"ECONOMIC VALUATION OF WETLAND ECOSYSTEMS: A CASE STUDY OF ONDIRI SWAMP IN KIAMBU, KENYA"

BY

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NOVEMBER 2005

DECLARATION

I DECLARE THAT THIS IS MY ORIGINAL WORK AND IT HAS NOT BEEN SUBMITTED FOR EXAMINATION IN ANY OTHER UNIVERSITY

19.12.05

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THIS PROJECT REPORT HAS BEEN SUBMITTED FOR EXAMINATION WITH OUR APPROVAL, AS UNIVERSITY SUPERVISORS.

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DEDICATION

To the friend that sticks closer than a brother:

who read my thoughts,

has seen my challenges,

made all grace and sufficiency abide and

brought to pass this piece of work.

To Him be the GLORY.

And to

James, Bernice, Amy and Jonathan.

This is ours.

ABSTRACT

The main purpose of this study was to establish the economic value of Ondiri swamp. Apart from determining the available resources and services provided by the wetland, the study further attempted to append value to the swamp as option value under the Total Economic Value (TEV) Framework. The Contingent Valuation Method (CVM) was used to establish how much the residents were willing to pay for the conservation of the swamp.

The study focused on households within the Kikuyu Township sub-location within which the swamp is located. This was due to the fact that these were the people who are likely to benefit most from the swamp or be most affected as a result of its degradation. A sample size of 94 was chosen from households both from rural and urban enumeration areas and from the swamp site. Both primary and secondary data was used. Face to face interviews and field observations were employed in data collection. The main challenge of this study was to provide sufficient incentives for respondents in order for them to come up with a realistic payment (WTP). There was qualitative and quantitative analyses of the data with the aid of the SPSS (Statistical Package for Social Scientists) technique. Simple descriptives such as averages and percentages were used and advanced statistical analysis undertaken to determine the correlation and regression of data variables.

The study estimated the value of Ondiri swamp at about Kshs. 1.5 million. The study established that Ondiri swamp provides various resources and services to the people living in its environs with water supply being the key among them. It further outlined that there were no restrictions on the exploitation of the Wetland resources at Ondiri Swamp. The study established that the swamp operates as a common property resource and this threatens the future existence of the wetland ecosystem. It is notable that the residents were willing to pay for the conservation of the swamp. It was however disappointing to register that the education level attained was not a significant determinant of the peoples' willingness to pay for the conservation of Ondiri swamp. The study therefore recommends that a community based management plan for the swamp be established to

ensure sustainable utilization and effective conservation programmes. A future study on the total economic value of the swamp is also recommended.

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I am greatly indebted to my family. Thanks to my husband James for his encouragement, financial and moral support throughout the course. I appreciate your sacrifices and your commitment to pick me up every evening after my classes. I appreciate my children Bernice Amy and Jonathan for your understanding and support as I studied.

To all of you I say may the Lord remember you.

LIST OF ABBREVIATIONS AND ACRONYMS

BV - Bequest Value

CBA - Cost Benefit Analysis

CVM - Contingent Valuation Method

DC - Dichotomous Choice

DUV - Direct Use Value

GOK - Government of Kenya

H_0 - Null Hypothesis

H_1 - Alternate Hypothesis

HPFM- Health-Production-function-Method

HPM - Hedonic Pricing Method

IUCN - The World Conservation Union

IUV - Indirect Use Value

KWS - Kenya Wildlife Service

NUV - Non-Use Value

OE - Open Ended Elicitation method

OECD- Organization for Economic Cooperation and Development

OV - Option Value

PC - Payment Card Elicitation method

RAMSAR- Ramsar Convention on Wetlands of International Importance

SPSS - Statistical Package for Social Science

TCM - Travel Cost Method

TEV - Total Economic Valuation

UV - Use Value

WTA - Willingness to Accept

WTP - Willingness to Pay.

XV - Existence Value

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CHAPTER ONE

INTRODUCTION

1.0 Introduction

This chapter outlines the background information of the study of the economic valuation of wetland ecosystems: a case study of Ondiri swamp. This includes the statement problem, the study objectives, research questions, justification of the study, assumptions of the study., scope and limitation of the study.

1.1 Overview of Wetlands

Wetlands are ecosystems or units of the landscapes that are found on the interface between land and water. While water is a major factor of wetlands definition (Ramsar Convention 1996), soils, vegetation, and animal life also contribute to their unique characteristics (Roggeri, 1995). The Ramsar Convention on Wetlands of International Importance especially as waterfowl habitats defines 'wetlands' in its Article 1 as "areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters" (Dugan, 1990). The Ramsar Convention recognizes five major wetland systems (Ramsar Convention, 1996), which include:-

- Marine (coastal wetlands)
- Estuarine (deltas, tidal marshes, and mangroves);
- Lacustrine (lakes and associated wetlands);
- Riverine (rivers, streams and associated wetlands).
- Palustrine (marshes, swamps and bogs)

Wetlands are distributed all over the globe and are estimated to cover about 6% of some 5.7 million km^2 of the earth's surface (Maltby, 1986). Although Africa is best known for

its savannahs and hot deserts, 1% of its surface area (345,000km²) is covered by wetlands.

Dugan (1990) explains that wetland values are best understood in terms of their intrinsic conditions (biological, chemical and physical), which allow them to carry out their distinctive functions and generate a wide range of products. Their functions comprise those natural procedures that sustain economic activities and fortify ecological integrity. Examples are groundwater discharge and recharge, flood control, shoreline stabilization and nutrient retention. Besides water being the most basic product that a wetland can provide, food, fuel wood, wildlife, fisheries, forage and agricultural resources are additional wetland products of importance (Roggeri, 1995).

Wetlands have been described both as "the kidneys of the landscape," because of the functions they can perform in the hydrological and chemical cycles, and as "biological supermarkets because of the extensive food webs and rich biodiversity they support (Mitsch and Gosselink, 1993). Wetlands are among the earth's most productive ecosystems. They directly support millions of people and provide goods and services to the world outside the wetlands.

Only about 2.6% of the world's water is fresh and only a fraction of the world's fresh water is available for consumption because so much of it is locked up in polar icecaps and glaciers. Fresh water resources are a finite, but global consumption rates are known to increase 2-3% every year. Wetlands are therefore the main custodians of these valuable water sources. They act as 'banks' from where water may be drawn, and ground water replenished. Wetlands are many things, to many people once they are understood and appreciated as valuable ecosystems.

1.2 Background to the Research Problem

Throughout human history, the term wetlands, conjured up for many people a swamp full of slimy creatures, harbouring diseases such as malaria and schistosomiasis. Indeed it is this view of wetlands as wastelands that has led to extensive drainage and conversion of

wetlands for intensive agriculture, fishponds, industrial or residential land. The view that wetlands are wastelands has resulted from ignorance or misunderstanding of the value of the goods and services they supply.

Wetland areas suffer in many ways due to developments from elsewhere. They are commonly taken over or encroached upon for their uses, and are damaged or destroyed indirectly by pollution or other forms of interference. Sometimes the damage is an unavoidable result of pressures of land, but in many other cases it happens because the value of wetlands is either-hidden, misunderstood or unappreciated. Wetlands are very sensitive to anything that alters the characteristics of the water flowing in, or changes its level. Hence they are disturbed by such developments as upstream river basin development (damming, irrigation, drainage) or the construction of impoundments to surface run-off (roads, or radical changes to land use), (Winpenny, 1991).

In the past, wetlands have been undervalued because many of the ecological services, biological resources and amenity values, they provide are not tradable and hence are difficult to price. However, in recent years there has been increasing awareness of the fact that natural wetlands provide many valuable functions and attributes free of charge.

Economic valuation is an attempt to assign quantitative values to the goods and services provided by environmental resources, whether or not market prices are available or not.. There must be a mechanism whereby goods and services, and in turn natural resources can be utilized, exchanged, and valued within society. In most cases the "value" set, is its price. Valuation is important because it is a reminder that the environment is not 'free' even though there may be no conventional market for its services. It measures the rate at which environmental resources are being used up and signals the growing scarcity to their users.

Today, most planning and development decisions are made on economic grounds and more and more, on the basis of the forces at play in the free market system. While this new paradigm has its own limitations, and dangers, it would be unrealistic to ignore it and to have our quest for the conservation and wise use of wetlands on a completely

different set of values. Decisions affecting wetlands are frequently made on economic and financial grounds. The attitude that wetlands are practically worthless will only disperse as knowledge of their functions become more widespread and attempts are made to place economic values on them. If wetland conservation is to compete on equal terms with alternative land uses, a quantitative value for wetland components functions and attributes needs to be calculated. This can be achieved by defining the direct and indirect uses and non-use values of wetlands, including people's willingness to pay for their services.

Economic valuation can be useful at a number of levels including impact of specific development, making choices between options and setting regional or national policy. By providing a means for measuring and comparing the various benefits of wetlands, economic valuation can be a powerful tool and improve wise use and management of global wetland resources. The Ramsar Convention is promoting new methods of economic valuation to demonstrate that wetlands are valuable and should be conserved and wisely used.

1.3 Problem Statement

While wetlands are amongst the most productive ecosystems on earth, they are today facing a severe threat to their continued existence from encroaching human development activities. Most of the threats that wetlands face result from their misuse and related unsustainable extraction of natural resources. As a result, many wetlands are temporary features that disappear, re-appear and recreate themselves over time (Barbier *et al* 1997).

In the case of Ondiri swamp, there has been increased demand for its use as a source of water. Many boreholes have been sunk in the area surrounding Ondiri swamp as it replenishes the underground water resources. There has been unchecked utilization of resources by communities surrounding the swamp. One household can harvest about 200kg per day of grass for livestock, some of which may go to waste (Okong'o and Njumbi, 1999). Ondiri swamp also faces threats of water over- extraction. Excessive

harvesting could reduce future yields of the product or even damage the wetland's ability to full-fill other important functions.

Population growth as well as increased economic activity is a sure way of increasing pressure on natural resources and eco-systems such as the Ondiri swamp. The sustainability of these resources as well as the benefits derived from the swamp is threatened by human activities around the swamp (Gichuki, 1998).

The major reason for excessive depletion and conversion of wetland resources is often the failure to adequately account for their non-market environmental values. There is need to build up enough information about wetland resources at Ondiri swamp to determine their value and the scale of threats against them. What is necessary therefore is to define clearly, assess, and identify the costs and benefits of various wetland uses so that decisions can be taken in objective terms and the implementation of environmental policies harmonized with economic policy objectives. It is important to underscore here that wetland valuation is not an end in itself but a means to achieve sustainable wetland management by ensuring that wetland contributions to our national economy is recognized, and the seriousness we attach to wetland conservation is commensurate with this contribution.

This study attempts to carry out an economic valuation of the swamp environment in respect to option value as a guide to decision makers. The study considered the value of the environmental assets of Ondiri swamp where exclusion is not possible by the consumer. In this case a mechanism was used to infer values through asking individuals directly through contingent valuation techniques how much they would be willing to pay (WTP) for the conservation of the particular site and species.

1. 4 Objectives of Study

This research addressed three specific objectives and one hypothesis as follows:

1.4.1 Overall Objective

The broad objective of the study was to investigate the economic value of Ondiri swamp and the possibility of its conservation.

