insecurity leading to greater WTP.

Furthermore, an observed decline in average WTP with land ownership was noted in both the SPC –MBDC Lowered BR and SPC-MBDC Raised BR models. This trend aligns with findings from studies conducted by Holmes *et al*., (2002, 2004). The outcomes of this study suggest that disparities in environmental and economic values among landowners may contribute to this negative correlation. The research conducted by Nyongesa *et al.,* (2016) reinforces the notion that differing values and priorities regarding the environment can significantly influence households' WTP for conservation efforts. Within the scope of this study, it is conceivable that households owning land within the riparian areas might have prioritized economic gains over

environmental benefits as shown by results in Appendix C2, leading to a diminished WTP for RH protection. Income as a variable was positive and significant in SPC-MBDC Raised BR model as expected, hence it theoretically validates the outcome of this study. This finding is in line with the theory and similar to what has been widely observed by other researchers (Daly *et al*., 2015; Tassie & Endalew 2020; Ndambiri *et al*., 2016; Holmes *et al*., 2004; Wang & Whittington, 1997; Colby & Orr, 2005) in environmental valuation literature. The positive sign for the income variable in this study implies that increase in income by say 1% led to an increase in mean WTP for Raised BR by 15.9%, even though its effect was insignificant in other models. This finding suggests that households can only pay more with higher incomes since increase in income increases households purchasing power for environmental goods hence higher WTP even at higher bid amounts (Neupane *et al*., 2017). Studies such as Colby and Orr (2005) have explored the connection between income and quality of life. Higher-income households often regard environmental quality as integral to their overall quality of life. For these households, investing in RH protection is seen as a means to enhance their living environment and personal well-being. Consequently, they exhibit a higher WTP even at elevated prices, as they prioritize long-term lifestyle and health benefits. Education level significantly influenced mean WTP with expected positive sign in the SPC-MBDC Raised BR model and in the pooled model. A finding in line with most of the environmental literature such as (Ndambiri *et al*., 2015; Brouwer, 2011; Tassie & Endalew, 2020; Fonta *et al*., 2010; Ichoku *et al*., 2009). Higher levels of education have been associated with increased environmental awareness. Studies by Tuan and Navrud (2007) and Daly *et al*., (2015) have found that households with higher educational attainment are more likely to recognize the importance of environmental conservation. Education enables households to access

information more easily, enhancing their awareness of issues such as the effects of unprotected RH on their health, surrounding environment, and social wellbeing. This increased awareness, as noted by Ndambiri *et al*., (2015, 2016), leads to a higher WTP for environmental protection (Remoundou & Koundouri, 2009; Neupane *et al*., 2017). Some studies such as Nicosia *et al*. (2014) have found no relationship between education level and WTP. In this study focusing on RH protection, there was a notable correlation between attaining College and University education levels and a higher WTP, even at higher bid amounts. This finding suggests that households with college and university education backgrounds were likely more inclined to offer higher WTP values, potentially influenced by their exposure to new ideas, knowledge, and interactions with scholars. Additionally, it's plausible that such households perceive a direct personal benefit from investing in higher education. Higher education is commonly associated with improved job prospects, higher income, and an enhanced quality of life.

This tangible benefits could have contributed to the increase in their WTP values as equally noted by (Ndambiri et al., 2015; Colby & Orr, 2005; Kline *et al*., 2000; Wang & Jie, 2010). Change in EF significantly and positively influenced mean WTP values across the three models. As much there is a dearth of literature on SPC and MBDC format comparisons, this study's findings were very close to that of Ndambiri *et al*., (2016) despite the fact that change in EF was not a variable in their study. Moreover, this result is supported by Champ & Bishop (2006) given that in this study of RH, SPC and MBDC formats were compared in the same context, unlike their study which compared open ended and dichotomous choice formats. This result on RH valuation implies that as EF changed from SPC to MBDC, mean WTP values increased. A plausible explanation could be attributed to the fact that MBDC format recorded higher

mean WTP values as shown in Table 4.5 unlike in SPC format. Change in BR significantly and positively influenced mean WTP values in the pooled model. A finding similar to that of Roach *et al*., (2002). Implying that as the BR changed from Lowered towards Raised, WTP value increased by 23.7%. This is associated to the fact that Raised BR sample gave rise to higher mean WTP values as shown in Table 4.6. A plausible explanation could be that MBDC households had registered higher incomes when compared to SPC households as shown in Table 4.1 hence had higher WTP towards RH protection even at higher bids (Colby & Orr, 2005; Omanga *et al*., 2014). Moreover, it could happen that for those respondents who were interviewed under Raised bid range category expressed a heightened vulnerability to the consequences of unprotected RH, leading them to higher WTP. However, the observation is contrary to what is commonly observed by most rational consumers whose WTP decline with bid price. Kenyan RH consumers demand for RH protection increased with increase in bid price contrary to most environmental and economic theory findings as noted by Wang & Whittington, (1997, 2005).

This is because of previous Kenyan experiences on consumables which tend to be lowly priced but of low quality and which later on impacted them negatively. So it could happen that majority of Kenyans believe that cheap is expensive and could only perceive the good as quality when it is price is high (Tulula, 2012). The models recorded adjusted R^2 values of approximately 0.60 for both SPC-MBDC Lowered and SPC-MBDC Raised bid ranges, and 0.70 for the pooled model. This indicates that 60% to 70% of the variations in WTP were explained by the explanatory variables (Age, Distance, Necessity to protect RH, Land ownership in riparian land, EF, Income, BR and attainment of College and University education levels). The overall models were statistically fit at 1% and significant determinants influenced mean WTP values

differently across the three models as shown by the F tests ($p<0.01$, F=9.30; $p<0.01$, F=16.05; $p<0.01$, F=12.16) respectively, implying that apart from socio economic and physical variables, change in BR equally influenced the WTP values across different bid ranges leading to rejection of H_0. Table 4.8 below shows results of SD for different bid ranges.

Table 4.8: SD estimates and the determinant factors for the different bid ranges.

Characteristics	**SPC-MBDC Lowered bid range** DV=Log(σ_i)		**SPC-MBDC Raised bid range** DV=Log(σ_i)		**SPC-MBDC Lowered-Raised** DV=Log(σ_i)	
	Coefficient	**Std error**	**Coefficient**	**Std error**	**Coefficient**	**Std error**
Age (Years)	.011***(0.000)	0.003	0.006**(.0321)	0.002	0.001(0.204)	0.002
Gender (1=Male)	-0.062 (0.058)	0.060	-0.030 (0.186)	0.044	-.072*(0.080)	0.041
Income (KES)	-0.071 (0.165)	0.077	-.113**(0.027)	0.056	-0.045 (0.167)	0.050
Distance (Metres)	0.242***(.000)	0.051	0.501***(.001)	0.057	0.049***(.000)	0.012
Informal educ	0.166(0.568)	0.185	0.095(0.575)	0.225	0.173(0.790)	0.220
Primary	-0.054(0.668)	0.060	0.124(0.541)	0.110	0.060(0.574)	0.107
Secondary	-0.050(0.569)	0.031	0.063(0.375)	0.712	0.324(0.711)	0.135
College	-.055**(0.003)	0.046	0.091(0.108)	0.056	0.052(0.998)	0.154
University	-0.006(0.891)	0.050	0.036(0.502)	0.155	-.109***(.003)	0.058
Household size (No. of persons)	0.031 (0.166)	0.039	0.076**(0.031)	0.037	0.029 (0.209)	0.031
Necessity to protect RH (1=Yes)	-.217***(.001)	0.083	-0.019 (0.063)	0.072	-.167***(.008)	0.062
Certainty of future income (1=Yes)	0.014 (0.321)	0.058	0.018 (0.170)	0.053	0.014 (0.125)	0.044
Owning land within riparian area (1=Yes)	0.070 (0.775)	0.066	0.086*(0.053)	0.048	0.096**(.001)	0.045
EF (1=MBDC)	-.897***(.024)	0.320	-0.093**(.021)	0.044	-0.052 (0.180)	0.055
BR (1=Raised)	-	-	-	-	-.194***(.000)	0.055
Constant	0.521**(0.035)	0.245	0.199 (0.064)	0.293	0.498***(.000)	0.126
Summary statistics						
F-statistic	9.07		15.22		10.24	
Prob > F	0.000		0.000		0.000	
Adjusted R-squared	0.613		0.583		0.631	
Number of observations	129		129		258	

Explanatory notes: the character 'σ_i' refers to the SD of the mean WTP estimates for the ith household; * p<0.1; ** p<0.05; *** p< 0.01. In parentheses are the p values. Source: Author's Survey Data, 2021.

Table 4.8 above presents findings of the joint effects of the explanatory variables on SD of WTP values for SPC-MBDC Lowered BR, SPC-MBDC Raised BR and SPC-MBDC Lowered-Raised BR which were tested using F statistic for statistical differences. The results show that Age variable significantly and positively influenced dispersions in both the Lowered and Raised BR samples, a finding similar to that of Brouwer (2011) but contrary to that of Wang & Whittington (1997). This implies that older people had higher dispersion due to their precautionary motive for holding money compared to the young (Gobbens & Van Assen, 2018). Gender significantly and negatively influenced the deviations in the pooled model. Implying that male headed households had lower dispersions in their WTP values compared to female headed households. A finding in line with that of Brouwer (2011), but contrary to that of (Wang & Whittington, 1997; 2005; Laroche *et al*., 2001).

A plausible explanation could be that in the African culture men make major household financial decisions unlike women and thus it was expected that they could have lower deviations in their valuation when compared to women as noted earlier by Fonta *et al*., (2005; 2010). Income significantly and negatively influenced dispersion of mean WTP values in SPC-MBDC Raised BR model, a result contrary to what was observed by Wang & Whittington, (1997), but similar to what was observed by Daly *et al*., (2015). In this research, a 1% rise in monthly income corresponded to an 11.3% decrease in the SD of household WTP distributions. This suggests that as household income increased, there was an inclination to pay more at higher bid amounts, resulting in a reduction in the variability of their WTP values. It is plausible that households perceived RH protection as a normal good, exhibiting increased demand with rising income, aligning with the concept of normal goods in economic theory (Varian, 2005). As anticipated

based on welfare economics theory, this outcome aligns with the notion that households are more capable of comfortably affording a good when their income is higher, consequently leading to a reduction in deviations. The observed negative correlation between income and SD enhances the credibility and robustness of this study. Contrary to the findings of Fonta *et al*., (2010), Distance exhibited a significant and positive influence on the dispersion of mean WTP values across the models in this study. Despite the variable showing a positive correlation with WTP earlier on, an increase in Distance resulted in higher deviations across the models. This outcome suggests that residents situated farther from the habitats had WTP values that were more widely dispersed, possibly due to variations in the perceived environmental quality of the RH as discussed in studies by Colby & Orr (2005) and Carson *et al*., (2001). Additionally, households located farther from RH may have less frequent exposure to environmental campaigns or educational initiatives focused on habitat conservation.

This limited exposure could lead to more varied opinions and attitudes towards the importance of RH protection, contributing to greater variability in WTP estimates and higher SD. In contrast to findings by Wang & Whittington (1997; 2005), education level had a significant negative impact on dispersions in both the SPC-MBDC Lowered BR and in the pooled models. Respondents with a College education level exhibited lower deviations in the Lowered BR model, while those with a University education level similarly demonstrated reduced deviations in their valuations within the pooled model. Specifically, attainment of a College education level reduced the deviations in the Lowered BR model by 5.5%, whereas attainment of a University education level reduced the deviations in the pooled model by 10.9%. Studies such as those conducted by Holmes *et al*., (2002; 2004) have emphasized the crucial role of education in the valuation of RH. The finding that attaining College and University education levels

contributed to decreased deviations suggests that educated respondents possess greater knowledge and awareness of the benefits of RH protection. This heightened awareness fosters a perceived necessity to protect RH, leading to consistency in their valuation distribution (Daly *et al.*, 2015). Additionally, since these households had previously indicated higher WTP at higher bid amounts, as shown in Table 4.7, it is evident that they likely have higher incomes, resulting in greater financial stability. This financial security means that they may not have been constrained by lower bid amounts when valuing RH protection. Consequently, their WTP values are more consistent, contributing to lower SD. As anticipated, Household size had a significant and positive impact on deviations in the SPC-MBDC Raised BR model. This suggests that an increase in household size say by one more person led to an increase in SD by 7.6%. This result implies that at higher bid amounts, larger families are more constrained in their ability to contribute towards RH protection, leading to higher deviations in their WTP. One possible explanation is that with more family members to support, priorities may shift towards immediate needs and necessities rather than environmental contributions. Some families may prioritize differently based on their specific circumstances, leading to a higher dispersion in their valuation (Temesgen & Teferi, 2015).

The perceived necessity to protect RH had a significant and negative impact on deviations in both the SPC-MBDC Lowered BR and the pooled models, aligning with the findings of Brouwer (2011). In the context of RH protection in this study, households that recognized the importance of safeguarding habitats exhibited lower deviations in their distributions. A plausible explanation for this phenomenon could be that these households were well-educated, knowledgeable, and aware of the adverse effects associated with unprotected habitats, as discussed by Daly *et al*. (2015). As a

result, their valuation distributions showed greater consistency and less variability. Dispersion increased with land ownership within the riparian area in both the SPC-MBDC Raised and SPC-MBDC Lowered-Raised BR models, aligning with the findings of Holmes *et al*. (2004).

This result suggests that households owning land within the riparian area exhibited larger dispersions in their valuations compared to their counterparts. Previous studies, such as Hanley & Schlapfer (2001), have indicated that households may assign lower value to public goods or environmental conservation efforts when they perceive minimal personal benefits. In the context of this research on RH, it is plausible that some respondents who owned land within the riparian area, despite their education levels, prioritized economic interests over environmental concerns. Consequently, they might have been less willing to pay for RH protection, perceiving limited benefits compared to other developmental activities, which could explain the higher dispersions observed (Nyongesa *et al*., 2016). EF exerted a notable and adverse impact on dispersions in both SPC-MBDC Lowered and SPC-MBDC Raised BR models. The transition from SPC to MBDC resulted in decreased dispersion, with this outcome being linked to the observation that MBDC WTP values exhibited lower COEFV in contrast to SPC, as earlier illustrated in Table 4.6.

It is noteworthy that BR had a significant and negative impact on dispersions in the aggregated model, indicating a decrease in dispersions as BR shifted from Lowered to Raised. Specifically, changing the BR from Lowered to Raised resulted in a 19.4% decrease in dispersion in the pooled model. The transition toward Raised BR resulted in narrower dispersions, attributed to the lower COEFV (86%) associated with Raised BR compared to the 120% observed with Lowered BR (refer to Table 4.6).

Furthermore, attaining a College education level decreased deviations in the SPC-MBDC Lowered BR model, while attaining a University education level decreased deviations in the pooled model. Specifically, College education reduced deviations by 5.5% in the Lowered BR model, and University education reduced deviations by 10.9% in the pooled model. This finding could be closely linked to the results in Table 4.7 where households who had attained College and University education were willing to pay more at higher bid ranges, suggesting a positive correlation between higher education levels and higher WTP. It is plausible that attainment of College and University education enhance critical thinking and information processing skills. Educated households are better equipped to evaluate the benefits of RH protection and make informed decisions about their contributions, resulting in more uniform responses hence leading to lower deviations (Daly *et al*., 2015). The variables (Age, Gender, Income, Distance, College and University education levels, Household size, Necessity to protect RH, Owning land within riparian, EF, BR) exerted statistically significant and distinct influences on the SD of WTP estimates across the models, with F tests indicating significance at the 1% level (*$p<0.01$, $F=9.07$; $p<0.01$, $F=15.22$; $p<0.01$, $F=10.24$*). All three models were fit and significant at the 1% level, exhibiting adjusted R^2 values ranging from 58.3% to 63.1%. This suggests that the determinants explained a maximum of 63.1% of the dispersions observed. When BR was regressed on both pooled mean WTP and SD estimates, the results were significant at the 1% level, consequently, the null hypothesis was rejected in favor of the alternative, signifying that changing the BR significantly affects household CV estimates towards RH protection in Kenya. Notably, raising the BR resulted in increased WTP values and consistent valuation estimates, while lowering the BR led to inconsistent and understated valuation estimates. This suggests that Lower bid ranges were more preferable for the valuation of

RH protection in Kenya. Furthermore, in addition to socio-economic, physical, and institutional characteristics, changes in EF significantly influenced both WTP and SD of WTP estimates associated with alterations in BR.