1.4.2 Specific Objectives

a. To determine the available resources and ecological services.
b. To identify the use of resources and ecological services
c. To estimate the community's minimum willingness to pay (WTP) for the conservation of Ondiri swamp.

1.4.3 Hypothesis

H_o There will be a relationship between willingness to pay (WTP) and the level of education.

H_1 There will be no relationship between willingness to pay (WTP) and the level of education.

1.5 Assumptions

i. The researcher expected to collect information within the stated period and was able to collect the expected data that made it possible to complete writing the project report.
ii. The researcher expected positive responses from the respondents.
iii. The researcher assumed that the respondents filled in the questionnaires accurately and promptly.

The researcher expected a hundred percent response from the respondents.

1.6 Justification of the Study

At its meeting in Brisbane, Australia, in March 1996, the Conference of the Parties to the Ramsar Convention on Wetlands approved a strategic plan that recognizes the

importance and urgency of carrying out economic valuation of wetlands. According to operational objective 2.4 of the strategic plan, the Ramsar Convention will promote the economic valuation of wetland benefits and functions through dissemination of valuation methods. This study attempts to value the Ondiri swamp in adherence to that objective.

Ondiri swamp is one of the few highland bogs remaining on the eastern margins of the rift valley in central Kenya. The Ondiri catchment area is located in a high potential area in terms of agricultural productivity. The area supports a large number of people within the Kikuyu town area as well as adjacent trading centres in the outskirts of Nairobi. The high potential of the area is mainly derived from the swamp as an important economic source. The swamp also provides fodder to livestock during dry seasons (GOK 1997). The economic and ecological arguments for its conservation basically derive from its value as a source of "clean" water. The swamp is also an important source of the threatened Nairobi River which runs through the city of Nairobi.

Ondiri swamp is a very important resource in view of the benefits that the people around it derive. It is therefore necessary to use the swamp in a sustainable manner. Unfortunately, most research projects and case studies on wetlands in Kenya are mainly contributed by biological scientists (Njuguna, 1982) with a bias towards the technical eco-hydrological aspects of wetlands and not the socio-economic aspects.

This study was therefore intended to provide an insight on the value of the swamp as revealed by the local people. This is because economic valuation is concerned ultimately with the allocation of wetland resources to improve human welfare. It is hoped that the study will contribute towards the natural wetland policy, which is expected to promote the conservation of Kenya's' wetlands in order to sustain the ecological and social-economic functions now and in the future. Considering that the southern by pass is likely to affect the Ondiri swamp the findings of the study could guide planners and decision makers in making appropriate choices concerning the management of the wetland resources. The findings of the study will also provide valuable information upon which a management plan for Ondiri swamp may eventually be developed. The results will also be used in future District Development Plans to help the local community in preserving

their valuable wetland. Finally apart from contributing towards National Wetlands Inventory, the outcome of the study may be used for further research and educational purposes.

In summary, the main questions that this research addressed were as follows:

i. What ecosystem goods and services are provided by the Ondiri swamp ?
ii. Which are the key use values of Ondiri swamp to the people living near the wetland?
iii. What is the economic value of the conservation of Ondiri swamp?

1.7 Description of Study Area

The Ondiri swamp is found in Kikuyu division of Kiambu district (Map 1) lying between latitude 0^0 54' and 36^0 85' East in Central Kenya. Ondiri swamp occurs in a tectonic depression as is common on the lower slopes of the Nyandarua – Aberdare ranges (Gichuki 1998).The swamp is located on the Kikuyu slope of the eastern margins of the Rift Valley in Central Kenya (Map 2). The swamp lies at an average altitude of 1800 m and one kilometre down the slope from Kikuyu Township. The average area of the swamp is approximately 15 hectares. This size of the swamp changes regularly due to flooding and subsequent receding of the water level from the outermost edges. This is referred to as the process of natural drawdown. During the drawdown the water level falls considerably and some expanse of land is exposed.

Ondiri is a quaking bog and a permanent swamp. The depression within which the swamp occurs was probably formed due to reversed faulting during or after the formation of the Rift Valley (Nyamweru 1992). Among other wetlands occupying small troughs in the neighbourhood are Lari, Nyakumu, Riu and Limuru swamps. Ondiri swamp receives water from rainfall, three small streams, several springs located at the edges of the swamp, and run-off from the adjustment catchment area (Gichuki 1998). However most of the water is supplied through underground seepage from the outer margins of the Aberdares. During the dry season swamp water needs are high and the water is more silted, while during the wet season the water is cleaner and of a larger quantity. The water

level in the swamp is receding as a result of a number of factors such as over-harvesting of water for agricultural, industrial and domestic purposes; hydrological drought; and falling of the water table around the catchment areas. Some of the factors are not directly or indirectly connected to the swamp.

1.7.1 Biodiversity

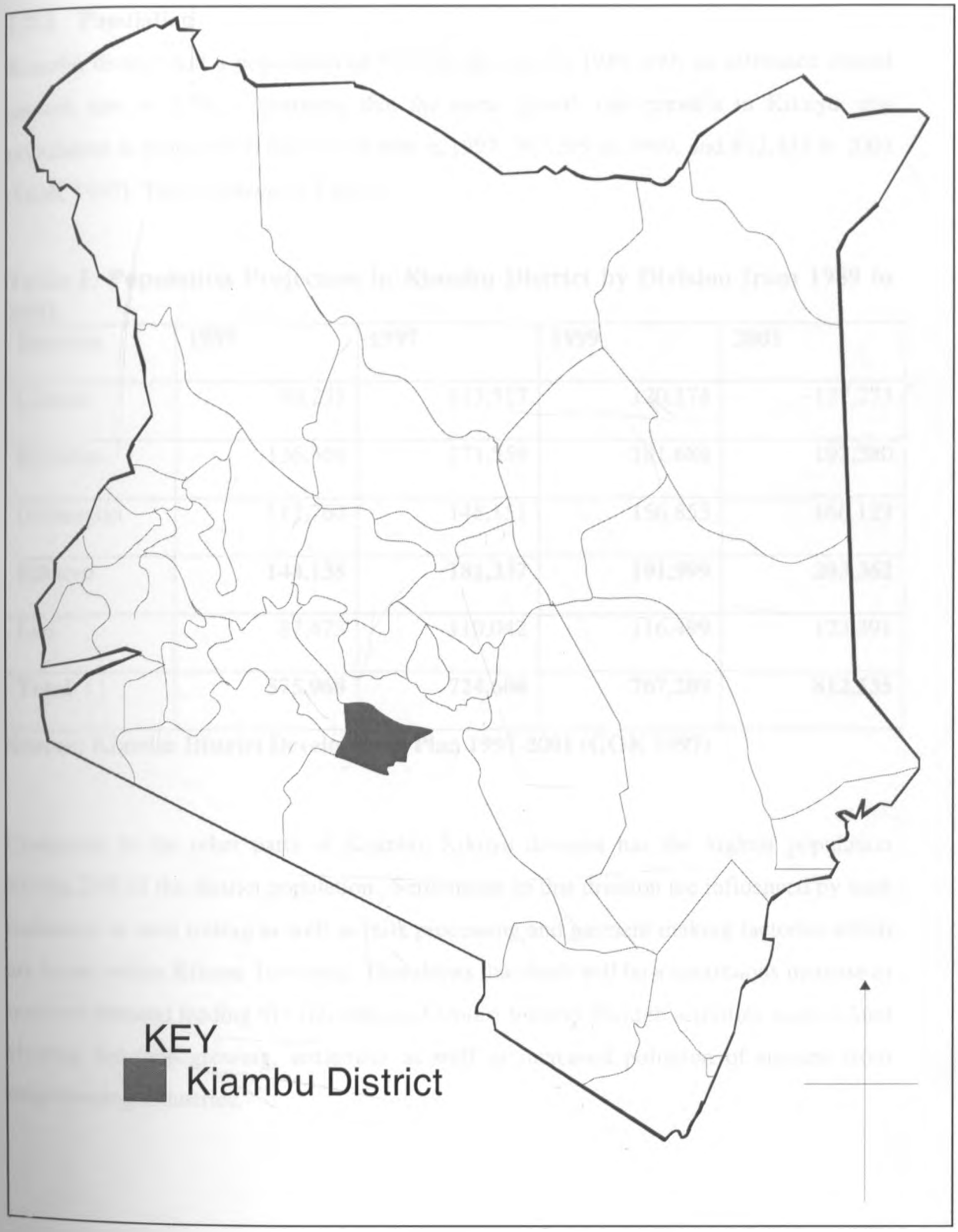
Ondiri swamp has a diverse community of herbaceous aquatic plants, and rich animal species. Sixty-eight plant species and seventy-four bird species have been recorded in the swamp. Some bird species include Cattle Egret, Sacred Ibis, Hadada Ibis and African Marsh Harrier. Small mammals, reptiles, and amphibians have also been recorded. Small mammals including otters, frogs and several invertebrates such as crayfish, water beetles and water skaters. There are also fish occurring in the swamp though in a small population (Gichuki, 1998).

1.7.2 Climate

The climate around Ondiri is influenced by altitude. The rainfall regime is bimodal, with the long rains occurring between April and May while the short rains fall from October to November. The total rainfall received ranges from 845mm to 1373mm. Temperatures in the swamp are in the average range of between 20.4°C and 34°C. July and August are the months with the lowest temperatures while the hottest are January through March.

1.7.3 Soil

Kiambu district has three broad categories of soils. There are different soils on high level uplands, on volcanic foot ridges and on plateaus. Soils around Ondiri are of the volcanic foot ridges type which is well-drained, extremely deep, grey/red in colour to dark brown friable clays. These soils are known to support a wide range of crops such as cabbages, tomatoes, and carrots alongside dairy farming.