4.7 Payment Vehicle (PV) and its effect on valuation of RH protection in Kenya.

Two payment mechanisms, Trust and Tax, were juxtaposed by assessing data elicitation formats and employing the Mann-Whitney test statistic to examine the statistical variances in mean WTP and its SD between the Tax and Trust samples. The results and insights derived from this analysis are documented in Table 4.9.

Table 4.9: Assessing disparities in mean WTP Estimates for various PV using EF values and pooled samples.

Descriptions	**Tax**		**Trust**	
	SPC	**MBDC**	**SPC**	**MBDC**
Mean WTP (μ) in KES/Month	941.54	1418.91	757.69	1110.94
Standard error of the mean (σ)	96.94	94.28	87.89	93.89
Coefficient of variation (σ/μ)	1.02	1.22	1.06	1.25
Number of observations	65	64	65	64
MWT-value(**α**)	3.681***		2.749***	
P-value	0.000		0.000	

Pooled samples

Details	**Tax (n=129)**	**Trust (n=129)**
Mean WTP (μ) in KES/Month	1180.93	934.42
Standard error of the mean (σ)	95.61	90.84
Coefficient of variation (σ/μ)	1.12	1.16
MWT-value (**α**)	1.865*	
P-value	0.063	

Explanatory notes: MWT implies Mann Whitney Test; * p<0.1; ** p<0.05; *** p<0.01.
Source: Author's Survey Data, 2021.

In comparing the two vehicles, Tax consistently exhibited higher WTP values compared to Trust. Specifically, when Tax was employed as the vehicle, the MBDC sample demonstrated WTP values one and a half times higher than that of the SPC sample. Despite higher dispersion indicated by the COEFV of 122% for MBDC,

compared to 102% for SPC, a significant difference in sample mean WTP values amounting to KES 477.3 or $3.13 was realized at the 1% level as shown by the Mann-Whitney test ($p < 0.01$, α=3.681). Similarly, when Trust served as the PV, the MBDC sample still exhibited WTP values nearly one and a half times higher than that of the SPC sample. The MBDC sample also displayed a higher degree of variation, with a COEFV of 125%, compared to the 106% observed for SPC. Again, a significant difference in sample mean WTP values of KES 353.25 or $2.32 was noted at the 1% level as indicated by the Mann-Whitney test statistic of ($p<0.01$, α=2.749). Overall, it was evident that the use of Tax as a PV resulted in higher and more consistent WTP values compared to Trust.

This finding aligns with previous studies (Svenningsen & Jacobsen, 2018; Bateman *et al*., 1995) where Tax elicited higher WTP than donation in a stated preference context. The study on RH indicated households' willingness to contribute positive amounts for RH protection, with strong support for the Tax fund system, as evidenced by 64.2% of SPC households and 66.5% of MBDC households preferring this mode of payment (Refer to Appendix C5). Therefore, the RH protection policy implementation is likely to encounter minimal resistance. Moreover, the study found that SPC format exhibited lower SD values under both Tax and Trust vehicles, with values of KES 960.37 or $6.3 and KES 803.15 or $5.3 , respectively. Conversely, the MBDC format showed higher SD values under both Tax and Trust vehicles (KES 1731.07 or $11.36 and KES 1388.68 or $9.11, respectively). Significant differences in SD were observed under both Tax and Trust samples at the 1% significance level ($p<0.01$, α=3.681; $p<0.01$, α=2.749), leading to the rejection of the H_0. Upon pooling the samples based on PV and comparing the results for mean WTP values and their SD, Tax as a PV continued to elicit a higher mean WTP value, surpassing that of Trust by 1.26 times, as detailed in Table 4.9.

Nevertheless, the higher WTP associated with Tax was less dispersed by 4% compared to that of Trust PV. This outcome contradicts findings from previous studies (Huhtala, 2004; Fonta *et al*., 2010; Ndambiri *et al*., 2016; Ndambiri *et al*., 2015), where the use of Tax was anticipated to trigger objections and protest responses, leading to lower WTP estimates. The finding that Tax yielded a higher mean WTP value for RH protection aligns with research by (Bateman *et al*., 1995; Meyer & Liebe, 2010; Lewis *et al*., 2017; Kreye *et al*., 2016), with their WTP values exceeding eight times those observed in this study. The observed lower WTP in this study compared to other researchers might be attributed to the challenging economic circumstances during the Covid-19 pandemic, impacting households severely.

Additionally, variations could arise from currency conversion rates and the fact that the referenced studies were conducted in developed economies. The findings regarding Tax as a PV in this study imply that Kenyans have confidence in government-managed projects, considering past incidents of collapsed community and private financial schemes and projects in the context of developing economies, as noted by Fonta *et al*., (2005; 2010) and Macey, & O'Hara (2003). Moreover, given the high prevalence of financial fraud in the country, respondents felt that their funds could be secure in a special pool designated by the government, akin to observations by (Bateman *et al*., 1995), where money deducted at source in the form of tax contributes to the pool. In Kenya, substantial enhancements in infrastructure, encompassing roads, schools, hospitals, and utilities, foster the perception that the government is dedicated to improving the overall well-being of its citizens. Given the positive impact of these developments on nearly all households, confidence in government projects has steadily grown over time (ADB, 2019). Consequently, households have expressed comfort with the Tax fund. Specifically regarding the protection of Kenyan RH, Tax as a PV has

demonstrated its appropriateness, particularly when the collected funds are exclusively designated for RH protection. Governments actively combating corruption and implementing stringent anti-corruption measures create an environment where households believe their contributions are utilized for their intended purposes rather than being misappropriated. Notably, in 2023, Kenya was ranked 123rd globally in the Corruption Perception Index published by Transparency International, scoring 31 out of 100 points. This represents a decline compared to the 32 points recorded in 2022 (Transparency international, 2023).

The decrease in corruption levels suggests an increased level of trust among households, indicating that funds contributed towards RH protection can likely be utilized exclusively for that purpose. Henceforth, Tax as a vehicle can be considered for future valuations, given the elevated WTP estimates observed in this study. Moreover, the findings indicated a noteworthy difference at the 10% significance level in pooled mean WTP values between the Tax and Trust samples, as evidenced by the Mann-Whitney test statistic (MWT-value) of ($p<0.1$, $\boldsymbol{\alpha}=1.865$). Contrastingly, the Trust vehicle yielded underestimated WTP values, which is a favorable observation in CV studies, as noted in previous research (Svedsater, 2001). However, a minority of respondents (24% of SPC and 27.3% of MBDC), as outlined in Appendix C5, expressed confidence in the trust fund compared to those favoring the Tax fund. This preference for Tax as a PV reinforces its suitability for RH protection. Furthermore, the results indicated that the Tax vehicle exhibited a larger SD (KES. 1322.64 or $8.67), compared to Trust (KES. 1083.93 or $7.11). At the 10% significance level, a noteworthy difference in SD of mean WTP values was observed between the two samples, leading to the rejection of H_0. The analysis of WTP estimates involved multiplying the mean WTP values obtained from both the SPC and MBDC formats by the number of

households surveyed under the Trust and Tax funds. For the Trust fund, the total WTP values associated with SPC and MBDC formats amounted to KES 3.3 billion and KES 5.0 billion respectively, indicating the potential loss due to distrust in the Trust fund. Conversely, the Tax fund yielded total WTP values of KES 2.6 billion and KES 3.9 billion for the SPC and MBDC formats respectively, representing the expected collections. In the 2021/2022 fiscal year, the average monthly water bill for a household in Nairobi County was around KES 1,500 ($9.84), translating to an annual cost of KES 18,000 ($118) as per the Nairobi Water and Sewerage Company (NWSC), (2022). Multiplying these costs by the number of households yielded a total of KES 5.2 billion. Comparing this to the expected collections of KES 6.5 billion under the Tax fund, it was determined that 80% of the collections could cover the current costs of clean water provision leaving KES 1.3 billion for improved water supply and other water development projects in the study area.

Table 4.10: Mean WTP estimates and determinant factors for the various PV

Characteristics	**Tax Model** DV=Log(μ_i)		**Trust Model** DV=Log(μ_i)		**Tax-Trust Model** DV=Log(μ_i)	
	Coefficient	**Std error**	**Coefficient**	**Std error**	**Coefficient**	**Std error**
Age (Years)	0.014**(.004)	0.007	0.019**(0.048)	0.009	0.024**(0.039)	0.011
Gender (1=Male)	0.107 (0.552)	0.092	0.303*(0.084)	0.154	0.078 (0.601)	0.178
Income (KES)	0.225*(0.091)	0.132	0.344 (0.789)	0.228	0.107 (0.144)	0.260
Distance (Metres)	0.157 (0.721)	0.113	1.347***(.001)	0.231	0.485**(.001)	0.229
Informal educ	-0.013**(.048)	0.007	-0.095 (0.549)	0.458	-0.020 (0.826)	0.095
Primary educ	0.338 (0.399)	0.399	0.124 (0.541)	2.531	0. 061 (0.890)	0.441
Secondary educ	0.198 (0.327)	0.200	1.868 (0.462)	0.127	0. 020 (0.927)	0.218
College educ	0.134**(.032)	0.138	0.725 (0.570)	0.838	0.018 (0.829)	0.144
University educ	0.266 (0.541)	0.107	0.366**(0.036)	0.638	0. 017(0.884)	0.109
Household size (No. of persons)	-0.214**(.048)	0.096	-0.151 (0.155)	0.130	-0.223 (0.187)	0.165
Necessity to protect RH (1=Yes)	0.226 (0.773)	0.157	0.554*(0.087)	0.328	0.230 (0.662)	0.333
Certainty of future incomes (1=Yes)	0.202**(.004)	0.093	0.072 (0.209)	0.185	0.852***(.001)	0.184
Owning land within riparian area (1=Yes)	-0.137 (0.129)	0.112	-0.151 (0.531)	0.172	-0.164 (0.242)	0.210
EF(1=MBDC)	-0.180*(.088)	0.095	-.318***(.001)	0.154	-2.508***(.001)	0.174
PV(1=Trust)	-	-	-	-	-1.908***(.001)	0.175
Constant	0.352 (0.826)	0.533	3.013***(.000)	0.978	1.813*(0.053)	1.048
Summary statistics						
F-statistic	29.45		32.39		37.94	
Prob > F	0.000		0.000		0.000	
Adjusted R-squared	0.593		0.642		0.613	
No. of observations	129		129		258	

Explanatory notes: the character 'μ_i ' refers to the mean WTP for the ith household;* p < 0.1; ** p < 0.05; *** p < 0.01. In parentheses are the p values.
Source: Author's Survey Data, 2021.

Table 4.10 above presents the results of mean WTP values and their determinants based on different vehicles. The results indicated that Age exerted a statistically significant and positive influence on WTP values across the three models, aligning with the expected positive correlation observed in the impact of Age on WTP values for alterations in elicitation format (EF) and bid range (BR). This suggests that older households exhibited a greater inclination to contribute financially to RH protection compared to their younger counterparts. This observation echoes similar trends identified by Holmes *et al*., (2002, 2004) in the context of restoring riparian ecosystems. However, it's crucial to note a contrasting result reported by Ndambiri *et al*., (2016), who found that taxes led to protest responses among older respondents within the same county. Despite this discrepancy, the prevailing positive association in the present study may be attributed to the often-associated increased financial stability and capacity that comes with age. Older households, with greater financial resources, may find themselves in a more favorable position to allocate funds to causes they deem significant, such as RH protection. This enhanced financial stability contributes to their heightened WTP, a phenomenon divergent from the attitudes of the younger demographic (Colby & Orr, 2005; Ndambiri *et al*., 2016). Moreover, given that older households tend to have a longer-term perspective and may be more concerned about the well-being of future generations. Investing in the protection of RH could reflect a forward-looking approach to environmental stewardship, aligning with the interests of older households who are more focused on the legacy they leave behind hence higher WTP (Alam, 2013). For participants interviewed using the Trust PV, the results indicated that Gender had a significant and positive impact on their WTP values. Specifically, male-headed households had a WTP that was 30.3% higher compared to female-headed households. This suggests that male-headed households, who expressed

confidence in the Trust fund, showed a higher WTP than their female-headed counterparts. This outcome aligns with similar findings by (Fonta *et al*., 2010; Wang & Whittington, 1997) but contrasts with the results of (Fonta *et al*., 2008; Tassie & Endalew, 2020). One possible rationale for this positive effect stems from the fact that male households potentially have greater control over key resources compared to female-headed households. Consequently, it was assumed that male-headed households would contribute more towards RH protection, leading to higher WTP as also noted by (Fonta *et al.*, 2010; Ndambiri *et al*., 2015; Ndambiri *et al*., 2016). Additionally, within cultural contexts, women are often characterized as more conservative in negotiating prices in typical African market setups. Men, on the other hand, are naturally less patient in protracted price bargaining exercises, potentially resulting in higher WTP (Fonta *et al*., 2005).

However with time also female headed households can be sensitized on the need to participate in RH protection. In the Tax model, Income exhibited a significant and positive influence on WTP expectations. The model's results indicated that for every 1% increase in the monthly aggregate income of households, their WTP for RH protection increased by 22.5%. Implying that respondents with higher incomes expressed a greater willingness to contribute financially to RH protection. This finding on Income suggest that households with higher earnings were more inclined to allocate increased amounts for RH protection through a tax fund when compared to their counterparts. An observation consistent with economic theory and echoes the outcomes of various CV studies, such as those conducted by (Tassie & Endalew, 2020; Fonta *et al*., 2010; Holmes *et al*., 2002; Lewis *et al.,* 2017; Bateman *et al*., 1995), suggesting that households are more willing to invest in environmental goods and services that provide them with higher satisfaction (Colby & Orr, 2005; Fonta *et al*., 2010; Ichoku *et al*.,

2009). A plausible explanation for this pattern is that higher-income households may attach a greater value to RH protection, driven by their capacity to afford and appreciate the inherent values of natural habitats. Their disposable income allows them to prioritize and contribute more substantially to causes aligned with RH protection, given their financial capacity without significantly affecting their overall financial stability. Additionally, higher-income households tend to support progressive taxation, where wealthier households prefer contributing more towards public goods (Wiser,2007). This equity consideration can increase their WTP for RH protection through tax mechanisms, as they see it as a fair way to distribute the financial burden. However, it is also important to sensitize low-income earners of the need to conserve RH, as the benefits of protection extend over a wider geographical area. Distance was significant and positive in the Trust and pooled models, a finding similar to those of Holmes *et al*., (2002, 2004) and Fonta *et al*., (2007).