Map 1: Districts of Kenya (Source: District Development Plan of Kiambu , 1997)

1.7.4 Population

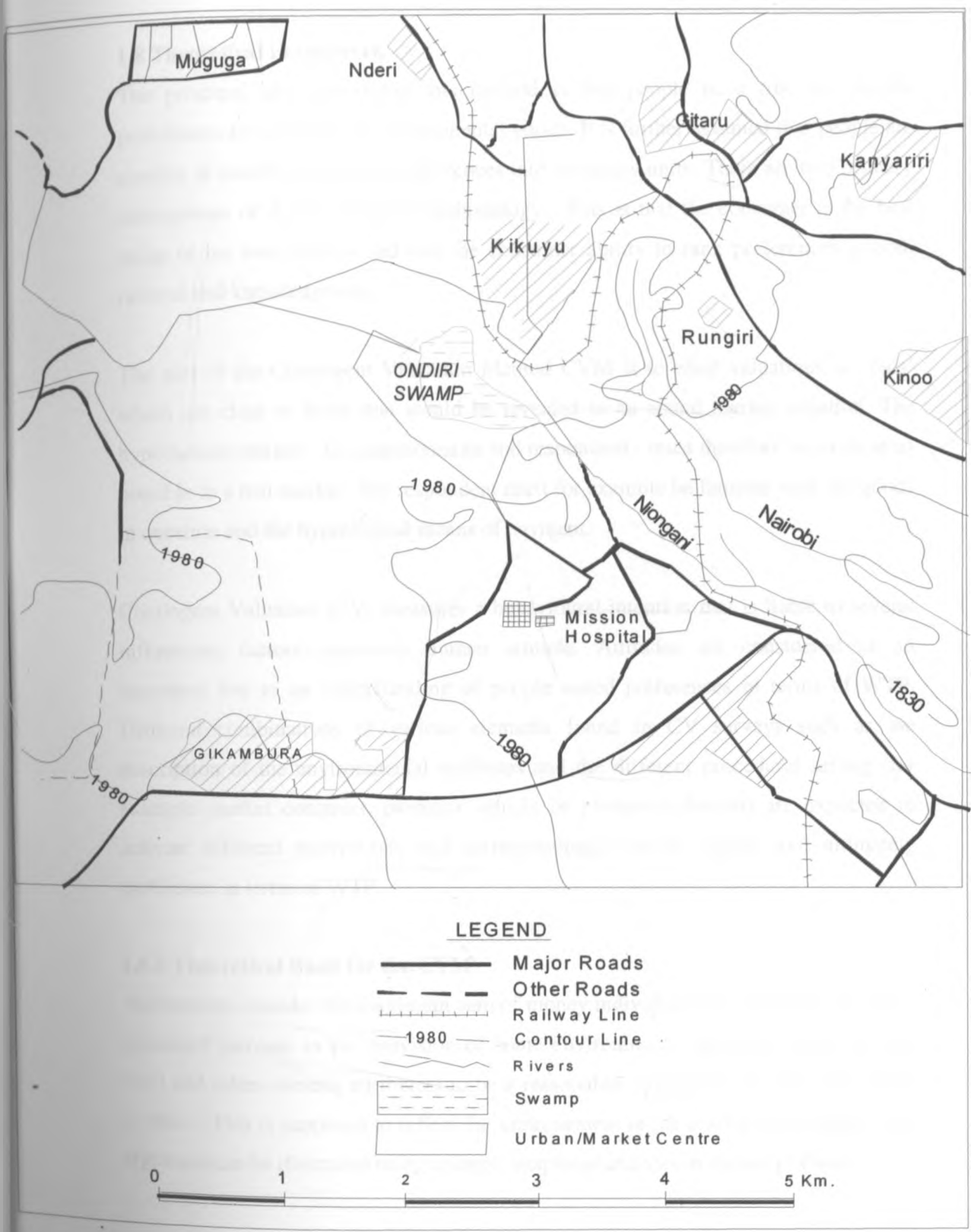
Kiambu district had a population of 575,968 persons in 1989 with an estimated annual growth rate of 2.7%. Assuming that the same growth rate prevails in Kikuyu, this population is projected to rise to 724,606 in 1997, 767,209 in 1999, and 812,535 in 2001 (GOK 1997). This is shown in Table 1

Table I: Population Projection in Kiambu District by Division from 1989 to 2001.

Division	1989	1997	1999	2001
Limuru	90,231	113,517	120,174	127,273
Kiambaa	136,366	171,559	181,684	192,380
Githunguri	117,760	148,151	156,853	166,129
Kikuyu	**144,138**	**181,337**	**191,999**	**203,362**
Lari	87,473	110,042	116,499	123,391
Total	**575,968**	**724,606**	**767,209**	**812,535**

Source: Kiambu District Development Plan 1997-2001 (GOK 1997)

Compared to the other parts of Kiambu, Kikuyu division has the highest population having 25% of the district population. Settlements in this division are influenced by such industries as steel rolling as well as milk processing and garment making factories which are based within Kikuyu Township. This shows that there will be a continuous increase in resource demand leading to exploitation of Ondiri Swamp through activities such as land clearing for crop growing, settlement as well as increased pollution of streams from neighbouring industries.



Map 2: Ondiri swamp and its environs (Source: Limuru sheet; Series SK61Y731 Ed3-SK6-SK)

1.8 Theoretical Framework

The principal idea underlying this method is that people have true but hidden preferences for all kinds of environmental goods. It is further assumed that people are capable of transforming these preferences into monetary units. There are two primary assumptions of direct valuation methodology. This is that the consumer is the best judge of his best interest and that the consumer ability to rank preferences is both rational and knowledgeable.

The aim of the Contingent Valuation Method CVM is to elicit valuations or 'bids' which are close to those that would be revealed in an actual market situation. The hypothetical market – the questionnaire and respondent - must therefore be as close as possible to a real market. The respondent must for example be familiar with the goods in question and the hypothetical means of payment.

Contingent Valuation (CV) measures a behavioural intention that is liable to several influencing factors especially human attitude. Attitudes are considered as an important key to an understanding of people stated preferences in terms of WTP. Different combinations of various elements found in CV surveys such as the description of the environmental attributes and the different procedural setting (for example market construct, payment vehicle or elicitation format) are expected to activate different motivations and correspondingly values, beliefs and ultimately preference in terms of WTP.

1.8.1 Theoretical Basis for the CVM

Economists consider the maximum sum of money individuals are willing to pay for a stipulated increase in the provision of some environmental amenity (given income level and other relevant attributes) to be a reasonable estimate of its economic value or price. This is supposed to reflect the improvement in the level of well being. This argument can be illustrated using a simple graphical analysis as shown in Figure 1

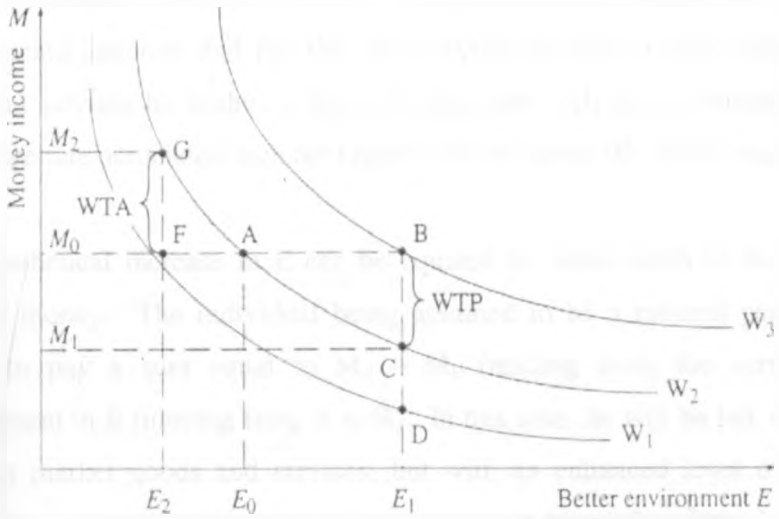


Figure 1: Translating preferences into monetary values

Consider a simplified representation of a person's preferences between two consumption options. One consumption option is represented by his total money income, denoted by M, with which he can purchase any combinations of market goods and services. His other option is an environmental commodity, say improved swamp conditions, denoted by E. Owing to its special nature, the swamp ecosystem cannot be 'purchased; at no (direct, out of pocket) cost to any individual or government authority. Consider a rational individual whose preferences are represented schematically as in Figure 1 by curves W_1, W_2 and W_3. The curves are drawn in such a way that the level of well being (Utility in economic parlance) along each curve remains constant, as more and more units of E replace units of the other goods and services (that is, M) in the individual overall consumption 'bundle'

Each curve depicts a different level of well-being with W_2 denoting a higher level than W_1, W_3 a higher level than W_2 and so on. Higher levels of welfare result from the (potential) consumption of larger quantities of both market goods and services (available through M) and the environmental amenity (E). Next, assume that the individual is initially at point A, with money income M_0 and Environmental quality E_0, which is fixed by the authorities and cannot be directly chosen by him. His maximum level of welfare at this point is W_2, indicated by the welfare curve which passes through point A. Would he prefer the situation at point B to his initial situation

at A? The answer is likely to be 'yes'. Why? This is because at B he enjoys more environmental amenity and has the same money income to enjoy whatever market goods and services he wishes to buy with this sum. All this is 'summarized' by the level of welfare associated with the higher welfare curve, W_3 which passes through B.

The hypothetical increase in E can be equated to some worth to the individual in terms of money. The individual being assumed to be a rational person would be willing to pay a sum equal to $M_0 - M_1$ (reading from the vertical axis) for improvement in E (moving from A to B). In this case, he will be left with only M to spend on market goods and services, but with an enhanced level of the amenity, namely E_1. This means he is now at a new point on his preface 'map,' point C at this point, his level of welfare is back down to the initial level, W_2. The sum $M_0 - M_1$ is termed as "willingness to pay" often denoted as WTP. The maximum sum of money a rational individual would be willing to pay for the improvement from E_0 to E_1 is $M_0 - M_1$. $M_0 - M_1$ is the money equivalent to the improvement that is the individuals valuation, or the amount of WTP. It is that sum of money which, when subtracted from the initial income level, keeps well-being constant at its original level prior to the increase in the environmental good from E_0 to E_1. From this it follows that the benefit for, or loss to, the consumer due to a policy change is measured by the amount of money income that must be subtracted or added to leave the consumers' level of well being unchanged.

1.8.2 Formal Definition of WTP Welfare Measure

The goal of contingent valuation is to measure the compensating or equivalent variation for the good in question. Compensating variation is the appropriate measure when the person must purchase the good such as an improvement in environmental quality. Both compensating and equivalent variation can be elicited by asking a person to report a willingness to pay amount. For instance, the person may be asked to report his WTP to obtain the good or to avoid the loss of the good. Formally WTP is defined as the amount that must be taken away from the person's income while keeping his utility constant.

1.9 Limitations of the Study

While conducting the research, the researcher encountered a number of limitations;-

- The study was undertaken within Kikuyu Township sub-location where the swamp is located because of the limited time within which the research was carried out and time needed to compile the report.
- Being a self sponsored student, shortage of finances was a major problem. This limited the sample size but did not hinder the researcher from doing quality work.
- The fact that the survey asks respondents for their hypothetical WTP may provide insufficient incentive for respondents to come up with a realistic payment.
- Time was also a factor that made the researcher's work a bit strenuous. Time within which the study was to be completed was very limited.
- The respondents were to complete the questionnaires within the shortest time possible.

CHAPTER TWO

LITERATURE REVIEW

2.0. Introduction

The researcher endeavoured to review literature on economic valuation of wetlands. The aim of the review was to establish the existing knowledge in terms of wetland ecosystem valuation. This was necessary in order to screen the proposed research ideas and identify the existing scientific information gaps. The issues raised in areas are explained below.

2.1 Towards an Understanding of the Valuation Process

Many environmental resources are complex and multifunctional, and it is not obvious how the myriad goods and services provided by these resources affect human welfare. Loss of environmental resources is an economic problem because important values are lost, some perhaps irreversibly, when these resources are degraded or lost. Each choice or option for the environmental resource to leave it in its natural state, allow it to degrade or convert it to another use has implications in terms of values gained and lost. The decision as to what use to pursue for a given environmental resource, and ultimately whether current rates of resource loss are excessive, can only be made if these gains and losses are properly analyzed and evaluated.

The interaction between a person and an object (to be valued) involves perception of the objects and a process whereby relevant held values, beliefs, and dispositions come to the forefront. Perception and beliefs are interrelated and together result in an unbearable sense of value (utility), which may then be expressed as an assigned values and certain behaviour. It can be concluded that the valuation context may affect how objects are perceived, the beliefs that become relevant, the utility experienced and the value assigned. Perception, information, and beliefs all then feed into motivation. This is identified as a responsibility motive in the environmental cost context. The motive is best represented as a spectrum of feelings extending from personal responsibility to a more general concern for the environment unrelated to use value.

Maslow's psychology, for example, substitutes the concept of human needs for human wants and portrays needs in a Hierarchical structure. Instead of an individual facing a flat plane of substitutable wants, Maslow conceives of the same individual attempting to satisfy levels of need as is shown in Figure 2. The satisfaction of higher level needs leads to a process of 'self-actualization'. Self-actualized individuals would be expected to possess a strong responsibility motivation and hold no use values. Such individual might well be prepared to pay to maintain some environmental asset regardless of the benefits they themselves receive from that asset.

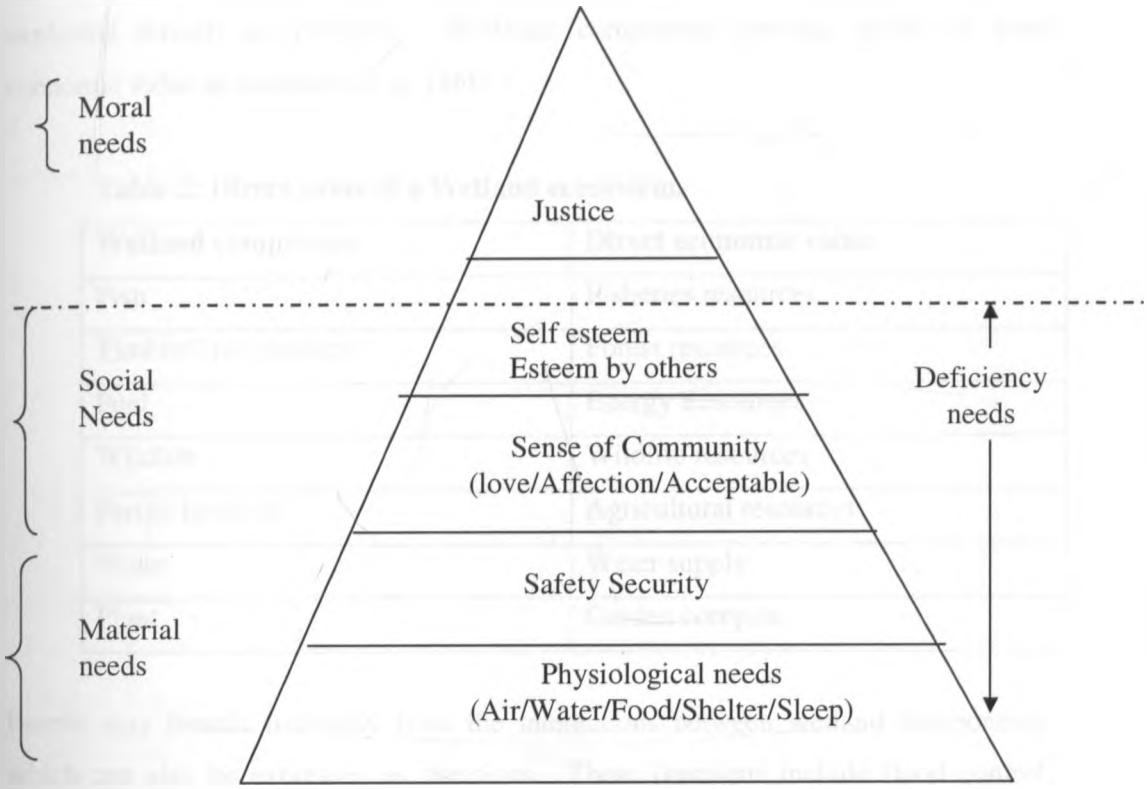


Figure 2: Maslow's hierarchy of needs. Source: Maslow (1970)

The economic value of any goods or services is generally measured in terms of what we are willing to pay for the commodity, less what it costs to supply it, where an environmental resource simply exists and provides us with our willingness to pay alone which describes the value of the resource in providing such commodities, whether or not we actually need any payment (Barbier, *et al* 1997).

2.2 Wetland Components, Functions and Attributes and their Human Uses.

Wetlands are among the Earth's most productive eco systems. The features of the system may be grouped into components, functions and attributes (Barbier 1993). The components of the system are the biotic and non-biotic features which include the soil, water, plants and animals. The interaction between the components express themselves as functions, including nutrient cycling and exchange of water between the surface and the ground water; and the surface and the atmosphere. The system also has attributes, such as the diversity of species. Wetlands components may be exploited directly as products. Wetlands components provide goods of great economic value as summarised in Table 2.

Table 2: Direct value of a Wetland ecosystem.

Wetland component	Direct economic value
Fish	Fisheries resources
Timber/Tree products	Forest resources
Fuel	Energy Resources
Wildlife	Wildlife resources
Fertile land/soil	Agricultural resources
Water	Water supply
Plant	Garden compost

People may benefit indirectly from the interactions between wetland components, which can also be expressed as functions. These functions include flood control, storm protection, ground water recharge, sediment or pollutant retention, nutrient retention and preservation of important archaeological and human remains.

At times people may just appreciate wetlands for their mere existence without benefiting directly from them. Wetlands may be appreciated for their biological diversity and value them highly. In other instances, the existence of a wetland may be valued as part of the people's cultural heritage and therefore a fundamental part of their lives. It is the consideration of the various characteristics that gives wetlands high economic values and support millions of people directly while providing goods

and services to the areas outside the wetland. Economic valuation of wetlands requires the quantification of wetland components, functions and attributes.

2.3 Economic Valuation

In economic theory, value means exchange value with money being the main medium of exchange. The value of any benefit is generally determined by its price that is, the quantity of money for which it will be exchanged. However, the value of a benefit is not simply the price of that product on the open market. It is rather the world of that benefit to be a potential buyer. This is measured in economic terms as Willingness to Pay. Market price is a measure of the minimum that some people are willing to pay for a benefit. There are many other forms of value beyond market economic terms including subjective and extensive values. These are particularly important in environmental conservation in general especially for wetlands. Economic valuation is but one of many ways to define and measure values. Other types of value (religion, social, cultural, global, intrinsic) are also important when decision makers have to make difficult choices about allocation of scarce government resources.

2.4 Basic Concepts of Economic Value

The term 'valuing the environment' means different things to different people depending on which of the world-views they find acceptable. Economists generally speak about total environmental value, interpreted as 'total economic value' (TEV), which distinguishes between use and non-use values. Non-use value covers situations in which individuals who do not make use, or intend to make use, of any given environmental asset or attribute would nevertheless feel a "loss" if such things were to disappear. They may just wish to see various environmental entities conserved 'in their own right' (termed existence value); or conservation may be supported on the basis of retaining options and opportunities for one's children, grand-children, and future generations beyond (termed bequest value). But the non-use category does not have well-defined boundaries because the existence value component can be defined in a variety of ways to include a range of possible motivations. Existence value therefore derives from individuals who feel a benefit from just knowing that a particular species, habitat, or ecosystem does exist and will continue to exist somewhere on the planet (Barbier, *et al*, 1997)

The concept of total economic value (TEV) may be used to provide a framework of valuing a wetland. The environment can be conceptualised as a functioning system in which activities of human kind interact with the natural systems to influence environmental attributes and services produced by the environment. The basic aim of environmental valuation is to determine the total economic value of an environment. Conceptually, the Total Economic Value (TEV) of a resource consists of its use value and non-use value. Use values are further broken down into direct use value (DUV) and Indirect Use Value (IUV). Non-use value (NUV) on the other hand can be sub-divided into Existence Value (XV) and Bequest Value (BV).

These are: $TEV = UV + NUV$

$TEV = (DUV + IUV + OV) + (XV + BV)$

Simply put, TEV distinguishes between use values and non-use values, the later referring to those current or future (potential) values associated with an environmental resource which rely merely on its continued existence and are unrelated to use. Figure 3 shows a sum of the expected elements of an ecosystem in a TEV framework.

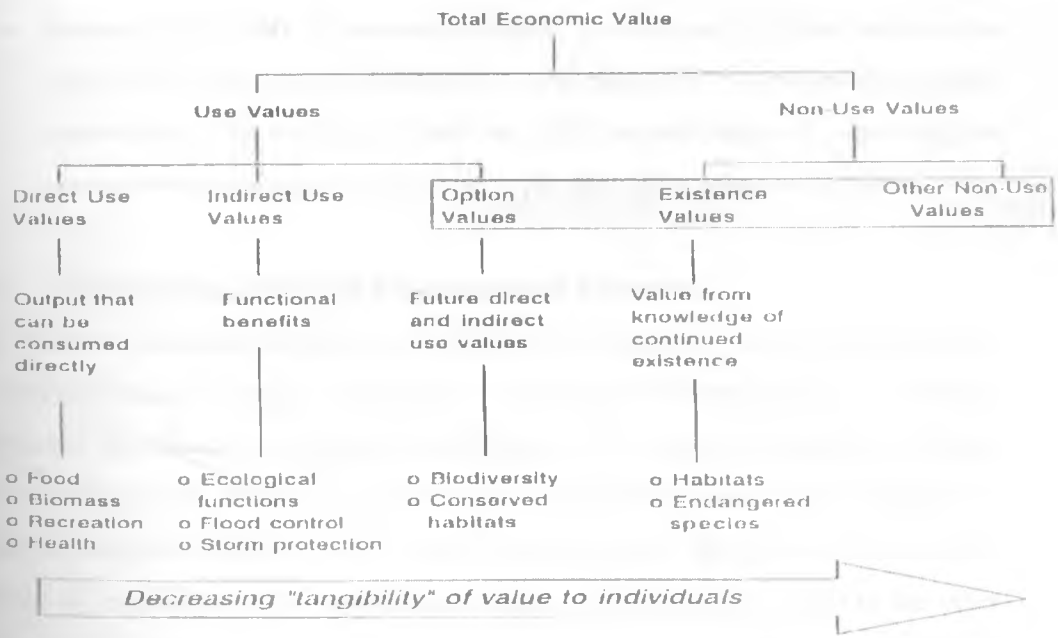


Figure 3: The disaggregating of TEV in schematic form (Source, Barbier, 1996)

The definition of the terms in the TEV framework in Figure 3 is as follows:

- Direct use value is determined by the contribution an environmental asset makes to current production. These can be consumptive or non-consumptive in nature. Examples of consumptive use include forage harvesting or water supply while non-consumptive includes recreational activities such as bird watching;
- Indirect use value includes benefits derived basically from functional services that the environment provides to support current production and consumption. This for example includes ecological functions like natural filtration of polluted water of recycling of nutrients;
- Option value is basically the premium that consumers are willing to pay for an unutilised asset, simply to avoid the risk of not having it available in the future. This arises from uncertainty of the future demand and need for a resource and/or its availability;
- Existence value arises from the satisfaction of merely knowing that the asset exists, although the valuer has no inclination of using it. It involves subjective valuation by individuals unrelated to either their own or other's use whether current or future; and
- Bequest value refers to preservation value. It is derived from the benefits that individuals obtain from knowing that a resource will be available for future generations. The individuals have the moral responsibility of conserving the natural environment and assign it on to the next generations with pride.