The result implied that people who resided far from RH were willing to pay more unlike those who resided near contrary to (Barrena *et al*., 2014; Pate & Loomis, 1997). Other studies such as Nicosia *et al*., (2014) have shown no correlation between distance and WTP. A plausible rationale for the findings in this study on RH protection suggests that households residing at a distance from RH habitats may view them as precious natural assets worth conserving for the benefit of future generations, despite not directly reaping the benefits. This altruistic perspective could have contributed to a heightened WTP among residents living farther away (Alam, 2013). Furthermore, households residing in proximity to these habitats might potentially develop a willingness to contribute to RH protection over time through increased awareness and sensitization efforts. The Informal education level variable exhibited a significant negative impact in the Tax only model, leading to a noteworthy decrease in WTP values. Non-informed

households, lacking formal education, demonstrated lower WTP values by 1.3%. This implies that the absence of formal education contributes to heightened levels of RH destruction, stemming from inhibited awareness levels and resulting in diminished WTP values (Ndambiri *et al*., 2016). Besides, informally educated residents are more likely to have lower incomes from low paying jobs and face more economic constraints (Remoundouk & Koundouri, 2009). With limited financial resources, households prioritize immediate and essential needs over environmental conservation, leading to a lower WTP for RH protection through additional taxes as also observed by Ndambiri *et al*., (2015). Moreover there could be a general distrust of government institutions among residents with informal education. This distrust can stem from negative experiences or a lack of positive engagement with government programs. Consequently, leading to lower WTP values through tax funds managed by the government (Ichoku *et al*., 2009). Although studies like Nicosia *et al*., (2014) have shown no direct correlation between environmental awareness and WTP values, in the context of RH protection, uninformed households, comprising 9.2% of SPC and 1% of MBDC as shown in Table 4.1, could potentially increase their WTP if sensitized on the importance of RH protection. In contrast, the attainment of a College education level positively and significantly influenced WTP values in the Tax model, while the attainment of a University education level positively and significantly influenced WTP values in the Trust model. Specifically, households with a College education exhibited a 13.4% increase in WTP in the Tax model. A plausible explanation is that such households are assumed to be knowledgeable and professional. Consequently, it is presumed that most of these households are employed in professional roles and earning more than those with informal education.

Therefore, they have a higher WTP for habitat conservation. In addition College graduates may have had a broader but less deep exposure to various subjects, leading them to prefer more straight forward and integrated methods of contribution like a voluntary tax fund. On the other hand those households who had acquired University education demonstrated a 36.6% increase in WTP in the Trust-only model. A result which suggest that respondents with post-college education levels were willing to pay more, indicating that improved access to information and processing is crucial for raising awareness about the necessity of RH protection as equally noted by Ndambiri *et al*., (2015, 2016) and Neupane *et al*., (2016). Literature has consistently highlighted the pivotal role of education in RH protection, aligning with the observed positive impact of College and University education variables, as noted by Kline *et al*., (2000) and Ndambiri *et al*., (2016). Additionally, well-educated households are more likely to recognize and appreciate both intrinsic and extrinsic values of these habitats, fostering enhanced protection. College and University education emphasize scientific literacy and research skills, empowering households to critically evaluate information about the importance of RH and fortifying their commitment to its protection. Education at higher levels encourages critical thinking and evidence-based decision-making, leading respondents with College and University education to make informed choices about the importance of the habitat and influencing their WTP for its protection. some of the respondents with university-level education, as indicated in Table 4.1 (36.9% for SPC and 22.1% for MBDC), expressed a higher WTP through a local trust fund. This preference may stem from a tendency among these households to seek long-term strategies and mechanisms that offer greater control and transparency.

A collective trust fund aligns with their desire for a targeted and managed approach, ensuring that funds are used efficiently and specifically for RH conservation. However,

if there is assurance that funds collected through a tax fund system could be managed transparently and specifically for RH protection, such households may shift their preference towards the tax fund over time. In the Tax-only model, Household size exhibited a significant and negative impact on WTP, aligning with the hypothesized relationship. Specifically, an increase in household size by one percent resulted in a notable decline in WTP by 21.4% in the Tax model. This finding implies that households with larger families WTP declined with the Tax fund. An observation consistent with a recurrent theme in environmental literature, as demonstrated by Oduor *et al*., (2018). The identified inverse correlation between Household size and WTP stands in contrast to the findings of Tassie & Endalew (2020). A plausible explanation for this inverse relationship is that larger families larger families often operate under stricter budget constraints. Their disposable income, after covering essential expenses, is limited. As a result, they may be less willing or able to contribute additional amounts through taxes, prioritizing immediate needs over environmental conservation. Moreover, the presence of competing demands for resources within the family, such as allocations for education, healthcare, and housing, may overshadow contributions toward habitat protection.

This dynamic can lead to a diminished emphasis on environmental preservation, resulting in lower WTP values, as noted in the study by Ndambiri *et al.*, (2016). In the Trust model, the perceived Necessity to protect RH demonstrated a significant and positive influence. This positive correlation echoes the findings of Daly *et al*., (2015). In the context of RH in this study, households that perceived a necessity to protect RH by 1% showed a significant increase in their WTP values, specifically by 55.4% in the Trust model. This implies that respondents who deemed habitat protection necessary had higher WTP values, driven by their confidence in the Trust fund, compared to those

who did not see the need for habitat protection and lacked confidence in the Trust fund. A plausible explanation for this result is that, besides having access to education and information about the importance of RH protection, households perceiving it as necessary to conserve the habitats might have felt a greater sense of control and accountability over how funds are used with the Trust fund. This is supported by studies such as Fonta *et al.*, (2010). Additionally, these respondents might have felt more control over their contributions with the Trust fund (Ichoku *et al*., 2009), leading to higher WTP. Furthermore, due to their previous experiences and interactions with community projects, these households might have perceived Trust funds as less likely to be diverted to other uses compared to Tax funds. This ensured that their contributions were specifically used for RH protection, which increased their WTP. However, with more frequent reporting and increased transparency measures from the government regarding the Tax fund, these households could also build confidence in the Tax fund as well. Similarly, the Certainty of future incomes exhibited significant and positive effects in both the Tax model and the pooled model, aligning with expectations and consistent with the findings of Brouwer (2011), Wang & Whittington, (2005) and Ndambiri *et al*., (2015). This outcome suggests that households are more inclined to pay higher amounts for a good when they possess certainty about their future incomes, as previously noted in studies by Huhtala (2004), Ndambiri *et al*., (2015), and Wang & Whittington (2005). In the context of this study on RH protection, only 48% of households reported being certain about their future incomes, while the majority (52%) expressed uncertainty, as documented in Table 4.1.

This implies that the impact of the Certainty of future income variable on WTP may evolve, potentially having a more positive effect if households that were initially uncertain become certain over time. Such a shift could occur as the economy stabilizes

and recovers from the shocks of the COVID-19 pandemic. However, further research is recommended to ascertain the reliability and persistence of this variable's influence on WTP in the context of RH protection. EF significantly and negatively influenced mean WTP values across the three models. This implies that a shift in EF from SPC towards MBDC decreased mean WTP values. This finding contradicts previous results in Table 4.9, where the MBDC sample exhibited higher WTP values compared to the SPC sample when the change in PV was not considered. This finding suggests that as EF changed with a shift in PV towards Trust, the WTP declined, especially since the MBDC format proved more responsive to changes in PV. While studies like Svenningsen & Jacobsen (2018) have noted the impact of EF changes on CV estimates, their findings may not directly apply to this study, as they compared hypothetical versus revealed preferences using Tax and Donations as PV. Plausibly, the observed result in this study could be attributed to the decrease in MBDC WTP values as Trust replaced Tax as the PV. However, this explanation lacks substantial support from existing literature, necessitating further investigation into this observation. PV was significant and negatively influenced WTP in the pooled model. A 1% change in PV from Tax towards Trust led to a substantial decline in WTP by 190.8%. This indicates that the shift in PV from Tax towards Trust was associated with a notable decrease in WTP values. This observation aligns with the findings in Table 4.9, where WTP generally decreased with the transition from Tax towards Trust, corroborated by Bateman *et al*., (1995) results, where Trust exhibited lower WTP values than Tax. Plausibly, respondents who had confidence in the hypothetical local Trust fund expressed lower WTP for RH protection policy compared to those with confidence in the Tax fund. This corresponds with the observations made by Bateman *et al*., (1995) and Svenningsen &

Jacobsen (2018) but contradicts the findings of Ichoku *et al*., (2009), where confidence in the Trust fund increased people's WTP.

Additionally, it is conceivable that households with past participation in locally initiated community development projects were less willing to pay, influenced by their prior experiences with unsuccessful policies and projects. Considering that current household decisions on payment for public goods are often influenced by past experiences, the reduced confidence in the trust fund within the city of Nairobi may stem from the surge in cases of fraud and deceptive financial schemes (Macey & O'Hara, 2003; Fonta *et al*., 2010). The linear models that analyzed the effects of the independent variables on respondents' WTP values were fit and significant at 1% level as shown by the adjusted R^2 of about ($59\% < R^2 < 65\%$) across the three models, an observation almost two times that observed by Fonta *et al*., (2010) in a developing economies context, owing its explanation to the changes in PV used. It was realized that determinants (Age, Gender, Household size, Distance, Necessity to protect RH, EF used, Income, Certainty of future incomes, PV used and Education level) significantly and differently influenced mean WTP values across the three models at 1% level as shown by the F values ($p<0.01$,F=29.45; $p<0.01$,F=32.39; $p<0.01$,F=37.94) respectively leading to rejection of null hypothesis in favor of the alternative (Changing the PV does significantly affect households' CV estimates towards RH protection in Kenya). Table 4.11 displays the outcomes of the SD of the mean WTP values and their influencing factors across various vehicles, assessed through F-tests.

Table 4.11: SD of the WTP estimates and their determinants for different PV

Characteristics	Tax Model DV=Log(σ_i)		Trust Model DV=Log(σ_i)		Tax-Trust Model DV=Log(σ_i)	
	Coefficient	Std error	Coefficient	Std error	Coefficient	Std error
Age (Years)	0.008*(0.060)	0.004	0.008*** 0.003)	0.004	0.005*(0.016)	0.003
Gender (1=Male)	-0.072 (0.600)	0.062	-0.098 (0.542)	0.064	-0.022 (0.978)	0.044
Income (KES)	-0.108 (0.976)	0.089	-0.092 (0.770)	0.094	-0.085 (0.532)	0.064
Distance (Metres)	0.261***(0.0001)	0.076	0.287***(0.001)	0.096	0.292***(0.001)	0.056
Informal educ	0.145*(0.060)	0.129	0.006 (0.385)	0.008	0. 020 (0.596)	0.826
Primary educ	-0.411 (0.447)	0.539	-0.396 (0.598)	0.750	-0. 061 (0.890)	0.441
Secondary educ	-0.243 (0.369)	0.270	-0.2156 (0.569)	0.378	-0.204 (0.927)	0.217
College educ	-0.046**(0.041)	0.186	-.148 **(0.032)	0.249	-0. 018 (0.899)	0.144
University educ	-0.083 (0.567)	0.145	-0.071 (0.708)	0.189	-0.109 (0.884)	0.109
Household size (No. of persons)	0.156*(0.096)	0.065	0.080 (0.855)	0.054	0.035 (0.903)	0.040
Necessity to protect RH (1=Yes)	-0.162 (0.144)	0.106	-0.180 (0.583)	0.135	-0.173**(0.023)	0.082
Certainty of future income (1=Yes)	0.134** (0.022)	0.063	0.162**(0.017)	0.076	0.078*(0.063)	0.045
Owning land within riparian area (1=Yes)	0.088 (0.554)	0.076	0.077 (0.411)	0.071	0.087*(0.089)	0.051
EF(1=MBDC)	0.067 (0.206)	0.064	0.180***(0.001)	0.061	0.150***(0.000)	0.043
PV (1=Trust)	-	-	-	-	0.130***(0.001)	0.043
Constant	0.959***(0.000)	0.359	0.178 (0.375)	0.404	0.548**(0.043)	0.257
Summary statistics						
F-statistic	4.20		4.26		7.39	
Prob > F	0.000		0.000		0.000	
Adjusted R-squared	0.622		0.658		0.583	
Number of observations	129		129		258	

Explanatory notes: the character 'σ_i' refers to SD of mean WTP estimates for the ith household; * p<0.1; ** p<0.05; *** p<0.01. In parentheses are the p values.
Source: Author's Survey Data, 2021.

The results from Table 4.11 reveal that certain factors (Age, Distance, and Certainty of future incomes) significantly and positively influence variations in WTP estimates across the models. Contrary to expectations, older households exhibited higher dispersions in their WTP values compared to younger respondents, despite initially indicating higher average WTP values in the WTP models. This finding aligns with the observations made by Brouwer (2011) but contradicts the findings of Wang & Whittington (1997), where older households demonstrated lower deviations in their WTP. The rationale behind this unexpected outcome in the current study may be attributed to the fact that older households tend to be more risk-averse, hence exhibiting a higher degree of contingency planning and saving for unforeseen events, leaving them with fewer resources that can be allocated to RH protection. Consequently, this circumstance leads to higher inconsistencies in their valuation, as discussed by Colby & Orr (2005). Distance positively and significantly influenced SD, a finding in line with that observed by Holmes *et al*., (2004).

The observed result for this study of RH implies that respondents who stayed far from RH had highly dispersed WTP values than those who stayed near the habitats. The rationale behind this observation might be that households residing in closer proximity to the RH could have experienced a heightened sense of ownership, direct access, and economic enjoyment from the habitat in contrast to those residing at a greater distance. This perceived proximity and accessibility may have exerted an influence on the WTP values of those living nearby, resulting in less variability and a lower SD in their valuation distributions. This alignment with the habitat could lead to a more consistent and cohesive valuation among nearby residents, as suggested by studies such as Pate & Loomis (1997), Colby & Orr (2005) and Nicosia *et al.*, (2014). Moreover, it could happen that households staying far from the RH had varied perceptions of the current

environmental quality of the RH as polluted and destroyed (Muketha, 2020). These varying perceptions could have resulted in a diverse range of WTP values, contributing to a higher SD. Contrary to the findings of Brouwer, (2011), deviations increased with the Certainty of future incomes in this study. In contrast, other studies, such as those by Wang & Jie (2010) and Wang & Whittington (1997), have reported no correlation between the certainty of future incomes and SD. Analyzing the descriptive statistics presented in Table 4.1, a significant portion (52%) of households expressed uncertainty about their future incomes. Among the few households who were certain about their future incomes, their valuation distribution exhibited a high degree of inconsistency. This discrepancy may be attributed to the likelihood that households certain about their future incomes had diverse financial priorities. Consequently, their contributions to RH protection may have varied depending on household preferences and priorities, potentially resulting in a higher SD in WTP values (International Monetary Fund, 2020). Deviations in the Tax-only model increased with Informal education levels, signifying a 14.5% rise in deviations for households with informal education. An explanation for this observation is that households with informal education backgrounds often experience more varied income levels and less financial stability leading to inconsistencies in their valuation. Moreover, informal education is commonly associated with a diverse range of occupations, from manual labor to small business ownership, which results in significant variability in income and occupation. This variability can greatly affect a household's ability to pay, leading to a wider range of WTP responses and thus a higher SD. Additionally, trust in government and tax fund management can vary considerably among households with informal education backgrounds (Wang & Whittington, 2005; Ndambiri *et al*., 2015). Some households may have confidence in the government's effective use of funds, while others may be

skeptical. This varying level of trust can further contribute to differing WTP amounts, resulting in a higher SD compared to households with formal education backgrounds. In this study of RH it could happen that households interviewed under the Tax only model were skeptical hence exhibiting higher SD. Conversely, the College education level variable exhibited a negative and significant influence on deviations in both the Tax and Trust models. This suggests that education played a crucial role in RH protection. Educated households were assumed to recognize the importance of habitat protection, leading to a negative correlation between education and SD, in contrast to their counterparts with only informal education.