2.5 The Economic Theory of Environmental Valuation

The two basic theoretical approaches available for non-market valuation methods can be divided into two main categories: revealed preferences (RP) (or indirect) approaches and stated (or expressed) preferences (SP) (or direct) approaches (Figure 4).The RP approach infers value indirectly by observing individuals behaviour in actual or simulated markets. For example, the value of a wilderness area may be inferred by expenditures that recreationists incur to travel to the area. On the other hand, stated preference methods attempt to elicit environmental values directly from respondents by asking them about their preferences for a given environmental good or service. Valuation methods can be categorized on the one hand according to which

type of market they rely on, and on the other hand, by considering how they make use of actual or potential behaviour of economic agents. Whereas the indirect approach uses data on observed goods, the direct approach simply asks people how much they are willing to pay for the improved use of the good.

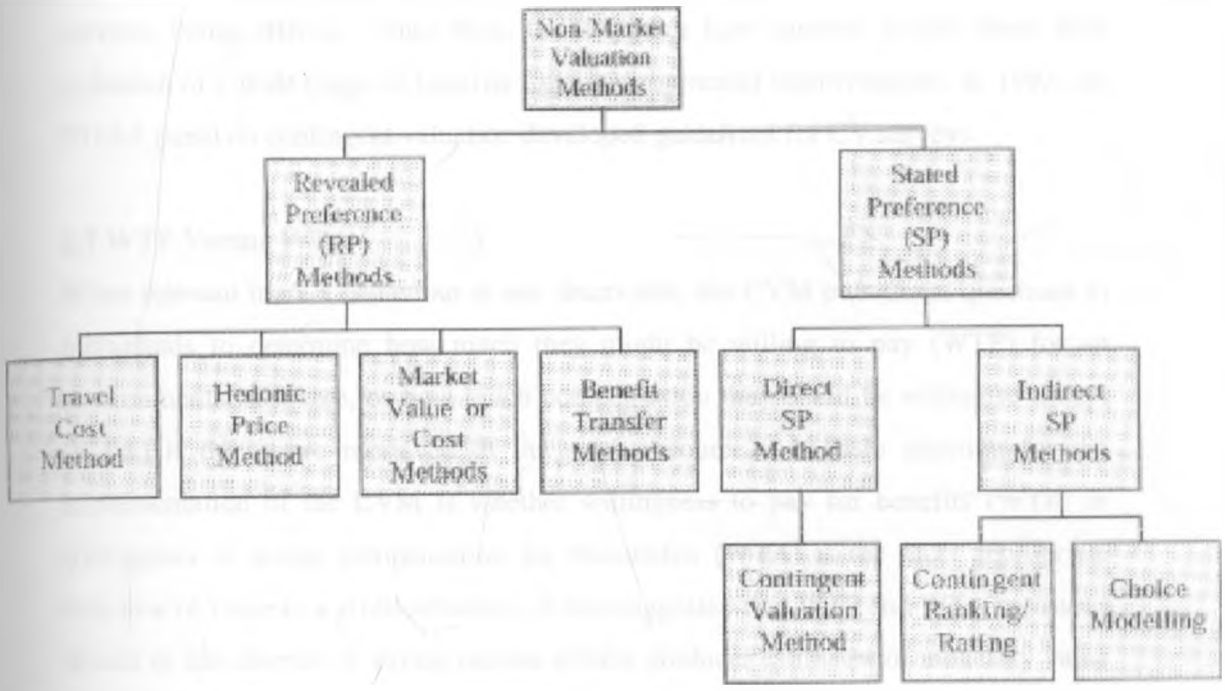


Figure 4: Classification of non- use valuation methods (Source, Barbier, 1996)

2.6 Using Hypothetical Markets to Extract Valuation

In instances, where market information cannot be used directly or indirectly, market like behaviour can be deduced through construction or simulation. In other cases, there are non-use benefits which are not associated with the actual use of an environmental asset or consumption of environmental sources and therefore cannot be easily coupled with the consumption of a market good. In the absence of appropriate data or independent market goods, the alternative is to ask people directly what their valuation of environmental quality is. This is done by the use of the CVM. The CVM invokes a framework of a hypothetical or contingent market through which it seeks to elicit valuations directly from individuals. The CVM is referred to as a "stated preference" method because it asks people directly to state their values rather than inferring values from actual choices as the revealed methods do.

The CVM was first put forward by Ciriacy- Wantrup (1947). A suggestion was made to use the direct interview method to measure the values associated with natural resources. Later on, other studies used the questionnaire to estimate the benefits of a recreation area. Davis in his book argued that this method would put the interviewer in the position of a seller who elicits the highest possible bid from the use of the services being offered. Since then, CVM studies have queried people about their valuation of a wide range of benefits from environmental improvements. In 1993, the NOAA panel on contingent valuation developed guidelines for CV surveys.

2.7 WTP Versus WTA

When relevant market behaviour is not observable, the CVM puts direct questions to individuals to determine how much they might be willing to pay (WTP) for an environmental resource, or how much compensation they could be willing to accept (WTA) if they were reprieved of the same resource. A basic question for the implementation of the CVM is whether willingness to pay for benefits (WTP) or willingness to accept compensation for disbenefits (WTA) is the most appropriate indicator of value in a given situation. It was suggested that WTP and WTA measures should in the absence of strong income effects producer estimates of monetary value that are fairly close or within 5%.

Empirical evidence has however indicated that there are significant differences between WTP and WTA as illustrated in Table 3. It is noted that questions about WTA compensation yield higher answers than questions about WTP to retain the same amenity. It is suggested that people are willing to spend actual income or wealth –money they do not yet have but may obtain. An explanation for this could lie in the theory of prospectus whereby individuals value losses more heavily than gains. Recent experiments by Knetsen (1990) found the WTA: WTP ratio to be 77:1 initially which stabilised at 61:1 in successive experiments. In most cases however, researchers have considered WTP measures to be more consistent and credible than WTA. Notable differences exist between WTP and WTA measures and problems persist in reconciling them.

Table 3: Comparisons between WTP and WTA.

Study	WTP	WTA
Hammock and Brown (1974)	247	1044
Bradford, Knetsen and Mauser (1973)	22	93
Sinclair (1976)	35	100
Bishop and Herbelin (1979)	21	101
Brookshire, Randall and Stoll (1980)	32	207 07
Rowe, d'Arge and Brookshire (1980)	685	133 68
Knetsen and Sindein (1983)	129	518
Abala (1989)	844	284479

Note - All figures are in current year US dollars except the ones by Abala, which is in Kshs. ***Source: Extracted and modified from Pearce and Markandya (1994).***

2.8 Comparison of CVM and Indirect Valuations

In an attempt to legitimise the CVM, several studies have compared their findings with those obtained from other studies for the same techniques. In theory CVM should produce the same valuations as other methods purporting to measure WTP. Considering the hypothetical nature of the CVM several studies have attempted to assess its reliability and accuracy against observed behaviour from parallel indirect market studies. Attempts have been made to compare hypothetical and actual WTP in experimental settings.

Comparisons have been made between the CVM and Travel Cost Method (TCM), Hedonic Pricing Method (HPM) (Cropper and Freeman 1991; OECD, 1989). All figures tend to diverge widely in the case of WTA. Results for WTP show a substantial amount of credibility on the CVM especially in the case of non-use benefits. The variations noted were determined by crucial parameters such as the elicitation technique used in the CVM and the nature of the commodity being valued.

A review by Pearce and Markandya (1989) compared valuation estimates obtained from market- based techniques and CVM using results from 7 studies carried out in industrial nations. The results were that the corresponding estimates overlapped within an accuracy range of plus or minus 60 percent. In another setting, studies that dealt with private goods, strawberries and hunting permits did not detect any

statistically significant difference between the mean values of WTP under the two experimental settings. (Cropper and Oats, 1992). It is therefore clear that CVM if cautiously and vigorously applied could provide rough estimates of value that could be helpful in economic decision making especially when other valuation techniques are unavailable (Munansinghe, 1993).

2.9 Related CVM Empirical Studies

In the last few years, the CVM has been applied extensively to the valuation of environmental quality and to a variety of public programmes especially in developing countries. The studies that have been reviewed adopted the CVM and used the WTP approach. A study was for example undertaken on the Norfolks Broads in East Anglia (UK) to determine the willingness to pay to conserve recreational benefits via the proposed protection strategy. In the survey, attempts were made to capture the non-use value, related to conserving the Norfolk Broads. A mail-survey was undertaken across the UK. The results demonstrated a significant decay factor that is values tend to decline as the respondents distance from the area increases. For households located in a zone close to the wetlands an average WTP of US$22 per household was elicited, compared with a figure of US $7.2 for households elsewhere in the UK.

Loomis (1987) used the CVM to qualify non-marketed environmental benefits from natural aquatic conditions. In this case, the problem was to determine the public trust values of Mono Lake. Loomis found out that the economic benefits to California residents of preserving Mono Lake could conservatively be estimated to be US$1.5 billion annually. The CVM was also used in a survey to estimate consumers' willingness to pay for an improved water system in a village in Southern Haiti. The project was executed by CARE. Fourteen percent of the households gave an answer of "I don't know" in response to WTP question put the value for public standposts which was estimated at 5.7 gourdes per month (US$ 1.14) per household.

In Kenya a study was undertaken to value the viewing of elephants on safaris in 1984 by the World Bank. In order to assess the consumers' willingness to pay to maintain the elephant population at current levels through increased enforcement activity, a survey was designed using the CVM approach. The average value was US$ 89 while the median was US$ 100. This yields to an annual viewing value of US$ 22 million to

US$ 21 million based on 250,000 adult safaris per year. Similarly a survey conducted by Kagunda (2002) to establish the willingness to pay for the conservation of Lake Naivasha in Kenya had the following results. The average WTP was found to be Kshs. 171 per household per annum as majority of those interviewed were from low income peasant groups while the maximum WTP was found to be Kshs. 1,000.

2.10 Overview of Empirical Studies

The inherent assumption in the CVM is that people are willing and able to report a monetary valuation of their preferences for a given good or service. This may not be easily realized in a subsistence based economy where people are not used to paying for goods and services in cash. It is important to pay attention to the design of the CVM study because the hypothetical nature of CVM methodology could result in uncertainty, doubt and irrationality to the average consumer when confronted with an imaginary commodity.

One issue that continues to raise concerns for CV practitioners is the choice of questions format. A number of studies have compared various parts of the three question formats namely open ended (OE), dichotomous choice (DC) and payment card (PC) to determine if they yield similar results. While the NOAA panel endorsed the DC format for its ease of use and resemblance to everyday decision making, DC has been found to have lower response rate as compared to OE or PC format. The choice of the payment vehicle too needs to be put into consideration. Different payment vehicles were tested during focus groups. Studies show that people are sceptical about the payment of taxes and may often bid low when it comes to WTP for goods they think should be public goods.