The significant and negative influence of College education level on deviations aligns with the findings of Tassie & Endalew (2020), where education enhanced WTP and resulted in lower deviations. This result contrasts with studies by Wang & Whittington (2005) and Wang & Jie (2010), where education had a positive correlation with variance. In the Tax and Trust models, respondents with College education level demonstrated lower deviations in their valuations compared to their counterparts. A plausible explanation is that higher education levels, such as college, often facilitate networking and participation in environmental communities. Being part of such networks can expose households to environmental concerns, discussions, and initiatives, influencing their attitudes and willingness to contribute positively to habitat protection, thereby reducing deviations in their valuations (Cristeche *et al*., 2015). Moreover, households with college education were presumed to understand that RH contributes to the overall health of ecosystems, with implications for human health. The recognition of the need to safeguard these habitats, not only prevent waterborne diseases and maintain a clean environment but also to provide clean water for use and prevent unpleasant odours, could have contributed to higher WTP values and lower inconsistencies in their

valuations, resulting in lower SD. In the Tax-only model, Household size show a significant positive sign, aligning with expectations. An observation in line with that of Temesgen & Teferi, (2015). A 1% increase in household size resulted in a 15.6% rise in SD, indicating that as family size increased, the SD also increased. One plausible explanation for this finding in the context of RH protection is that larger families may have been more focused on short-term survival and meeting immediate financial obligations for the family during the study period.

Consequently, they may have been apprehensive about tax deductions from their incomes, making them less likely to allocate funds for RH protection. This reluctance to contribute financially to RH protection could have led to more deviations in their WTP values, contrary to expectations that larger families might be more concerned about the consequences of unprotected RH. While it was anticipated that larger families could exhibit consistency in their WTP values, the observed trend suggests the need for more targeted sensitization efforts to bridge the gap in understanding the importance of RH protection among households with larger family sizes. In the pooled model, the Necessity to protect RH significantly and negatively influenced deviations, consistent with the findings of Daly *et al*., (2015). As households perceived it necessary to safeguard the habitats, their SD decreased by 17.3%. This observation implies that educated households, recognizing the importance of protecting RH, exhibited lower deviations in their valuation distributions.

Previous studies by Fonta *et al*., (2007) and Holmes *et al*., (2002) have established a connection between the perceived necessity to protect and education levels, suggesting that educated households are more inclined to view environmental conservation as necessary, thereby reducing deviations. A probable explanation for this scenario in the

context of RH protection is that households expressing a high degree of necessity to protect RH (almost 95% of both SPC and MBDC households) as shown in Table 4.1, tended to have higher WTP values. This elevated commitment could be attributed to their awareness and education regarding the adverse effects associated with the destruction of RH. Consequently, their informed perception and preference for higher-quality RH might have positively influenced their WTP valuations, contributing to the observed lower deviations (Ichoku *et al*., 2009; Holmes *et al*., 2002). In the Tax-Trust model, dispersion increased with land ownership within the riparian area, aligning with findings from Holmes *et al*., (2002) and Holmes *et al*., (2004) but contrasting with the observations by Endalew & Wondimagegnhu (2019). Specifically, land ownership within the riparian area led to an 8.7% increase in the SD. This outcome is attributed to the perception that landowners within the RH may have considered the perceived opportunity costs of habitat protection to outweigh the benefits derived from environmental conservation. Consequently, these landowners may have been averse to protection measures, fearing potential loss of benefits and exhibiting inconsistency in their valuation, as noted by Carson *et al*., (2001) and Brouwer *et al*., (2011). Additionally, it is conceivable that these landowners had limited awareness or understanding of the economic and environmental balance between RH protection and associated benefits (Mugo *et al*., 2022), contributing to the higher SD.

The observed finding suggests potential for unintended destruction of RH, which could be addressed through targeted educational campaigns. In the Trust and pooled models, deviations were significantly and positively influenced by the change in EF from SPC to MBDC. This indicates that deviations increased with the transition from SPC to MBDC format. A likely explanation is that the MBDC format exhibited a generally higher

COEFV compared to the SPC format, as evident in Table 4.9, contributing to the higher deviations in valuation.

In the pooled model, the PV variable significantly and positively influenced deviations. This means that the shift from Tax to Trust as the PV increased deviations by 13%, resulting in larger discrepancies in valuation distributions. This finding aligns with observations made by Svenningsen & Jacobsen (2018). The rationale behind this outcome could be attributed to the higher COEFV associated with the MBDC Trust PV, as indicated by the 125% value in Table 4.9. Additionally, households' past experiences with unsuccessful policy implementations, along with prevalent cases of fraud and conmanship within the city, contributed to low confidence in the local trust fund leading to higher deviations. This observation is consistent with the findings of Fonta *et al*., (2010), Bateman *et al*., (1995) and Macey & O'Hara, (2003). It was noted that the significant determinants influenced SD of WTP estimates at 1% level ($p<0.01$, F=4.20; $p<0.01$, F=4.26; $p<0.01$, F=7.39) respectively across the three models leading to rejection of null hypothesis. The models were fit and significant at 1% level with adjusted R^2 of about ($58\%<R^2<66\%$) across the three models, an observation almost two times that observed by Fonta *et al*., (2010) who had used Trust as PV, and the difference attributed to the use of Tax as a vehicle.

When PV was regressed on both mean WTP and SD estimates, the results were significant leading to the rejection of the null hypothesis in favor of the alternative (Changing the PV does significantly affect household CV estimates towards RH protection in Kenya). Further it was realized that the use of Trust as a PV led to lower WTP values which were highly dispersed. However, caution should be taken when using Taxes as a PV given that involuntary taxes can act as a form of coercion which

might affect WTP estimates given that they do not provide the warm glow to the tax payer (Svenningsen & Jacobsen, 2018). In this study the Tax vehicle was regarded as voluntary given that households had expressed interest to pay taxes through deduction at source or purchase of local goods within the county.

4.8 Valuation Good (VG) and its effects on valuation of RH protection in Kenya

Table 4.12 displays the outcomes concerning the average WTP estimates and its SD for both Public and Private goods based on EF, as well as when the samples were combined.

Table 4.12: Evaluating differences in Mean WTP estimates for the different VG based on the value EF and pooled samples.

Descriptions	**Private good**		**Public good**	
	SPC	**MBDC**	**SPC**	**MBDC**
Mean WTP (μ) in KES/Month	801.54	1172.66	875.38	1171.09
Standard error of the mean	97.13	127.11	92.65	98.42
Coefficient of variation (σ/μ)	0.98	1.34	1.22	1.36
Number of observations	65	64	65	64
MWT- ($\boldsymbol{\alpha}$) value	2.344		2.189	
P-value	0.021**		0.030**	
	Pooled samples			
Details	**Private good**		**Public good**	
Mean WTP (μ) in KES/Month	987.12		1022.09	
Standard error of the mean (σ)	112.11		95.48	
Coefficient of variation (σ/μ)	1.16		1.29	
Number of observations	129		129	
MWT-value	0.224			
P-value	0.823			

Explanatory notes: MWT implies Mann Whitney Test; * p < 0.1; ** p < 0.05; *** p < 0.01.
Source: Author's Survey Data, 2021.

When considering the VG as a Private good, the WTP for the MBDC sample was 1.46 times that of the SPC mean WTP, even with a one-unit difference in sample sizes.

Additionally, the COEFV for MBDC was 36% higher than that of the SPC format, indicating greater variability and inconsistency in MBDC values under the Private good category. A significant difference in mean WTP values within the Private good sample was observed at a 5% significance level, as indicated by the Mann-Whitney test statistic ($p<0.05$, $\boldsymbol{\alpha}=2.344$).

In contrast, when the VG was perceived as a Public good, the MBDC mean WTP value was 1.34 times that of the SPC mean value, and the MBDC COEFV was 14% higher than that of the SPC format. This aligns with the notion that public goods, which benefit society as a whole, tend to elicit higher WTP due to shared responsibility and perceived broader societal benefits (Cook *et al*., 2018). This finding contradicts that of Wiser (2007), where the Public good view resulted in lower WTP compared to the Private good. The observed finding in this study underscores the importance of recognizing the public nature of environmental resources like RH and the potential for collective stewardship in their preservation. Similarly, a significant difference in mean WTP values between SPC Public good and MBDC Public good was observed at a 5% significance level, as indicated by the Mann-Whitney test statistic ($p<0.05$, $\boldsymbol{\alpha}=2.189$). When comparing the Private and Public goods based on the EF, SPC Public good elicited a mean WTP value 1.092 times that of SPC Private good, with a COEFV 1.24 times that of SPC Private good. Furthermore, there was a slight difference in mean WTP value between MBDC Public and MBDC Private good, of approximately KES 1.57, associated with a 2% change in COEFV. In general, viewing the good as Public resulted in higher WTP values with a larger variance compared to when the good was considered Private. This observation contradicts Wiser (2007) but aligns with findings from Amondo *et al*. (2013) and Meyer & Liebe (2010), where residents exhibited higher WTP for the protection of a Public good compared to their counterparts. The results also

show that the view of RH as a Public good exhibits higher SD for both SPC and MBDC formats (KES. 1067.96 or $7.00 ; KES. 1592.68 or $10.45) compared to the SD exhibited by the Private good for SPC and MBDC formats (KES. 785.51or $ 5.15; KES. 1571.36 or $10.31). This finding aligns with Ichoku *et al*., (2009), where a Public good resulted in higher WTP for solid waste management compared to the charges imposed. A significant difference in the SD of mean WTP values was observed at a 5% significance level in both Private and Public good samples, leading to the rejection of H_0. When the samples were combined, and a comparison made between Private and Public goods, the results revealed that the perception of the good as Public yielded a WTP estimate that was 1.04 times higher than that of the Private good. This finding contrasts with the observations made by (Spindler *et al*., 2018; Zawadzki, 2016; Wiser, 2007). In this study, an insignificant difference of KES 34.97or $ 0.23 was observed at a 1% significance level between the two goods, as indicated by the Mann-Whitney test statistic ($p>0.01$; $\boldsymbol{\alpha}=0.224$).

Moreover, the perception of the good as Public exhibited a higher degree of variation, with a SD that was 1.29 times larger than its mean, compared to the Private good, which had a SD of 1.16 times larger than its mean WTP. This observation is closely related to the high COEFV registered by a Public good when the samples were distinct. However, when the mean WTP and SD of mean WTP values were tested for any statistical difference using the Mann-Whitney test, and no significant difference was observed at the 1% level, as shown by the test statistic ($p>0.01$, $\boldsymbol{\alpha}=0.224$) in the pooled sample. Nonetheless, there was a significant difference at the 5% level in mean WTP values and SD values for disjointed samples, indicating that EF contributed to the differences in WTP estimates for the two goods. Considering the literature's inclination towards VG that underestimate WTP values, future valuations may favor portraying RH as private

goods. This shift is motivated by the concern that VG, which often overestimate WTP values, could exceed household budgets.

Based on the findings of this study on RH protection, considering RH as a Private good is associated with a total WTP of KES 2.8 billion for SPC households and KES 4.1 billion for MBDC households, both of which perceive the habitats as private. Comparing these amounts to the costs of cholera treatment in the city, estimated at $17.6 to $35.16 per adult household per year (Kinga'u, 2015), the total treatment cost for the 289,898 households in this study would range from KES. 546 million to KES. 1.1 billion. Consequently, the hypothesized collections from WTP would cover approximately 15.9% of the treatment costs, leaving 84.1% available to enhance the current state of RH, thereby mitigating further expenses incurred for cholera treatment. Specifically the findings from the Private good WTP values indicate that each household would collect KES 23,690.4 or $ 155.42 per year and when subtracted from the current costs of cholera treatment for each adult household of KES 5645.32 or $155.42 per year, each household would save KES, 18,045.08 or $118.38 per year as a result of RH protection hence the need to enlighten households on the need to protect these habitats.

Table 4.13: Mean WTP estimates and the determinant factors for the different VG

Characteristics	**Private good Model** DV=Log(μ_i)		**Public good model** DV=Log(μ_i)		**Private-Public Good Model** DV=Log(μ_i)	
	Coefficient	**Std error**	**Coefficient**	**Std error**	**Coefficient**	**Std error**
Age (Years)	0.014**(.040)	0.006	0.012**(0.032)	0.006	0.010**(.048)	0.004
Gender (1=Male)	0.012 (0.605)	0.083	0.115 (0.129)	0.093	0.039 (0.870)	0.061
Inc (KES)	0.295 (0.286)	0.133	0.013 (0.768)	0.125	0.122 (0.690)	0.088
Dist(Metres)	0.221*(0.083)	0.122	.385***(.000)	0.137	0.335***(.001)	0.089
Informal educ	-0.078 (0.870)	0.476	-0.711 (0.449)	0.320	0.029(0.459)	0.444
Primary educ	0.086 (0.717)	0.238	0.267 (0.401)	0.102	0.712(0.324)	0.223
Secondary educ	0.058 (0.327)	0.160	0.152** (0.011)	0.065	0.189*(.071)	0.103
College educ	.134**(.022)	0.138	0.725** (0.034)	0.048	0.095*(.056)	0.669
University educ	.0645 (0.001)	0.023	0.0327* (0.066)	0.638	0.053**(.003)	0.049
Household size (No. of persons)	-0.076 (0.601)	0.084	-0.069 (0.422)	0.081	-0.005 (.134)	0.057
Necessity to protect RH (1=Yes)	0.057 (0.681)	0.211	0.446*(0.097)	0.258	0.355**(.042)	0.163
Certainty of future income (1=Yes)	0.200**(.031)	0.084	0.025 (0.701)	0.094	0.021 (0.521)	0.063
Owning land in riparian area (1=Yes)	-0.100 (0.402)	0.093	-0.136 (0.551)	0.111	-0.097 (0.711)	0.069
EF (1=MBDC)	0.159*(0.090)	0.084	.201***(0.002)	0.094	0.137**(.014)	0.062
VG (1=Public)	-	-	-	-	0.099*(.086)	0.058
Constant	0.685 (0.286)	0.535	0.061 (0.408)	0.681	0.242 (0.621)	0.417
Summary statistics						
F-statistic	6.25		2.86		7.03	
Prob > F	0.000		0.003		0.000	
Adjusted R-squared	0.533		0.412		0.517	
Number of observations	129		129		258	

Explanatory notes: The character 'μ_i' refers to the mean WTP for the ith household;* p<0.1; ** p<0.05; *** p<0.01. In parentheses are the p values.
Source: Author's Survey Data, 2021.

Table 4.13 above provides the findings for the mean WTP estimates and their influencing factors across various goods. Three models were considered and the findings show that factors (Age, Distance, EF and Education level) were significant across the three models with expected positive signs. The variable Age showed that older respondents were more willing to pay more for protection unlike the young, a

finding similar to those of (Tuan & Navrud, 2006; Tassie *et al*., 2020; Holmes *et al*., 2004), but dissents from studies such as (Fonta *et al*., 2007; Zawadzki, 2016). Researchers such as Wang (1997) have shown no correlation between Age and WTP. The observed finding means that WTP increased with Age. A simple explanation for this result could be that, older households may have a more profound understanding of the interconnectedness between environmental health and community well-being. Their life experiences and exposure to various environmental issues over time may contribute to a heightened sense of civic duty, resulting in a greater willingness to contribute to the preservation of public goods such as RH, an observation consistent with (Holmes *et al*., 2004; Ndambiri *et al*., 2016).

Moreover, it could happen that given their love for the young and future generation, they were willing to pay more for RH protection and for sustainability reasons (Alam, 2013). Distance from the RH had a positive influence on WTP values across different models, aligning with findings by Holmes *et al*., (2002) but differing from studies such as Pate & Loomis (1997), Fonta *et al*., (2008), and Ndambiri *et al*., (2016), where WTP for a public good decreased with distance. Other studies, like Nicosia *et al*., (2014), have reported no correlation between distance and WTP. The positive coefficient in this study may be explained by the perception of residents living at a distance regarding the protection of RH as a personal responsibility as indicated by some households (Refer to Appendix C2). This perception translates into a shared effort and responsibility benefiting the entire community over time. It could happen that the sense of collective environmental stewardship was highly considered among households residing farther from the habitats hence their higher WTP as observed in previous studies such as (Alam, 2013). As expected, Education level of the respondents had a statistically significant positive effect on households' WTP as expected, a finding in line with that

of (Wang & Whittington, 2005; Fonta *et al*., 2005; Tassie & Endalew, 2020). The findings on education reveal that the attainment of Secondary education level significantly and positively influence WTP values. The observed education influence only affected the Public good view model and the pooled model, a pattern akin to the impact of attaining a University education level.