2.11 Strengths and Limitations of CVM

CVM is capable of yielding estimates of all types of environmental values including non-user or passive use values (Mitchell and Carson, 1989). It can estimate use values, existence values, as well as bequest values. Option value price can also be estimated in the presence of uncertainty. CVM therefore presents a highly flexible framework for valuation of almost all environmental benefits. Unlike other techniques CVM can be used to value goods not previously available

Although CVM is considered superior to indirect methods by many authors (Smith and Krutilla, 1982, Rubinfield and Pundyde, 1989) it is faced by many problems. In developing countries, the ability to pay becomes a concern especially in low income areas where money value placed on environmental goods and services are traditionally low. Cultural difference, across application sites may require specific design considerations. The notion of associating monetary values with goods that may be regarded as free or God given may also present specific challenges.

Although the CVM approach is fairly simple and relatively straight forward to apply, it is associated with various biases as is shown in table 4.

Table 4: CVM associated biases.

Bias	Description
Hypothetical bias	It has been suggested that the hypothetical nature of the exercise might induce people to 'free ride', that is, understate their true WTP.
Strategic bias	Occurs when a person deliberately overstates (or understates) his or her true bid in order to influence the outcome. For example, some people who strongly support a proposed development may report a zero WTP for conservation even when they have a positive WTP.
Embedding effect	Occurs when a individual's WTP is lower when it is valued as part of a more inclusive good or service, rather than on its own. It has been suggested that embedding is caused by the existence of substitutes. That is, people will reduce their WTP if they are aware of substitutes.
Information bias	If insufficient information about the environmental good or service being valued is given, the individual's WTP many not the same as the actual WTP
Survey technique bias	Mail surveys generally have fewer respondents than face-to-face interviews, but interviewers could influence the responses. Also bias could result from the use of inappropriate sampling techniques.

Despite the limitations cited, the CVM could be the only available technique for estimating benefits. It has been applied to common property resources, amenity

resources with scenic, ecological and other characteristics and to other situations where market information is not available (Mitchell and Carson, 1989).

Considering the above literature review this study intended to carryout an economic valuation of a wetland ecosystem, namely Ondiri swamp as a contribution towards the field of environmental valuation in developing countries.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

This chapter deals with the research design. it describes the sampling design and the instruments used in the research. It not only outlines the data procedure but it also discusses the data collection methods used during the study in analyzing the data collected.

3.1. Research Design

This study utilizes a cross sectional survey design to carry out an economic valuation of Ondiri swamp. In employing the CVM technique the survey method was considered most appropriate. This is because CVM is a direct approach whereby respondents' personal valuations are sought contingent upon a hypothetical market.

This study was carried out in two phases namely the pilot survey and the main study. An initial questionnaire was tested in the pilot survey. The main study was done two weeks after the pilot study. The pilot survey had a sample size of 15, which was not part of the main study.

3.2. The Population and the Sample.

The population from which the sample was drawn consisted of household residents of Kikuyu Township sub-location and people working at the swamp site. In respect to households, statistics from the CBS of the 1999 census was used. The census statistics categorized the 2,987 households in the location into two enumeration areas namely the urban and rural areas. Samples were drawn from both the enumeration areas, as this was considered representative of the socio-economic characteristics of the population. This was done with the main assumption that all household members have homogenous preferences and that responses regarding the issues in question are similar.

A two-stage stratified random sampling procedure was utilized for the urban and rural strata. In these strata, a sample size of 43 households was selected from each of the

areas. Owing to resource constraints and time, the sampling frame of the study was determined by the margin of error of 0.15. An appropriate sample was therefore obtained by using the formulae:

$$n = \frac{N}{1 + Ne^2}$$

where $n \rightarrow$ sample size of the study area.

$N \rightarrow$ total number of households

$E \rightarrow$ Desired margin of error.

The sample size drawn from the two enumeration areas was 86. Systematic sampling was then carried along the main road transects to further select the appropriate sample of 43 households per area. Households from rural and urban areas were therefore selected after an interval of 20m and 50m respectively along the transects.

The third strata consisted of people found working at the swamp site. These people were not necessarily residents of Kikuyu Township sub location. A sample size of 8 was selected bringing the total sample size for the study to 94.

3.3 Types of Data

Primary data was collected based on research administered questionnaires. This was carried out among households and at the swamp sites. Observations were made by the researcher on the use and state of the wetland. A camera was used to capture data of the Ondiri swamp as it occurred within its natural setting.

Secondary data sources included published documents and maps. Literature available on valuation of natural resources using the CVM was reviewed. Studies undertaken by other research projects and government offices were valuable.

Interviews were carried out with key informants. They used a semi-structured format. Discussions were held with relevant government officers accorded responsibilities in the management and conservation of natural resources.

3.4 Data Variables

In the regression equation, the dependent variable is WTP, while the independent variables include:

- Age
- Education level
- Gender
- Household size.
- Income level
- Home / Land ownership
- Sampling zone

These variables were selected for inclusion in the full model, based on variables which could have been shown to matter in past studies, and on theoretical grounds (income, for example has a key role in the demand theory).

3.5 Instruments

Whereas various survey methods are possible, in-person interviews are generally held to produce the highest quality WTP data (Carson et al 1994). There however have been reports of difficulties even with in person interviews where people reacted with apprehension to the request of participating as a survey and have exaggerated their reported WTP. Apart from the questionnaire the GPS was used to estimate distances from one household to another. A digital camera was also used to capture data which was then presented as photographs.

Face-to-face interviews were therefore used to fill the questionnaire. These research-administered questionnaires were advantageous as they minimized the non-responses characterized by other types of survey. CVM requires that the respondent be familiar with the goods in question before the placement of their value of the same. Research administered questionnaires were therefore appropriate in ensuring that respondents were well informed before they could place their bids for WTP for conservation of the swamp.

3.6 The Structure of the Questionnaire

A questionnaire for the main survey was drawn up following revision of the pilot survey. This questionnaire is shown in appendix 1. The initial question asked respondents how long they had lived in the area and how far they lived from the swamp. This was both to provide data on a potential explanatory variable and to accustom respondents to the interview process. To increase the response rate of the interview, instructions were given to respondents assuring them of confidentiality of responses.

The questionnaire had three sections. The first dealt with the respondent background information. This consisted mainly of socio-economic and demographic data. These characteristics, which included age, gender, education level, income level, home ownership and family size were used to establish socio-economic factors affecting WTP. The second section dealt with the wetland information. Here respondents were expected to give their opinion on the state of the method, its uses and their value of it. The third section addressed the WTP for conservation. It was aimed at assessing the respondents' WTP for conserving Ondiri Swamp. Given the scenario of the contingent setting, individuals were asked how much they were willing to contribute into an independent trust fund for the purpose of conserving the swamp. Following the PC method, a number of possible values were listed and respondents were asked to choose an mount on the payment card that best represented their WTP. Those who gave a zero bid were then expected to give reasons for their bid.

3.7 CVM Biases and Corrections

Provisions were made to minimize the biases in an attempt to ensure that the data collected was reliable and valid data.

- As concerns the strategic bias, it was suggested that the survey results were to influence policy and that they were not just purely hypothetical. It was also stressed that payment by others was guaranteed. Other respondents' bids were concealed to avoid influencing other's bids.

- The hypothetical and information biases were dealt with by pointing a clear picture of the scenario in question. The scenario depicted was realistic and

clearly understood with a low degree of uncertainty. The research assistants were trained and subjected to filling in the questionnaire in order to help assure its clarity. This put them in a better position to administer the questionnaire.

- The starting point bias was minimized by the use of the selected elicitation method for WTP. According to Harris et al 1989, one approach of dealing with these problems is to allow the respondent to choose a bid from a range shown on a payment cash card.

3.8 Data Collection Procedure.

The respondents were guided by the interviewers who recorded the answers to ensure completeness of the questions and further clarity on any issue. The survey was administered by face-to-face interviews carried out by the main researcher and the assistants. This was carried out within a period of three days, mainly between, 9.00 a.m. – 12.30 pm and 2.00 – 5.00 pm. These times were considered convenient to avoid intrusion.

Household members under the age of 18 years were excluded from the survey with the consideration that they could not make valid decisions on behalf of the household. In cases where selected households could not be accessed, the immediate household was then selected. In respect to the onsite interviews, all respondents were interviewed on a single day. These included those who were found working at the different sites of the swamp. Each interview lasted 15 minutes.

3.9 Data Processing

The data collected was first sorted out then analysed using appropriate tools. Both qualitative and quantitative methods were employed. The SPSS was used in the analysis. This was in the form of simple descriptive averages and percentages. Complex analyses involving regression and correlation analyses were used. The student t test was used to test the stated hypothesis as this was considered appropriate in analysing the given data.

3.9.1 Handling the Data

In relation to the WTP question, 'protest zeros' were distinguished from respondents who genuinely had no value for the commodity. 'Protest zeros' were recognized from the answers to the other questions other than the WTP question. In this respect, respondents were expected to give reasons why they bided zero. Following the reasons for the zero bid all the bids were considered significant and therefore usable in the analysis.

3.9.2 Statistical Analysis of the Responses

The purpose of the payment question was to obtain information about the respondents WTP amount. WTP responses were statistically analyzed to obtain an estimate of mean WTP. The WTP figures reported by respondents were thus averaged to produce an estimate of mean WTP.

CHAPTER FOUR

DATA ANALYSIS AND RESULTS

4.0 Introduction

This chapter outlines the procedures that were followed in data processing, analysis and report of results. Descriptive statistics were used to describe the sample and summarize data. Results and findings of the study are presented in tables and graphs to illustrate the observed relationships. Some correlation was then used to describe relationships between WTP and various variables. A regression analysis was done to estimate the influence of the WTP by the personal data of the respondents.

4.1 Wetland Resources and Services

There exists a complex interaction between water, soils, microorganisms, plants and animals within a wetland. This interaction makes wetlands as among the earth's most productive ecosystems. Wetland resources were also then viewed in terms of components and their interactions can be expressed as services or functions. It is only when wetland components, functions and attributes are understood that the true value of wetlands is derived.

4.1.1 Wetland Components

The majority of the respondents agreed that the components highlighted below are the best indicators to describe the Ondiri Swamp site and that the wetland components provided a wide range of goods of great value.

(a) Water

Highland wetlands play an important role in water storage and flow regulation and are therefore sources of water to communities. The water flows out of Ondiri swamp in form of rivers such as Nionguni and Nairobi. Most of the water available for use is pumped from the springs located at the edges of the swamp. The swamp water has been proved good for consumption being clean and with low quantities of fluorides. The amount of water reduces during the dry season.

(b) Peat Soil

The swamp is underlain by peat soils. These soils have both static influences of holding water and dynamic influences of transmission and sedimentation of water. Soil substrate is extracted and used by Kenya Agricultural Research Institute (KARI) for research purposes in their plant nurseries.

(c) Vegetation

The plant species at Ondiri Swamp have evolved physiological and morphological attributes to allow them either grow as emergents within the lifforal zone, submergents below the water surface or as free floating vegetation on the surface of the waterways, at the sides or on the water. There are emergent macrophytes such as Typha, Australis, and Echinochloa grass. During the dry season residents are said to indiscriminately harvest this vegetation mainly for sale as fodder.

(d) Fertile Land

The land bordering the swamp is rich in nutrients. This is evident due to both the small scale and large scale farming that is going on. The soil nutrients support the growing of different types of vegetables. The farmers do not use any artificial fertilizers and yet realize a healthy crop yield. The continuous supply of water for irrigation from the swamp ensures that farming goes on all year round.