Similarly, the attainment of a College education level had a significant positive effect on WTP values across all models. This observation indicates that respondents with a College education level in the Private good model exhibited higher WTP compared to their counterparts. In the pooled model, households with post-secondary education levels demonstrated higher WTP than their counterparts. Educated respondents were presumed to possess a clear understanding of the risks associated with unprotected RH, had higher levels of knowledge and awareness (Daly *et al*., 2015). Additionally, their potential previous experiences with RH usage might have contributed to increased WTP. This outcome for RH protection underscores the significance of household education levels as a crucial determinant of WTP. The finding that households with higher education levels were willing to pay more for RH protection aligns with the results of previous studies conducted by Tuan & Navrud (2006), Ndambiri *et al*., (2015), and Ndambiri *et al*., (2016). Change of EF from SPC towards MBDC led to higher WTP across the models. This is corroborated by the higher WTP values observed for the MBDC format compared to the SPC format, as evident in Table 4.12. This finding contrasts with the observations of Ndambiri *et al*., (2016), and this discrepancy can be attributed to differences in the models, sample sizes, and the inclusion of change in EF as an independent variable in the current study. A plausible explanation for the higher WTP values in the MBDC format in this study could be linked to the slightly higher incomes reported by respondents in this sample, as indicated in the descriptive

statistics. Higher incomes are often associated with increased WTP (Ndambiri *et al*., 2016; Nicosia *et al*., 2014; Welsh & Poe, 1998), potentially contributing to the observed pattern. For the Private good model, Certainty of future incomes variable was significant and positive as expected, and in line with the theory together with other studies done such as (Fonta *et al*., 2008; Holmes *et al*., 2004; Tassie & Endalew; 2020). However, this finding is contrary to Wang & Whittington, (1997) and Wiser (2007) where uncertainty of future incomes increased WTP. The observed finding in this study means that as households became certain of their future incomes say by 1%, their WTP increased by 20%. A plausible explanation could be that certainty of future income may contribute to a more consistent commitment to Private goods. Unlike Public goods that are collectively funded, Private goods often require household contributions. The assurance of future income enables households to commit to regular payments, leading to higher WTP. Moreover, the Private good perspective may involve a sense of ownership or personal connection to the RH. Households who are certain about their future income and own property near these habitats might feel a stronger connection, leading to a higher WTP for their protection (Fonta *et al*., 2010; Daly *et al*., 2015). Hence the governments ought to consider privatization of these habitats for fostered management. Necessity to protect RH significantly and positively influenced WTP both in the Public good and in the Pooled model, a result similar to that of Kline *et al.,* (2000). Implying that respondents who found it necessary to protect RH had higher WTP unlike their counterparts. A plausible explanation is that the perception of the necessity to protect RH reflects a shared commitment among households to preserve these vital ecosystems. Households acknowledging this shared responsibility may exhibit a greater willingness to contribute financially to the common cause compared to their counterparts. Additionally, those households recognizing the necessity of

protecting the habitats may possess an understanding of the potential negative externalities associated with habitat destruction. This awareness could motivate them to prevent adverse effects on the environment, public health, and overall quality of life, consequently driving higher WTP (Pate & Loomis, 1997; Daly *et al*., 2015). Moreover, the association of Public goods with government provision and policies plays a role in this correlation. Households perceiving the Necessity of protection may view government initiatives positively, leading to a higher willingness to contribute through taxes or other means. This positive outlook supports effective policy implementation in safeguarding RH (Pate & Loomis, 1997; Daly *et al*., 2015). Of interest is the finding that VG variable was positive and significant in the pooled model. This implies that as the view of the VG changed from Private towards Public, WTP increased by 9.9%, a finding in line with that of Khanna (1994), but contrary to Wiser (2007). This observation follows the previous finding from Table 4.12 where mean WTP value for a Public was KES 1.04 times that of Private good.

A similar observation was made by studies such as (Pate & Loomis,1997; Konopka, 2013; Spindler *et al*., 2018). A plausible explanation for the positive sign for VG in this study could be that most Kenyans viewed RH as a Public good, and if protected it will have far much reaching effects to the public unlike in the case of Private good where benefits are only drawn by land owners (Schismenos *et al.*, 2018). Moreover, given that Public goods often require collective stewardship for their preservation, households who might have recognized RH as public goods might have had a fostered sense of community stewardship, where residents feel a shared responsibility for maintaining and protecting these valuable resources. This shared commitment could have positively influenced their WTP. The overall effects of the determinant factors for the different VG on mean WTP estimates in the Private good, Public good and Private-Public good

models were tested using F tests and the findings showed that the models were statistically fit at 1%, with the adjusted R^2 of about (41% to 53%) which is relatively high across the three models. The R^2 showed that the variables identified (Age, Education level, Distance, Necessity to protect RH, EF, Certainty of future income and VG) explained utmost 53% percent of the variation in participants WTP values. However, this also indicated that 47% of the variations were not explained. Equally, the overall models were significant and fit as shown by the F tests of ($p<0.00$, F=6.25; $p<0.01$, F=2.86; $p<0.00$, F=7.03) respectively across the three models. Table 4.14 presents results on estimated SD of household valuation functions and their determinants for the different VG.

Table 4.14: SD of the Mean WTP estimates and the determinant factors for the different VG

Characteristics	**Private good Model** DV=Log(σ_i)		**Public good model** DV=Log(σ_i)		**Private-Public Good model** DV=Log(σ_i)	
	Coefficient	**Std error**	**Coefficient**	**Std error**	**Coefficient**	**Std error**
Age (Years)	0.010**(.050)	0.004	0.007*(0.078)	0.004	0.005*(0.092)	0.003
Gender(1=Male)	-0.007 (0.414)	0.057	-0.145**(.913)	0.063	-0.028 (0.841)	0.041
Income (KES)	-.198**(.005)	0.091	-0.008 (0.433)	0.085	-0.083 (0.120)	0.060
Distance(Metres)	0.147 (0.115)	0.083	0.260***(.000)	0.093	0.225***(.000)	0.060
Informal educ	0.712 (0.770)	0.008	0.964 (0.149)	0.436	0.032 (0.459)	0.444
Primary educ	-0.124 (0.512)	0.650	-0.353 (0.203)	0.138	-0.712* (0.090)	0.223
Secondary educ	0.107 (0.221)	0.325	-0.191 (0.462)	0.089	-0.186 ** (.030)	0.103
College educ	-.068**(0.022)	0.219	-0.191 (0.233)	0.066	-0.095** (0.029)	0.069
University educ	-.077***(.001)	0.169	-0.036 (0.236)	0.044	-0.053***(.001)	0.049
Household size (No. of persons)	0.046 (0.611)	0.057	0.044 (0.635)	0.055	0.004 (0.863)	0.038
Necessity to protect RH(1=Yes)	-.332***(.005)	0.144	-0.362**(.042)	0.175	-0.247**(.0345)	0.111
Certainty of future income (1=Yes)	0.023 (0.307)	0.057	0.029 (0.400)	0.064	0.074*(0.076)	0.043
Owning land within riparian area (1=Yes)	0.064 (0.321)	0.063	0.090 (0.145)	0.076	0.063 (0.103)	0.047
EF (1=MBDC)	0.111*(0.052)	0.057	0.199***(.001)	0.064	0.093**(0.000)	0.042
VG (1=Public)	-	-	-	-	0.079*(0.072)	0.040
Constant	1.259***(.000)	0.365	0.805*(0.091)	0.462	0.939***(0.000)	0.284
Summary statistics						
F-statistic	6.13		2.76		6.84	
Prob > F	0.000		0.004		0.000	
Adjusted R-squared	0.556		0.493		0.531	
Number of observations	129		129		258	

Explanatory notes: the character 'σ_i' refers to the SD of the mean WTP estimates for the ith household; * p<0.1; ** p<0.05; *** p<0.01. In parentheses are the P values. Source: Author's Survey Data, 2021.

The findings show that significant factors (Age and EF) positively influenced deviations, whereas Necessity to protect RH negatively influenced deviations across the three models. Implying that older people had higher deviations in their mean WTP distributions compared to the young, even though they had earlier indicated higher WTP values. This finding is similar to that observed by Brouwer (2011) where Age increased with SD. The observed result in this study can be attributed to the limited exposure of older households to contemporary environmental campaigns, educational initiatives, and evolving societal values concerning habitat conservation. The lack of recent exposure among older households may have led to a diverse and inconsistent range of WTP values.

Furthermore, as households age, their preferences, values, and experiences tend to become more varied, contributing to disparities in their WTP values and ultimately leading to higher SD. The change in EF from SPC towards MBDC implied higher WTP values which were highly dispersed. A plausible explanation for the positive sign for this variable is that MBDC format had earlier on exhibited higher SD as evidenced from results in Table 4.12. Despite the fact that MBDC sample respondents had slightly higher incomes and higher mean WTP, their valuation distribution was highly inconsistent.

The plausible explanation is that households with higher incomes may have varied priorities, opinions and preferences which could have adverse impacts on the perceived value placed by households on the RH protection leading to higher inconsistencies in their valuation (Kline *et al*., 2000). Moreover, given the fact that MBDC format was associated with higher COEFV both under Public and Private goods valuation, it was expected that the format could exhibit larger dispersions when compared to SPC format.

However, limited studies exist to support this finding. The Necessity to protect RH variable had a negative and significant impact on deviations across the models, aligning with expectations and consistent with findings from Daly *et al.,* (2015). This result indicates that households expressing a higher perceived necessity to protect RH experienced lower SD in their WTP values. Existing studies have established links between the perceived necessity to protect RH, education levels, awareness of environmental conservation, and the perceived benefits derived from the environmental good (Kline *et al*., 2000; Wang & Whittington, 2005; Tassie & Endalew, 2020). Descriptive statistics in Table 4.1 reveal that a majority of respondents, irrespective of their view on the VG, found it Necessary to protect RH. Consequently, these households demonstrated a greater willingness to contribute financially to habitat protection, resulting in less variability in their WTP estimates. This finding is consistent with prior research, including studies by Pate & Loomis (1997) and Brouwer (2011). The negative coefficient for the Necessity to protect variable suggests that households perceiving the habitats as essential may have experienced the adverse effects of unprotected RH, motivating them to contribute to protection efforts leading to more consistent valuation estimates with lower deviations.

Education level had a significant and negative impact on the SD of WTP values in both the Private good and Private-Public good models, aligning with expectations. In the Private good model, the attainment of College education level reduced the SD by 6.8%, while University education level reduced it by 7.7%. Similarly, in the pooled model, attainment of Primary, Secondary, College, and University education levels reduced SD by 71.2%, 18.6%, 9.5%, and 5.3%, respectively. Respondents who perceived the good as Private and had achieved post-Secondary education level exhibited lower deviations in their valuations, consistent with observations reported by Wiser (2007) for a Privately

provided good. One plausible explanation for this behavior is that educated households, particularly those with College and University education levels, are presumed to possess a better understanding of the importance of environmental conservation, including the protection of RH. These households are more likely to be informed about the significance of these habitats and the potential consequences of their destruction. Consequently, they may demonstrate more consistent and aligned valuation estimates, leading to lower SD in their WTP. Additionally, respondents with post-primary education levels in the pooled model showed lower deviations in their valuation distributions, contrasting with studies such as Wang & Whittington (2005) and Wang & Jie (2010), where households with higher education levels had higher dispersions in their valuations. This finding in this study of RH implies that respondents with post-primary education levels in the pooled model had lower deviations compared to their counterparts. A plausible explanation is that higher levels of education are associated with more knowledge and higher levels of awareness, contributing to increased consistency in valuation (Ichoku *et al*., 2009; Fonta *et al*., 2007). Household Income level exhibited a negative influence on deviations across the models, with a significant effect observed in the Private good model, aligning with findings from studies such as Brouwer (2011) and Fonta *et al*., (2007, 2008). This contradicts observations from other studies (Wang & Whittington, 1997, 2005; Wang & Jie, 2010). The result indicated that a 1% increase in the average monthly income of a respondent led to a notable 19.8% reduction in SD.

This finding suggests that respondents with higher incomes demonstrated less variability in their valuation estimates, reflecting a consistent pattern. The implication is that respondents with higher incomes tended to have more stable and aligned WTP values, in line with economic theory (Fonta *et al*., 2010; Nicosia *et al*., 2014; Lewis *et*

al., 2018; Wiser, 2007). Research by Ndambiri *et al*. (2015) also supports the notion that higher-income households exhibit less variability in WTP due to their greater financial capacity and security. In contrast, respondents with lower incomes who viewed the good as Private indicated higher deviations in their valuation distributions.

This can be attributed to economic constraints faced by lower-income households, limiting their ability to contribute significantly to RH protection. The observed negative correlation underscores the influence of economic factors on the consistency of WTP values, particularly in the context of viewing the habitat as a Private good. Gender had a significant and negative impact on dispersion in the Public good model, aligning with findings from previous studies such as Fonta *et al*. (2007), Brouwer (2011), and Wiser (2007), but contradicting results reported by (Wang & Whittington, 1997; 2005) and Fonta *et al*., (2009). In contrast to Wang & Jie, (2010) findings that Gender had no correlation with deviations, this study on RH protection reveal that male-headed households, perceiving RH as a Public good, exhibited lower deviations in their valuation distributions by 14.5% compared to their female counterparts. The observed gender-based differences suggest that women respondents viewing RH as a Public good had larger deviations in their WTP distributions compared to men, potentially linked to women's limited ownership of key resources and reduced decision-making authority within households in developing countries (Fonta *et al*., 2010; Ndambiri *et al*., 2016). Furthermore, the observed gender-based variation in deviation could be explained by differences in education and awareness levels. Men, particularly those with higher levels of education and awareness, may possess a more informed understanding of the significance of protecting RH. This shared knowledge and understanding may contribute to a more consistent WTP for habitat protection among men, resulting in a lower SD.

In addition cultural factors and social norms that emphasize masculinity associated with protection and provision can influence men to support environmental causes such as RH protection that ensure the safety and well-being of their community. Social pressures and norms can lead to consistencies in their WTP valuation as men seek to fulfill these roles through the view of RH as public goods. Distance positively and significantly influenced deviations both in Public good and Private –Public good models, a finding similar to that of Holmes *et al*., (2004) but contrary to that observed by (Fonta *et al*., 2008; Pate & Loomis, 1997). However, limited literature exist on the correlation between distance and SD of WTP.

A possible reason for the positive relationship observed in this study could be that households living closer to other natural areas or recreational facilities may have perceived RH protection as less crucial, resulting in more diverse WTP estimates and higher SD among households located farther away from the RH. Moreover, it could happen that households living farther away from RH perceived themselves as less directly affected by the consequences of habitat destruction. As a result, their valuation of RH protection may be more heterogeneous, leading to a wider range of WTP estimates thus a higher SD. Certainty of future incomes positively and significantly influenced deviations in the pooled model. This result concedes with findings of Brouwer (2011) and dissents from what was observed by (Wang & Whittington, 1997; 2005). Other studies such as Wiser (2007) have shown that certainty of future incomes increase with public provision of a good and reduces with its SD, a finding contrary to what was observed in this study. As households gained greater Certainty about their future incomes, the SD increased by 7.4%. This finding suggests that respondents who expressed certainty regarding their future incomes exhibited larger deviations compared to their counterparts. Contrary to findings by Wang & Jie (2010), which indicated no

significant impact of income certainty on SD, and Wang & Whittington (2005), who observed larger variances in valuation distribution for respondents with higher uncertainties about future income.

The positive coefficient for the Certainty variable in this study on RH protection may be attributed to the financial behaviors of the respondents certain about their incomes. Approximately 48% of respondents who were certain about their incomes might have engaged in more intricate financial planning, encompassing considerations such as savings and contingencies upon receiving their incomes (International Monetary Fund, 2020; Cheryll *et al*., 2011). Consequently, a limited amount of funds may have been available for RH protection. Additionally, these households might have allocated their financial resources differently based on personal preferences, potentially prioritizing other financial objectives over RH protection. This diversity in financial prioritization could lead to varied WTP estimates and ultimately result in a higher SD. It is noteworthy that the VG variable had a significant and positive impact on deviations in the pooled model. This finding diverges from the results observed by Wiser (2007), where the view of the good as Public was associated with higher WTP leading to lower deviations. In the context of RH protection in this study, the view of the good as Public was linked to both higher WTP and higher SD as equally observed by Messerk *et al*. (2008) in a Public good set up. As the view of the VG changed from Private towards Public, the SD increased by 7.9%. This suggests that while Public goods elicited higher WTP values, they also exhibited higher COEFV as noted in Table 4.12, resulting in greater inconsistency in valuations and consequently higher SD.

The variables including Age, Gender, Income, Education level, Distance, Necessity to protect RH, EF used, Certainty of future income, and VG collectively explained 55.6%,

49.3% and 53.1% of the variations in SD of WTP values respectively across the models, as indicated by the models' adjusted R-squared values. The overall models were significant at 1% level, as demonstrated by the F-tests (*$p<0.00, F=6.13; p<0.01, F=2.76; p<0.00, F=6.84$)* across the three models. This implies that the significant variables influenced deviations differently across the models. When the VG was regressed on both mean WTP and SD estimates of the pooled models, the results were positive and significant, leading to the rejection of the H_0 in favor of the H_A(Changing the VG does significantly affected household CV estimates towards RH protection in Kenya). It is worth noting that residents of Nairobi were willing to pay more for a Publicly provided good compared to a Privately provided one. In the context of CV literature, policy implementers often prefer working with an option that understates the estimates, making Private good valuation the preferred choice for RH protection in Nairobi.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Overview of the chapter coverage

This chapter provides a systematic discussion of the findings drawn from the previous chapter in light of the theoretical and empirical literature. Section 5.2 discusses the findings in a summary form. Section 5.3 presents the study conclusions while section 5.4 gives recommendations and suggestions for future research.

5.2 Summary of the findings

The study aimed to evaluate the economic value of protecting RH in Kenya through analyzing households' socioeconomic profiles, physical and institutional characteristics, and their valuation. The study also explored the effects of altering factors (EF, BR, PV, and VG) on households' CV estimates using responses collected through CV preference uncertainty data elicitation cards. The results indicated a consistent positive WTP for RH protection among Kenyan respondents. Significant differences in mean WTP values and SD were observed across all objectives, leading to the rejection of null hypotheses. Specifically, when investigating the impact of changing EF on CV estimates for RH protection, significant disparities in mean WTP estimates and SD of WTP values were found between the two EF, with the MBDC format showing higher and more variable mean WTP estimates compared to the SPC format. The SPC format was favored for future valuations due to its tendency to underestimate WTP values. Various factors including Age, Gender, Income, Distance, and perceived Necessity to protect RH significantly influenced WTP estimates, alongside factors like Land ownership, Household size, and Education level.

Moreover, Distance and the perceived Necessity to protect RH significantly impacted the SD of WTP distributions. Transitioning from the SPC to the MBDC format increased mean WTP by 6.7%, with changes in EF positively influencing deviations in CV estimates for RH protection in Kenya by 9.8%. Objective two investigated the impact of BR variations on valuation estimates. The results indicated that Raised BR yielded higher and more consistent mean WTP values compared to Lowered BR. This finding contradicts economic theory, suggesting that Kenyan households were willing to pay more at higher bid prices for RH protection, underscoring the urgent need for RH preservation. However, for future valuations, it may be prudent to consider using lowered bid amounts, as the higher WTP expressed for Raised BR could potentially be exaggerated and not constrained by budget limitations. Factors such as Age, Distance, Necessity to protect RH, EF, attainment of College and University education levels, and BR significantly and positively influenced mean WTP values. Bid range SD was positively influenced by Distance and Land ownership within the riparian area, while Gender, attainment of a University education level, necessity to protect RH, and BR were negatively correlated with SD. Notably, transitioning from Lowered to Raised BR resulted in inconsistent WTP values. Objective three of the study examined the use of Tax and Trust as PV for RH protection valuation in Kenya. It was observed that Tax generated higher and more consistent WTP values compared to Trust, indicating a preference for government management of funds. Factors such as Age, Certainty of future incomes, and Distance positively and significantly influenced WTP values, while changes in EF and PV negatively impacted WTP values. The SD of the PV was positively and significantly influenced by Age, changes in EF and PV, Distance, and Land ownership, and negatively by the Necessity to protect RH.

Although Trust may be preferred for RH valuation, inconsistencies in WTP values raised concerns about respondent payment behavior, highlighting the dilemma between payment probability and stated amounts in valuation studies. Ultimately, Tax was deemed suitable for RH valuation due to its overstated WTP values and respondents' confidence in making payments. In objective four, the view of RH as a Public good, led to higher and inconsistent WTP values when compared to the Private good view. Factors such as Age, Distance, EF, Necessity to protect RH, VG and Education level were significantly and positively correlated with WTP values. Regarding the valuation of SD distributions based on the nature of VG, factors such as Age, Distance, VG, Certainty of future incomes, and EF significantly and positively influenced WTP values, while Necessity to protect RH and attainment of formal education negatively influenced deviations across the models.

5.3 Conclusions

In summary, the study concludes that RH protection is benefitial to the well being of the households as evidenced by the positive WTP amounts expressed by the households and the costs saved as a result of the habitat protection. Households surveyed using the SPC format exhibited a preference for paying lower taxes for increased provision of a private good in Nairobi County, contributing to enhanced RH protection. Additionally, several conclusions can be drawn from the study's specific objectives as follows: From objective one, MBDC format generated higher and more variable mean WTP values compared to the SPC format. However, the SPC format appeared to undervalue WTP for RH protection, making it preferable for future valuations. The positive WTP for RH protection was influenced by factors such as Age, Gender, Income, Distance, and perceived Necessity to protect RH. Contextual factors like Land ownership in riparian

areas significantly impacted WTP estimates. Dispersion of WTP estimates was significantly influenced by Distance, Gender, Age, Land ownership within riparian areas, and Income. Transitioning from SPC to MBDC format increased mean WTP, emphasizing the importance of EF in the valuation of RH protection. Objective two found that Raised BR overstated WTP, particularly in the SPC format, which exhibited consistent distributions with lower SD. BR WTP values increased with Age, Distance, College and University education levels, Necessity to protect RH, EF and BR. BR deviations increased with factors such as Distance, Ownership of land within RH but declined with variables like Gender, University education level, Necessity to protect RH, and BR. Objective three established the effect of PV change on valuation estimates by comparing Tax and hypothetical Local Trust Fund for RH protection. Tax showed overstated but consistent WTP values, while trust towards the hypothetical fund was low. WTP increased with Age, Distance, and Certainty of future incomes but decreased with EF and PV. SD varied with regressors such as Age, Distance, Ownership of land within the riparian area, EF, and PV, but declined with the perceived Necessity to protect RH. Objective four explored RH perception as a public or private good, noting higher and inconsistent WTP values for the former and understated values for the latter. Treating RH as private yielded more accurate WTP estimates. WTP for valuation good increased with Age, Distance, Secondary, College and University education levels, Necessity to protect the RH, EF, and VG. Meanwhile, SD increased with regressors such as Age, Distance, Certainty of future incomes, EF, and VG, but declined with factors like Necessity to protect RH and attainment of College and University education levels. These findings underscore the need for tailored RH protection policies considering socio-economic factors and the choice of valuation methods.

5.4 Recommendations

Households in Nairobi exhibited a positive WTP for RH protection, indicating robust support for conservation policies. It is recommended to prioritize the SPC format for RH protection valuations due to its consistent WTP estimates. Additionally, EF estimates could inform downward revisions of future city sanitation fees from the current KES 300 ($1.97) with enhanced RH protection efforts. Demographic factors like education level, income, and age significantly influenced WTP, highlighting the importance of targeted educational campaigns. The Kenya National Environment Management Authority (NEMA) could enhance awareness and support for RH protection by focusing campaigns on youth and less-educated groups. The low participation of women and youth in RH protection also calls for targeted sensitization efforts. Economic empowerment programs for women are particularly encouraged, including involving female-headed households in local women's groups and community-based organizations to foster inclusive decision-making and promote environmental stewardship. Mapping households within riparian areas and promoting eco-friendly land uses near RH can contribute to protection efforts while addressing valuation deviations among landowners. However, both government intervention and active participation from riparian communities are essential to prevent further human encroachment and ensure sustainability. Utilization of a questionnaire design with Lowered BR is recommended, as it is associated with lower mean WTP estimates, which is crucial for methodological consistency in CV studies. Exploring different BR variations could provide deeper insights into household preferences, and Lowered BR estimates could serve as a motivating factor for RH protection by households and entities like Karura Forest. Establishing a voluntary environmental tax fund specifically for RH protection is strongly recommended. This fund, managed by county

governments, would ensure transparency and build public trust, thereby boosting household morale and contributions toward RH protection. While privatizing Kenyan RH for better management is suggested, it is crucial to have government oversight to mitigate potential drawbacks, such as restricted public access. Private entities could be contracted to manage and protect RH, with government oversight to ensure transparency and accountability. The Estimated mean and SD of WTP estimates associated with VG can be used to inform budget and policy proposals for RH protection. Adjustments for socio-demographic characteristics are necessary to ensure equitable resource allocation and address potential biases. Given that viewing the resource as a public good elicited higher and more consistent WTP values, further studies using different data generation formats and environmental goods are encouraged to explore valuation distribution aspects. Addressing methodological challenges, such as biases and consistency in data interpretation across samples, is crucial for achieving reliable results and a deeper understanding of valuation patterns. Suggestions for further research are as follows:

1. Investigate women and youth participation: Given the limited participation of women and youth in RH protection, future studies can focus on understanding the constraints of their involvement in RH protection effort.
2. Explore Tax as PV: Since Tax yielded higher CV estimates and did not lead to objections or protest responses, future studies could explore its use in valuing other environmental goods and services. Comparative studies using split samples and different analytical models can enhance understanding of CV and provide diverse information for decision-makers.
3. Include various variables: Future valuation studies should consider including EF, BR, PV, VG as variables, as they have shown influence on WTP and its SD.

Understanding the tradeoff between understated WTP values and lower SD is essential for decision-making.

4. Consider post pandemic effects: The study was conducted during the pandemic, impacting household finances. Further studies could investigate how post-pandemic conditions affect WTP estimates and household valuations, especially among older demographics.
5. Identify specific RH protection attributes: Further research can focus on determining the specific aspects of RH protection that households are willing to pay for. Understanding these preferences can inform more targeted conservation efforts and policy formulations.

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APPENDICES: APPENDIX I

Questionnaire On Economic Valuation Of RH Protection In Kenya
Name of the administrative area……..……...

Interviewer's name: …….……...
Date:……Phone No.……..……..
Questionnaire category: -1=SPC private status quo, 2=SPC private valuation Tax, 3=SPC private valuation Raised, 4= SPC private valuation Lowered, 5= SPC public valuation Lowered, 6=SPC public valuation Raised, 7=SPC public valuation Tax, 8=SPC public valuation Trust, 9= SPC private Valuation Good public, 10=SPC private Valuation Good private, 11= SPC public Valuation Good public, 12=SPC public Valuation Good private, 13=MBDC private status quo, 14=MBDC private valuation Tax, 15=MBDC private valuation Raised, 16= MBDC private valuation Lowered, 17= MBDC public valuation Lowered, 18=MBDC public valuation Raised, 19=MBDC public valuation Tax, 20=MBDC public valuation Trust, 21= MBDC private Valuation Good public, 22=MBDC private Valuation Good private, 23= MBDC public Valuation Good public, 24=MBDC public Valuation Good private.

Preamble

I am a PhD student in agricultural economics and resource management at Moi University conducting academic research towards my thesis ***"Economic Valuation of riparian habitat protection in Kenya."*** The study is all about knowing the value you would pay for protection of RH in the city of Nairobi. As such, you have been selected, through a random sampling procedure, as one of the persons to participate in this survey. Your answers are voluntary and will be kept strictly confidential and only used for the purpose of this study. Let me take this opportunity to thank you in advance for taking part in this study.

Yours sincerely,

ESTHER MACHANA MAGEMBE

SANR/DPHIL/AE/03/18

To begin with, I would like to ask you the following few questions:

1) Have you ever heard/do you have some knowledge/awareness about riparian habitat protection (enumerator should explain/clarify in local language before the question is answered)? If the individual has no knowledge drop him/her.

1. YES **2. NO**

2) What are the **MAIN** benefits associated with protection of riparian habitats? **Tick one**.

a) aesthetic beauty **b**) recreation and tourism **c)** clean environment free of diseases **d)** clean water for domestic use e**)** social cohesion **f)** reflection of life **g)** spiritual values **h)** control of soil erosion **i)** Any other/specify

3) What are the **MAIN** problems associated with destroyed riparian habitats?

a) loss of property b**)** loss of lifes **c**) diseases, **d**) bad odour **e**) dirty environment **f**) dirty and contaminated water for use **g**) poor scenic sight **i**) increased insecurity **j)** Any other/specify

……

4) Do you think Nairobi suffers from riparian habitat destruction associated problems?

1. YES 2. NO

5) If the answer is **yes**, what is the **MAIN source of** riparian habitat destruction in Nairobi?

A) conflicting laws and acts **b)** effects of human encroachment **c)** poor legal enforcement d**)** effects of climate change

6) Should riparian habitats be protected in your locality? **1. Yes 2. No**

7) From your own understanding, how would you categorize **un protected riparian habitats**? **(Tick one)**.

a) as a political problem **b)** as an economic problem, **c)** as a social problem, **d)** as an environmental problem, **e)** as an individual problem.

8) According to you, problems arising from **un protected riparian habitats** are issues that concern who?

a) Government agencies e.g. NEMA, local authorities, the police. **B)** Non-governmental organizations e.g. owners' associations. **C)** Business

community. **D)** All of us in Kenya. **E)** An individual **f)** Churches **g)** Any other(specify)……

9) What degree of seriousness would you place on the problems associated with **un protected riparian habitats**? **1) Very serious. 2) Serious. 3)Less serious**.

10) What do you think is the level of attention by the concerned authorities with regard to **riparian habitats protection** in Nairobi?

1) They have given **a lot of attention** to the problem. **2)** Only **some attention** to the problem. **3) Not too much attention** to the problem. **4) No attention at all**.

11) Which **ONE** of the following measures should be applied in Nairobi to **protect riparian habitats**?

1) A protection subsidy (**2)** non-protection tax/Penalty 3**)** imprisonment of RH destructors **4)** holding educational campaigns on the need to protect riparian habitats **5)** Demolishing of buildings along riparian habitats **6)** fencing riparian habitats 7**)** discharge of treated effluents to riparian habitats **8)** Any other (specify)……

12) Are you familiar with the WTP scenario/valuation of riparian habitats?

1. Very new **2**. Slightly known **3**. Very familiar **4**. Never heard of it

13) If a ‘’TRUST FUND/TAX FUND’’ is established and an appropriate policy is implemented to riparian habitats protection, would you like to be involved in such a program?