(e) Wildlife

Ondiri Swamp is a habitat for migratory bird species. Not having an open surface of water, the swamp attracts a limited number of bird species. Some of these include herons, Storks, hammer cops and red knobbed cops. The dominant bird species are the Sacred Ibis. Most of the birds are spotted at the swamp mainly in the evenings. There are also other animals such as frogs, crabs, water worms and mosquitoes

4.1.2 Wetland Functions

Wetlands have a wide range of functions some of which the residents were not aware of. These have been enumerated below as follows;

(a) Ground water recharge

The swamp acts as a natural regulation of hydrological regions. It holds water during the rainy season and saturates the surrounding. With the onset of the dry season, it releases the water into river margins, which then join Nairobi River. It also releases groundwater by sub surface flow.

(b) Sediment/pollutant retention

Sediments are often the major pollutant in watercourses and storages such as lakes, dams and oceans. Wetlands serve as sediment settling ponds. The reeds and grasses in Ondiri Swamp have high trapping effects for sediments and water pollutants and therefore act as an accumulation site for incoming sediments. These grasses ensure that erosion due to wave action and strong water currents do not erode the soils. During the rainy season, the swamp receives both natural and anthropogenic waste from the surrounding areas. These not only include plain silt but also a wide range of agro-industrial chemicals. The macrophytes have a filtering effect of such chemicals making the water "clean" for human, livestock and wildlife consumption.

(c) Evaporation

Evaporation is normally dismissed as being a simple loss of water from a wetland. However, much inland rainfall actually derives from locally evaporated water and not from moist air from the oceans. The swamp therefore acts as a component of the global water cycle by receiving rainfall and groundwater and then releasing it through evapo-transpiration to the atmosphere.

4.1.3 Wetland attributes

The main wetland attributes of Ondiri swamp included biodiversity and cultural heritage.

(a) Biodiversity

The swamp supports the existence of biological biodiversity. The wetland is a home to several water birds, frogs, snails and larvae of insects. It also supports a wide range of aquatic plant species. This biodiversity has contributed to the stability of the ecosystem

(b) Cultural Heritage.

The elderly people living around the swamp referred to the swamp as part of their livelihood. Many recounted pleasant memories of their childhood when they swam in the waters of Ondiri. To this group, the swamp is part of their history. The swamp is also associated with a popular myth which indicates possible hydrological linkage to Lake Naivasha in the Rift valley floor.

4.1.4 Importance of Wetland Characteristics.

The components, functions and attributes of Ondiri swamp were analysed in their order of importance (Table 5). This was assessed in terms of high, medium or low importance as was appropriate. The researcher established that water supply and agricultural resources were the key direct uses of the swamp being noted to be of high importance. Similarly, forage resources and wildlife were noted as being of medium and low importance respectively. Among the indirect use values, ground water recharge was considered of high importance while sediment retention and evaporation were of medium importance. Recreation was of low importance. Both biological diversity and cultural heritage were noted as attributes of medium importance.

Table 5: A summary of the economic importance of Ondiri wetland ecosystems

Economic values	Direct	Indirect	Non-use
Components			
Forage resources	◊◊		
Agricultural resources	◊◊◊		
Water supply	◊◊◊		
Wildlife	◊		
Functions/services			
Ground water recharge		◊◊◊	
Sediment retention		◊◊	
Recreation		◊	
Evaporation		◊◊	
Attributes			
Biological diversity	◊◊	◊◊	◊◊
Cultural heritage/uniqueness			◊◊

Key ◊ = Low ◊◊ = Medium ◊◊◊ = High

Source: Adapted from Barbier (1989a and 1989b)

4.2 The Direct Use of Resources and Ecological Services

It was noted that most of the respondents used the swamp as a source of water. This water was obtained from the pumps or boreholes found at the edge of the swamp. The swamp was considered a source of water for domestic, agricultural and industrial purposes. The near surface water was easily available through pumping. Various institutions including Alliance High School, Kenya Railways, Kikuyu Campus of the University of Nairobi and Kikuyu Hospital pumped water from the Swamp. The local people used the water for various domestic activities.

The swamp was used as a source of water supply for irrigation to both small and large scale farmers whose farms bordered the swamp. Farms adjacent to the swamp used the water to irrigate their crops especially during the dry season. This ensured that farming activities took place all year round. The crops that were grown included cabbages, kales, spinach and carrots. The harvested crops were either consumed at home or were sold to the residents in the nearby Kikuyu town or to markets such as Dagoreti in Nairobi.

Fodder was harvested and used to feed livestock. Some people were seen harvesting grass at the swamp-site (Plate 1) The respondents confirmed that grass from the swamp was most appreciated during the dry season. Those who harvested the grass sold it to people as far as the Limuru. Some respondents however alleged that the forage was said to cause death to livestock and was only used when no alternative was available. Alternatively, the grass was sold to unsuspecting people for profit. There was however no confirmation of this allegation by the researcher.

Plate 1: Harvested fodder from swamp- site

Some respondents confirmed that they occasionally visited the swamp site, as this was refreshing. They claimed that they were motivated by the cool environment and the fascinating history of the wetland. There were claims that if one stepped in the middle of the swamp one would disappear underground or would be swallowed by the swamp and would resurface in Lake Naivasha. Some respondents also recounted their earlier visits to the wetland as students on educational tours. This was recorded as an important non-consumptive use of the wetland ecosystem.

When asked to outline ways in which they directly used the swamp, it emerged clearly that 87 respondents used the swamp as a source of water supply. 38 of them irrigated their crops using swamp water, 14 had at one time harvested the grass to feed their livestock, while only 27 had visited the swamp site for recreational purposes. The following information is summarised in Figure 5

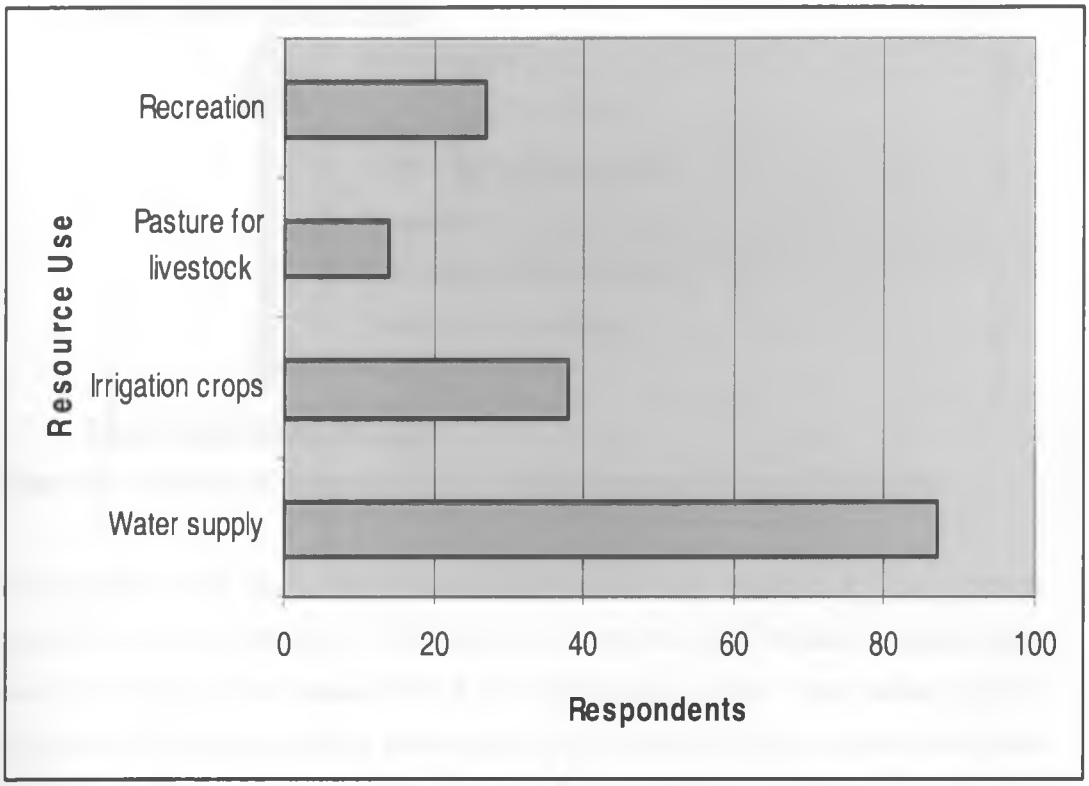


Figure 5: Key direct uses of Ondiri swamp (Source: Field data)

4.3 The Ranking of Resource Use

The Ondiri swamp was considered to perform many important functions. The swamps' resources were evaluated in terms of their direct use value as provided for in the total economic valuation framework. The researcher presented possible direct uses in the questionnaire and respondents were asked to rank these uses in order of their perceived value of importance. The results of the possible direct use value of Ondiri Swamp were ranked by all households as presented in the Figure 6. According to this ranking, 1 meant the most important use while increasing to 7 as the least important use. The majority of respondents named water supply as the most important direct use. Generally, the availability of water for irrigation was considered the second important use because of the value for agricultural production. The harvesting of wetland macrophytes particularly during the dry season was ranked third. The exploitation of the swamp for fish was rated as the least important direct use and therefore not significant for the Ondiri swamp. All these resource uses indicated that the wetland area was rated to have direct economic value.

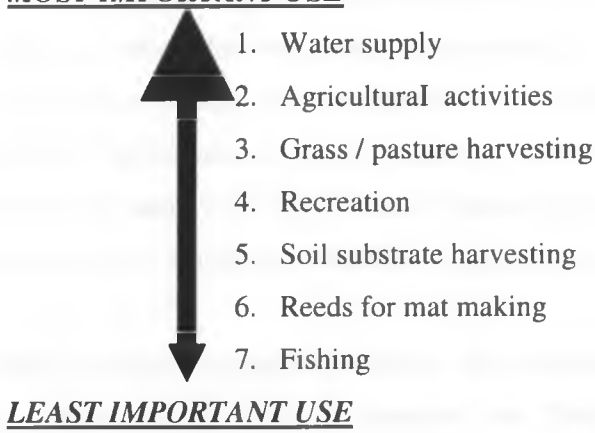


Figure 6: Ranking of Resource Use of Ondiri swamp (Source: Field data)

When asked which of the direct uses of the swamp they would rank first, different groups had their preferences. Whereas the swamp was said to have various direct uses, only three were ranked first by all the groups. These were water supply, irrigation of crops and pasture harvesting which were ranked first, second and third respectively. The survey showed that most of the respondents considered water supply as the key direct use of Ondiri swamp. All the groups ranked it first except those who were above forty years of age and those found at the swamp site. Interesting to note is that the respondents found at the swamp site ranked pasture harvesting as most important. This summary is shown in Table 6.