1.Not interested **2**. Depends on program **3**. Very interested

14) For appropriate riparian habitat protection policy, finance is essential. So, if a “**TRUST FU ND”** would be established, and the account is transparent to everyone, would you like to donate some money per month for the policy?

1.Not interested **2.** Depends on program/policy **3**. Very interested

15) If **VERY INTERESTED (from Qn 14 ABOVE),** how much would you be willing to contribute to the established **TRUST FUND/Year**? ……

16) Suppose the established **TRUST FUND** will be geared towards protection of riparian habitats, what will be your preferred level of protection? **(show the picture)……..**

No protection

25% Protection

50% Protection **75% Protection**

17*)* *How much will you be willing to pay for that preferred level of protection (**in qn 16**), and with what level of certainty? if it meant that you will contribute **KES. X** into the special fund per year? How much will you pay?.....*

Please it is very important to first think of your monthly income and expenditure on other basic items before suggesting which price your household would be WTP towards RH Protection. Suppose the amounts given on the left hand column (in KES) indicate an

increase in household expenditure (assuming once per year), to help finance the implementation of the RH Protection in Nairobi, how likely is it you would vote for a plan to help implement the new scheme in Nairobi?

Please indicate the level of certainty by circling the probability to pay each one of the amounts shown in the table below).

Bid KES)	**Definitely yes**	**Probably yes**				**Not sure**	**Probably no**				**Definitely no**
0	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0
50	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0
100	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0
150	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0
200	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0
250	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0
300	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0
350	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0
400	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0
450	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0
500	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0
550	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0
1000	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0
1950	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0
2000	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0

18) If the answer to question **(17)** is KESs. 0 (**Zero**), which of the following reasons best describes why you would "not" be willing to pay anything to the special trust fund to protect riparian habitats?

1) Because riparian habitat protection has no value to me.
2) Because it is the responsibility of the Government.
3) Because I have many other basic financial commitments.
4) Because that is the work of those who pollute

19) If the policy manages to protect the riparian habitats (either by proper management or reduced degradation), how would you change your WTP?

1.Decrease **2**. Remain unchanged **3**. Increase.

20) If increase or decrease in **QN 19** Above, by what percentage would you be willing to change?

a). 10% **b)**. 25% **c)**. 50% **d)**. 75% **e)**. 100%

21) Indicate one of the following methods that you feel would be fairest and convenient for you in making your contribution towards riparian habitat protection promotion policy in Nairobi?

a) Donations e.g. labour. **b)** Special Trust fund e.g. an account managed by trustees, **c)** Amenity bills e.g. amount to be paid added to water bills, electricity bills, **d)** Some environmental Tax deducted straight from my income/on purchase of local items. **e)** Along with childs school fees, **f)** Along with insurance premium, g**)** Direct bank deposit, **i)** Cash, **j)** Mpesa **K)** Others. Indicate……..

Section C

22) This section concerns personal data of the respondents as related to the study.

Indicate the responses in the response box.

Variable	Description	Measurement	Response
a) Age	What is the age of the household head?	Years (continuous variable)	
b) Gender	What is the gender of the head of the household?	1= Male 0 = otherwise	
c) Education	What is the highest level of formal schooling attained by the head of the household?	0=None,1=Primary,2 =Secondary,3=Colleg e,4=University)	
d) Income	What is the monthly income level of the household head?	Amount in Ksh. (continuous variable)	
e) Household size.	what is the number of adults and children feeding from the same source	Numbers (continuous variable)	
f) Distance household head resides from the nearest RH	what is the distance to the nearest RH from where household resides/farms/does business?	Distance in Metres (continuous variable)	
g) Special trust/Tax fund.	Is the household head confident about the hypothetical trust/tax fund used as the payment vehicle for the WTP amount?	1= Yes 0 = Otherwise	
h) Knowledge.	Does the household head know the effects associated with degradation of RH such as flooding, low property values?	1= Yes 0 = Otherwise	
i) Necessity.	Does the household head find it necessary to control degradation in order to protect RH?	1= Yes 0 = Otherwise	
j) Certainty of future income	Is the household head certain about her future income for the next one year?	1= Yes 0 = Otherwise	
k) Land ownership	Does the household own land within the riparian?	0=None, 1= Leasehold 2 = freehold	

THANK YOU FOR YOUR COOPERATION

QUESTION 17:- FOR MBDC CARD

Q17) *What would you be willing to pay and with what level of certainty for the new policy geared towards protection of riparian habitats by by* ***x% in Nairobi (show picture to respondents****) if it meant that you will contribute* ***KES. X*** *into the special fund per year? How much will you be WTP to the fund?.....*

Please indicate the level of certainty by circling the probability to pay each one of the amounts shown in the table below.

Bid	**Definitely yes**	**Probably yes**				**Not sure**	**Probably no**				**Definitely no**
0											
50											
100											
150											
200											
250											
300											
350											
400											
450											
500											
550											
1000											
1950											
2000											

QUESTION 17:-BID RANGE FOR MBDC LOWERED &RAISED

Bid lowered	Bid Raised	Bid Raised	Definitely yes	Probably yes				Not sure	Probably no				Definitely no
0	0												
45	55												
95	105												
145	155												
195	205												
245	225												
295	305												
345	355												
395	405												
445	455												
495	505												
545	555												
995	1005												
1945	1955												
1995	2000												

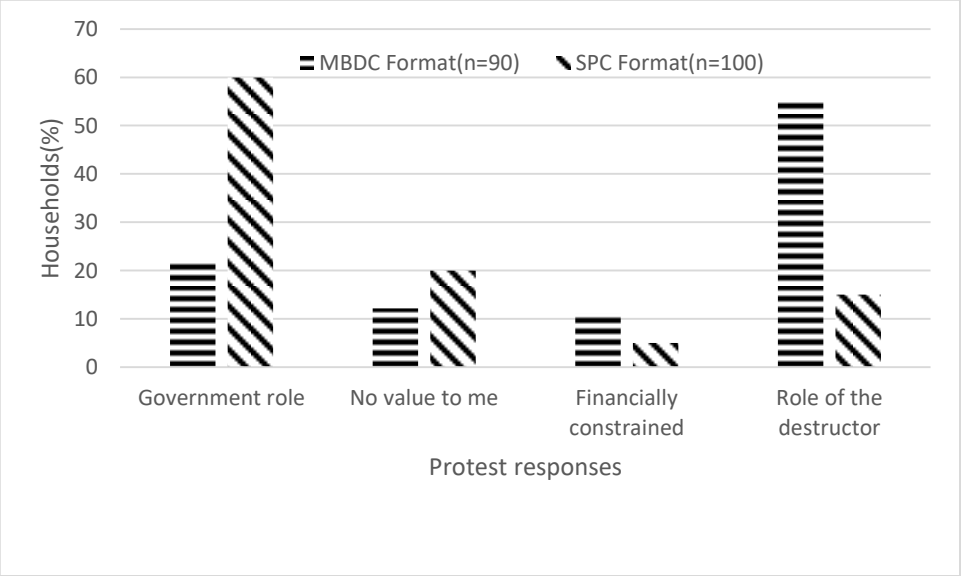
N/B: If collecting data for bid range lowered, enumerators must shadow bid range increased column and vice versa.

QUESTION 17:-BID RANGE FOR SPC VARIED-INCREASED, LOWERED

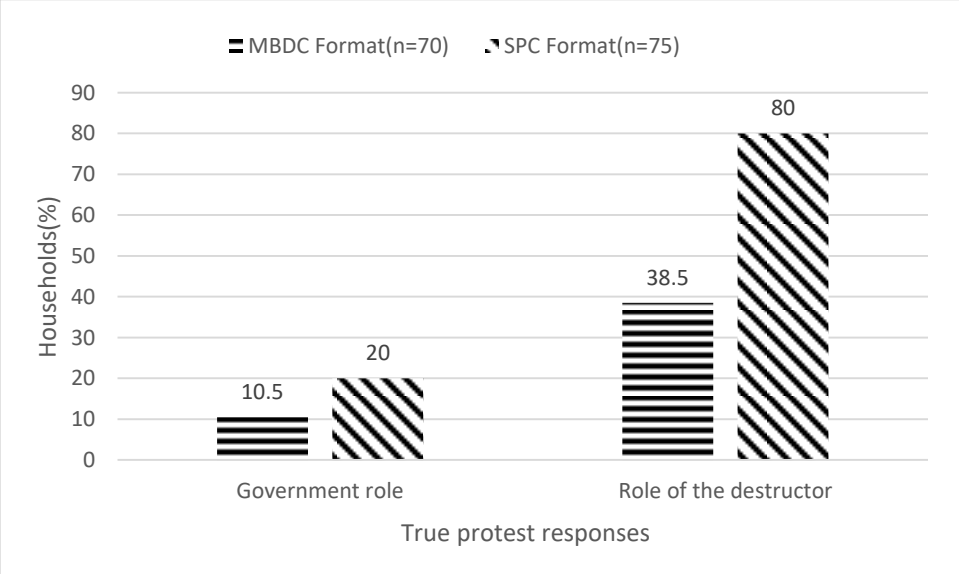
Bid Increased	Bid lowered	Definitely yes	Probably yes				Not sure	Probably no				Definitely no
0	45	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0
55	95	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0
105	145	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0
155	195	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0
205	245	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0
225	295	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0
305	345	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0
355	395	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0
405	445	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0
455	495	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0
505	545	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0
555	995	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0
1005	1945	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0
1955	1995	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0
2000	45	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0

If collecting data for bid range lowered, enumerators must shadow bid range increased column and vice versa.

APPENDIX B
OTHER RESULTS ON INVALID RESPONSES NOT FOUND IN THE MAIN TEXT
APPENDIX B1: Results on Protest Responses of SPC and MBDC Formats Not Presented in the Main Document.



APPENDIX B2: Results on True Protest Responses of SPC and MBDC Formats Not Presented in the Main Document.



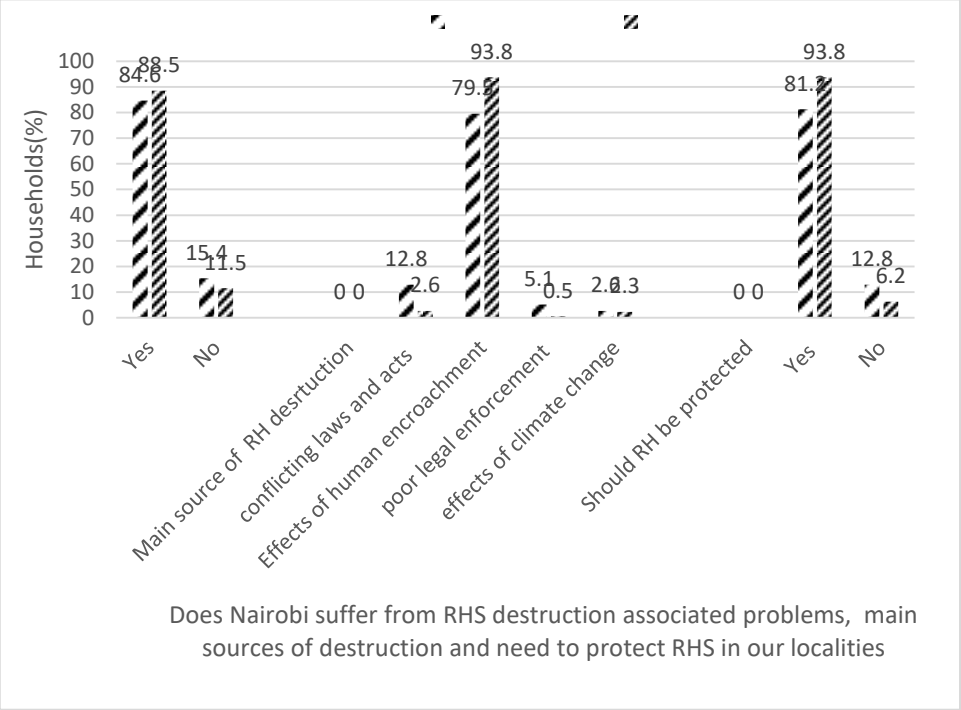
APPENDIX B3: Results On Invalid Responses of SPC And MBDC Formats

Independent Variables.

Characteristics	**SPC valid responses (n=390)**		**SPC invalid responses (n=116)**			
	Mean/Proportion	**Std error**	**Mean/proportion**	**Std error**	**t value**	**Chi-Square test value**
Age (Years)	36.692	0.433	37.258	0.473	0.678	
Income (KES)	32,092	25,305	31,908	25,121	1.028	
Distance (Metres)	3.009	1.576	3.340	0.151	-1.384	
Household size	3.862	0.078	3.931	0.163	-0.438	
Gender(1=Male)	0.644	0.024	0.647	0.044		0.008
Education						
0=Informal educ	0.092	0.036	0.0340	0.017		0.001
1= Primary	0.138	0.043	0.112	0.030		0.018
2=Secondary	0.169	0.047	0. 138	0.032		0.022
3=College	0.231	0.053	0.276	0.041		-0.032
4=University	0.369	0.060	0.439	0.046		-0.050
Certainty of future incomes(1=Yes)	0.479	0.025	0.534	.047		1.039
Necessity to protect RH (1=Necessary)	0.944	0.012	0.956	0.019		0.564
Ownership of land within riparian (1=Yes)	0.218	0.021	0.250	0.040		0.724
	MBDC valid responses (n=384)		**MBDC invalid responses (n=110)**			
	Mean/Proportion	**Std error**	**Mean/proportion**	**Std error**	**t value**	**Chi-Square test value**
Age (Years)	38.153	0.488	37.990	0.923	0.157	
Income (KES)	50,444	44,222	49,452	43,230	1.439	
Distance (Metres)	3.949	2.576	3.840	0. 058	-1.440	
Household size	3.896	0.088	3.990	0.155	-0.518	

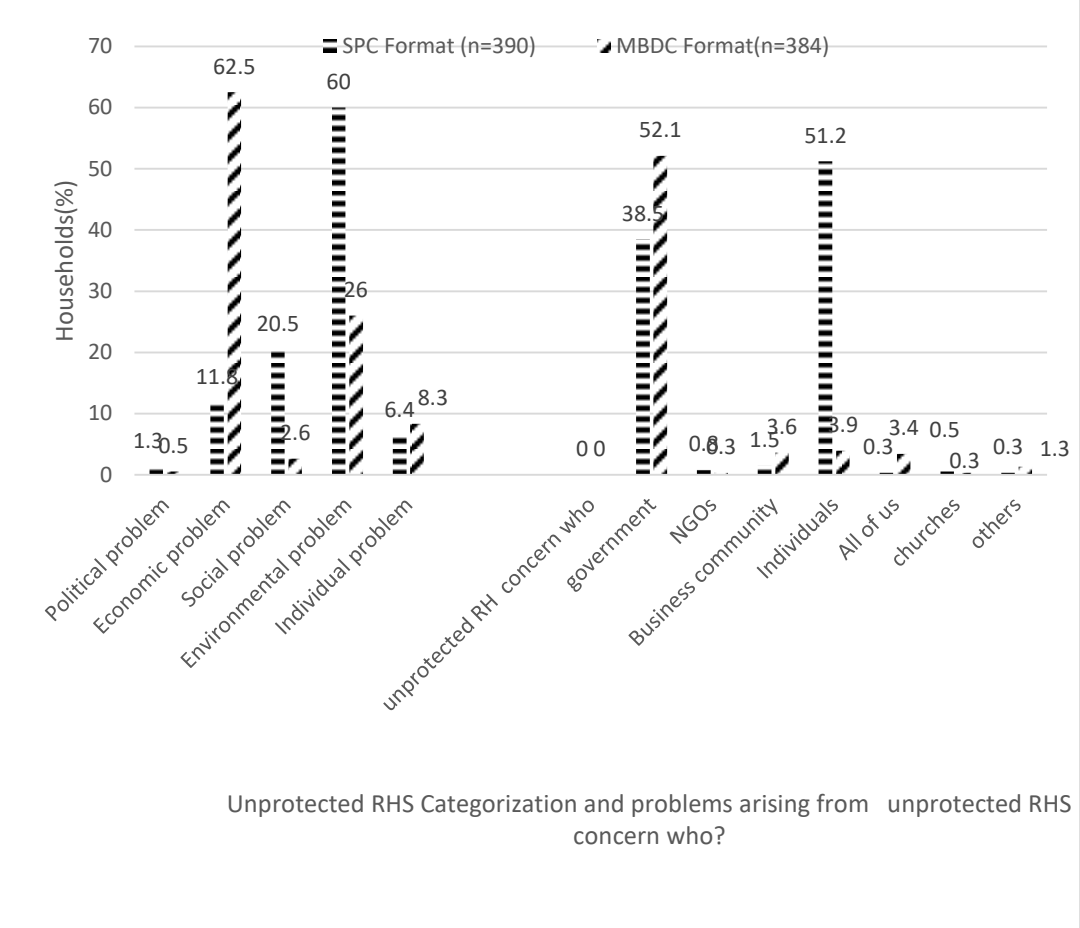
Gender (1=Male)	0.622	0.025	0.654	0.045	-0.615
Education					
0=Informal educ	0.010	0.005	0.009	0.009	0.001
1= Primary	0.135	0.017	0.110	0.029	0.493
2=Secondary	0.284	0.023	0.284	0.043	0.000
3=College	0.349	0.024	0.358	0.046	-0.006
4=University	0.221	0.021	0.2385	0.046	-0.013
Certainty of future incomes(1=Yes)	0.479	0.026	0.473	0.041	0.119
Necessity to protect RH(1=Necessary)	0.945	0.011	0.936	0.023	0.357
Ownership of land within riparian (1=Yes)	0.258	0.022	0.255	0.041	0.069

APPENDIX C
RESULTS ON GENERAL INFORMATION CONCERNING RIPARIAN HABITATS NOT FOUND IN MAIN TEXT
APPENDIX C1: ***Is Nairobi County Facing a Problem With Riparian Habitat Destruction? If So, What Is The Main Cause of This Issue? Should Riparian Habitats Be Protected In Your Local Area***?

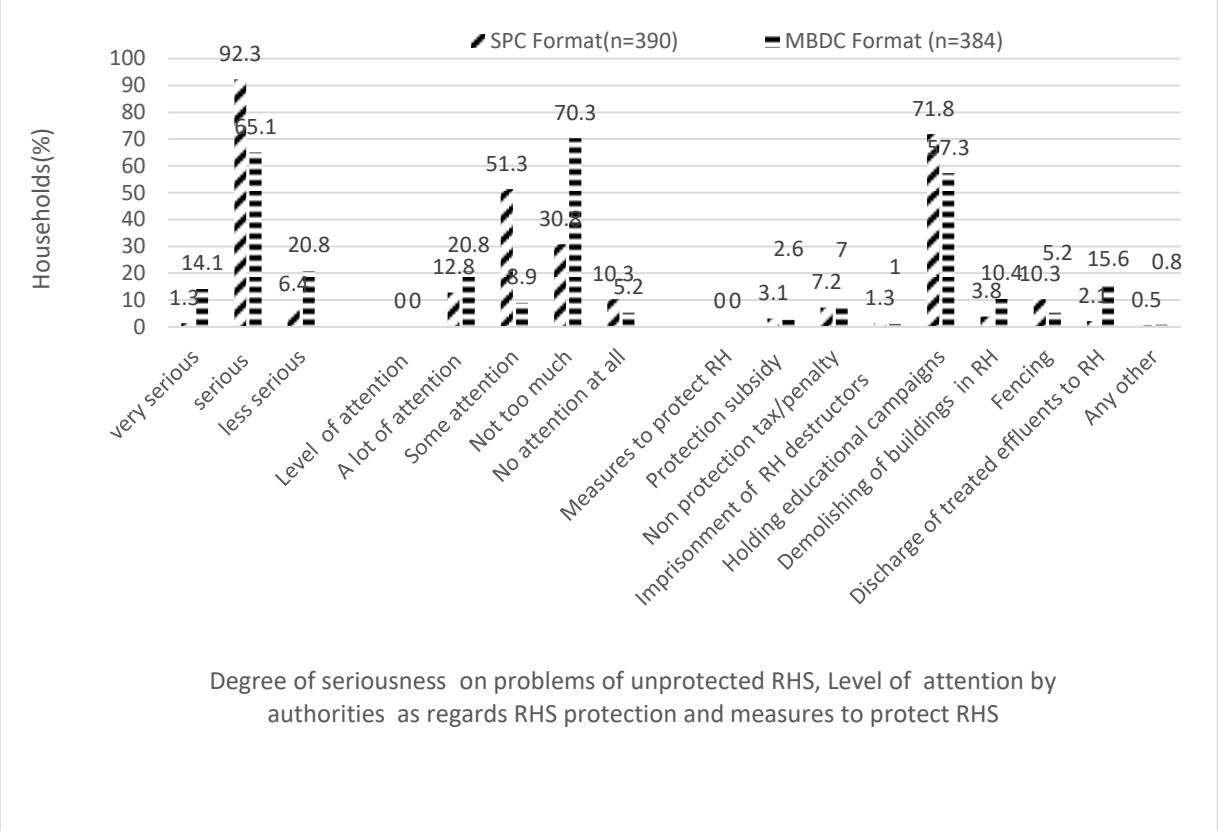


Does Nairobi suffer from RHS destruction associated problems, main sources of destruction and need to protect RHS in our localities

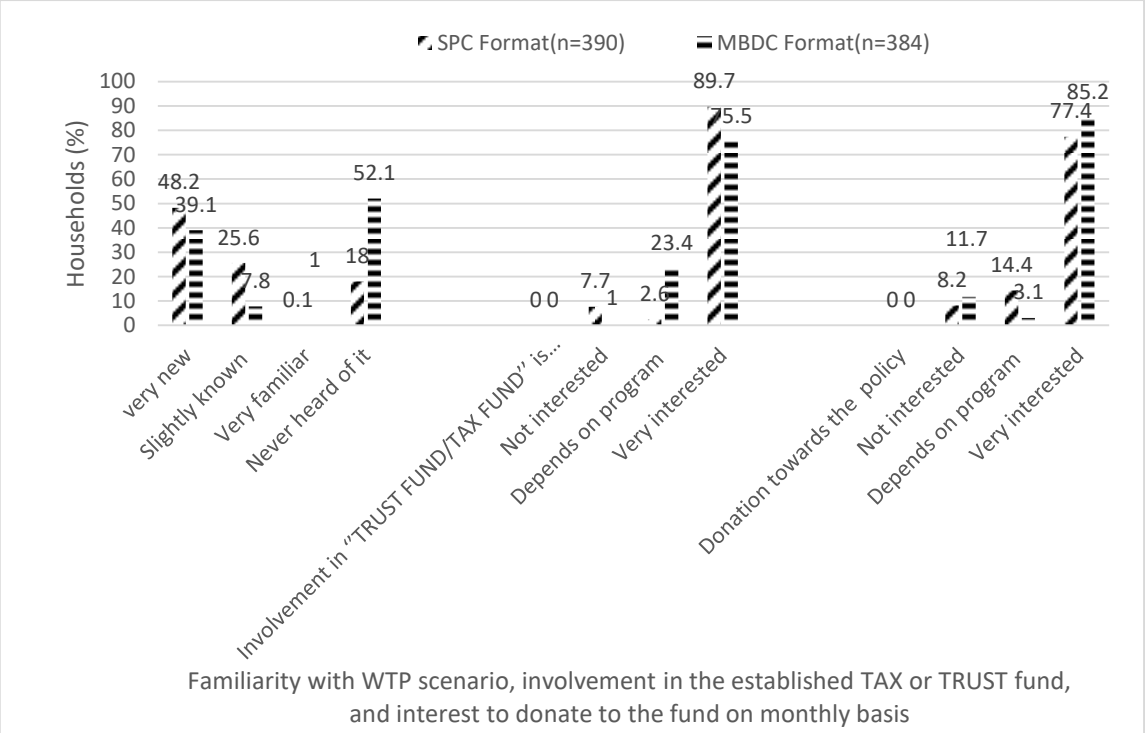
APPENDIX C2: ***Categorization Of Riparian Habitat Destruction Problems: Who Is Concerned With Issues Associated With Unprotected Riparian Habitats?***



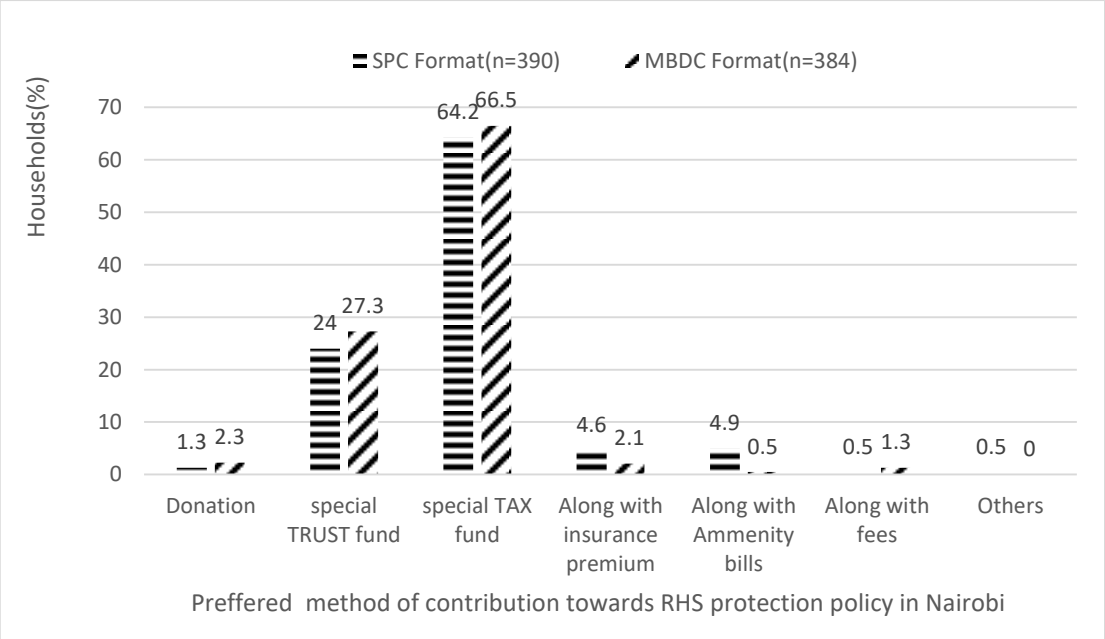
APPENDIX C3 : ***Degree of Seriousness of Problems Related to Unprotected Riparian Habitats, Level of Attention Given by Authorities to Riparian Habitat Protection, and Measures to Protect Riparian Habitat*.**



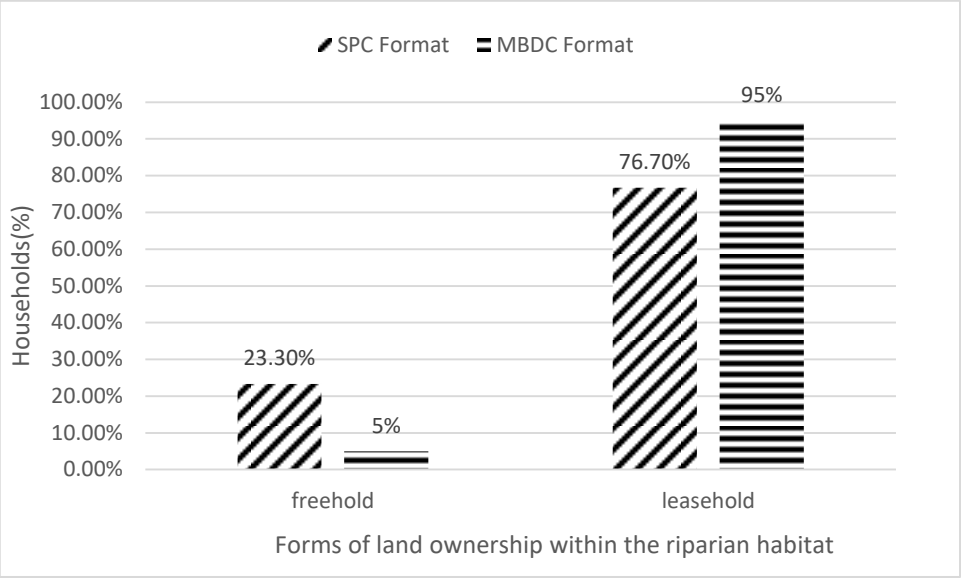
APPENDIX C4 : ***Familiarity with the WTP Scenario, Involvement in the Established Fund, and Monthly Contribution to the Fund*.**



APPENDIX C5: Households Convenient And Fairest Mode of Payment Towards the Established Hypothetical Fund.



APPENDIX C6: Forms of Land Ownership In SPC and MBDC Formats



APPENDIX D

Moi University Introductory Letter

MOI UNIVERSITY
(ISO 9001:2015 CERTIFIED INSTITUTION)

SCHOOL OF AGRICULTURE AND NATURAL RESOURCES

Tel: (020)2680945
Fax: 5343047
E-mail: deansanr@mu.ac.ke,
ernestsaina2017@gmail.com

P.O. Box 3900-30100
Eldoret – Kenya
deansanr@gmail.com

RE: SANR/DPHIL/AE/03/18 **DATE:** 26TH SEPT, 2019

TO WHOM IT MAY CONCERN

RE: ESTHER MACHANA MAGEMBE - SANR/DPHIL/AE/03/18

The above named is a bonafide postgraduate student of Moi University in the School of Agriculture and Natural Resources.

She is undertaking her Doctor of Philosophy Degree programme in Agricultural Economics and Resource Management.

Esther has completed coursework ;successfully defended her proposal and now proceeding to the field for data collection.The research title: ECONOMIC VALUATION OF RIPARIAN HABITAT PROTECTION IN NAIROBI COUNTY KENYA

The research will be contacted in Arboretum, karura forest, gikombaa, mkuru kwa njenga, mkuru kwa reuben, kariobangi, kileleshwa, ngong racecourse, Grogan, kibera, langata, Lavington, Kilimani, uhuru park,Mathare, Michuki Park, Mlango Kubwa and Kariobangi for a period of 7 Months

Any assistance accorded to her will be highly appreciated.

Thanks

DEAN
SCHOOL OF AGRICULTURE
AND NATURAL RESOURCES
MOI UNIVERSITY
Date .....

DR.ERNEST SAINA
DEAN, SCHOOL OF AGRICULTURE AND NATURAL RESOURCES

APPENDIX E: Research Permit

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **512273**

Date of Issue: **15/December/2023**

RESEARCH LICENSE

This is to Certify that Ms.. Esther Machana Magembe of Moi University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Nairobi on the topic: Economic valuation of riparian habitat protection in Kenya for the period ending : 15/December/2024.

License No: **NACOSTI/P/23/31705**

512273

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

See overleaf for conditions

APPENDIX F: Plagiarism Awareness Certificate

SR476

ISO 9001:2019 Certified Institution

THESIS WRITING COURSE

PLAGIARISM AWARENESS CERTIFICATE

This certificate is awarded to

MAGEMBE MACHANA ESTHER

SANR/DPHIL/AE/03/18

In recognition for passing the University's plagiarism

Awareness test for Thesis entitled: **ECONOMIC VALUATION OF RIPARIAN HABITAT PROTECTION IN NAIROBI COUNTY KENYA** with similarity index of 4% and striving to maintain academic integrity.

Word count: 54194

Awarded by

Prof. Anne Syomwene Kisilu
CERM-ESA Project Leader Date: 04/04/2024