Table 6: Ranking by groups of the direct uses of Ondiri swamp

Direct use	Urban	Rural	Onsite	Women	Men	>40	<40	Total	Rank
Irrigation crops	17	20	2	9	32	16	25	121	2
Pasture	4	3	6	2	5	1	6	25	3
Water supply	22	20	0	12	34	15	31	134	1

Source: Field data

4.4 Willingness-to Pay for Conservation of the Swamp.

Although the question that was asked was hypothetical, it was expected to establish a value of the Ondiri swamp, based on the WTP for conservation. In the analysis, it was assumed that Willingness to Pay for its conservation depended on a combination of different factors namely the respondents' income, age, family size, educational level, gender and whether or not they owned their home or land bordering the swamp.

This study was out to establish whether the residents of Kikuyu Township sub-location appreciated the need to conserve the Ondiri swamp. The fundamental question was about determining the option value of the swamp by stating the WTP. When asked whether they considered the conservation of the wetland as being important, the response from the respondents was overwhelming with all of them expressing the need for the swamp to be conserved. However, when asked more precisely how much they would towards the preservation measures of the swamp, opinions differed. Of the 94 respondents, 78 were willing to pay for the conservation of the swamp accounting for 83%. 17% of the respondents were not willing to pay. These were the 16 respondents that gave a ' 0 ' or 'protest bid.'

However there were differences in opinion as concerns the WTP for conservation in respect of who was to pay for the conservation. The respondents however qualified their unwillingness to pay by giving various reasons as shown in table 7. About 12.5% of the respondents were unwilling to pay because they could not afford it. Both of these respondents had a monthly income of less than Kshs.3,000 and a family size of 6 and 7 respectively. About 56% of the respondents were unwilling to pay expressing the notion that it was the government's responsibility to conserve the swamp.

Table 7: Reasons for not being willing to pay for conservation.

Reason	Frequency	Percentage
I cannot afford it	2	12.4
Conservation is of no value to me	5	31.3
Government to pay for conservation	9	56.3
Total	16	

Source: Field data

4.5 Respondents Bids for WTP.

WTP was expressed in terms of Kenya shillings (Kshs). Although a payment card with several figures was presented to the respondents, no bids were made for some of the amounts especially the bid of Kshs 700. 40 out of 94 respondents gave a bid of Kshs. 2000/=. Up to 82% of the respondents bided between Kshs. 0 and Kshs. 500. The 200 bid was the most popular amounting a percentage of 42.6 of all the bids given by respondents. Kshs 0 was considered the minimum bid while Kshs 2000 was the maximum bid. Table 8 gives a summary of WTP bids.

Table 8: Summary of Respondents Bids for Willingness to Pay

WTP(Kshs)	Frequency	Percentage
0	16	17
200	40	42.6
300	3	3.2
500	18	19.1
600	2	2.1
800	3	3.2
1000	8	8.5
2000	4	4.3

Source: Field data

4.6 Factors Determining WTP

Several socio-economic factors were assumed to influence WTP. The researcher used the mean as an ideal measure of central tendency to determine the willingness to pay for each factor. The willingness to pay was also assumed to be a result of the influence of many factors. Correlation was used to determine whether there existed a relation between the WTP and various variables. The results did vary between the factors said to influence the WTP. The most notable difference found was that of income in relation to the mean willingness to pay for conservation of the swamp. The gender factor was also identified as a key influence on the bidding pattern. Each of these factors has been discussed.

4.6.1 Income level

This referred to income that respondents got from their earnings and other sources on a monthly basis. This was on a monthly basis. Table 9 shows the relationship between

the respondent's income level per month and the willingness to pay for conservation activities per annum.

Table 9: Income level and Willingness to Pay

Income per Month (Ksh.)	Income per Month (Ksh.) Mid point	Frequency	Percentage	WTP (mean Ksh.)
0 – 1000	500	3	3.19	167
1001 – 3000	2000	19	20.21	337
3001 – 6000	4500	36	38.30	267
6001 – 9000	7500	12	12.77	642
Above 9000	Above 9000	24	25.53	546
Total		**94**	**100**	

Source: Field data

The figures provided for willingness to pay were averages for each income level. These figures show that there is a positive relationship between income levels and willingness to pay. The higher the income level, the higher the respondents are willing to pay for conservation per annum.

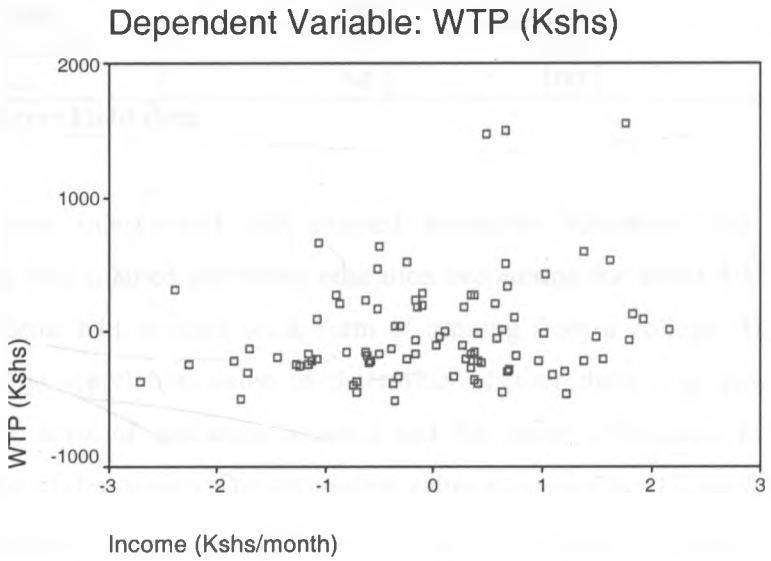


Figure 7: Partial Regression Plot of Income and WTP

Source: Field data

The correlation value that depicts this relationship is 0.8. The scatter plot in Figure 7 also indicates the same relationship as being positive. To see the correlation between WTP and the mean amount in each income level, the researcher established that there was a strong positive correlation of 0.8. This gave the information that the Willingness To Pay increased constantly from the lower income levels to higher income levels indicating the positive correlation obtained. The data presented clearly shows the increasing WTP for conservation corresponding with higher income levels.

4.6.2 Education

This was considered an important variable that would affect WTP. Although provision was made on the questionnaire for various levels of education including illiterate respondents, results revealed that all respondents had been through formal education. The summary of WTP in relation to the educational level of the respondents is shown in Table 10.

Table 10: Education Level and Willingness to Pay

Education level	Frequency	Percentage	WTP (Mean in kshs.)
Primary	31	32.98	300
Secondary	35	37.23	503
College	24	25.53	417
University	4	4.26	275
Total	94	100	

Source: Field data

70% of those interviewed had attained secondary education and less. Four respondents had attained university education accounting for about 4.3%. 25.5% of the respondents had attained some form of training from a college. The researcher calculated the correlation value to determine whether there was any relationship between the level of education attained and the mean willingness to pay for the conservation of the swamp. The correlation value attained was -0.2 showing that there was no relationship between the level of education attained and the households' willingness to pay for the conservation of the swamp. This is reflected in the scatter plot of Figure 8.

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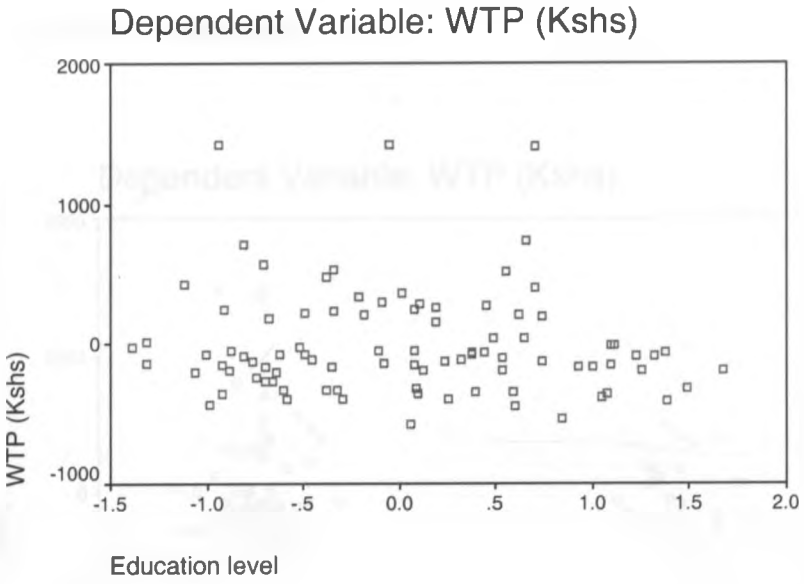

Figure 8: Partial Regression Plot of Education Level and WTP

Source: Field data

4.6.3 Gender

The study was out to determine whether the respondents being male or female would have an effect on WTP. The results are given in Table 11 below.

Table 11: Gender and Willingness to Pay

Gender	Frequency	Percentage	Mean WTP
Female	23	24.47	247.83
Male	71	75.53	440.85
Total	**94**	**100**	

Source: Field data

Most of the respondents interviewed were male forming a high percentage of the 75.5%. Female respondents were 24.5% of those interviewed. Table 11 indicates that there was an increase in the mean WTP for conservation of the Ondiri swamp from Ksh 247 to 440 for female to male respectively. This showed that men were more willing to pay for conservation than women. The partial regression shows that there was a relationship between gender and WTP as is given in Figure 9. The reverse was anticipated considering that women were more likely to be negatively affected

following the degradation of the swamp as they would have to travel far to fetch water. These results can however be qualified by the low number of female respondents as opposed to the male.

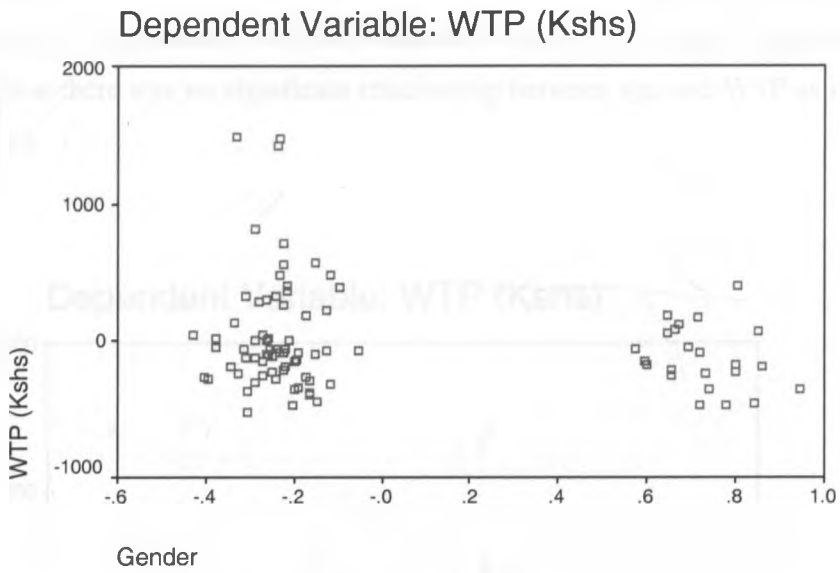

Figure 9: Partial Regression Plot of Gender and WTP

Source: Field data

4.6.4 Age

In this study, the respondents were divided into two main categories according to age. These were those below and above 40 years of age. It was assumed that decisions and priorities of the respondents were likely to be influenced by their age which would then ultimately affect WTP. Individuals above 40 years of age were noted as having a high option value for the conservation of the swamp than those below 40 years of age as indicated in Table 12. A partial regression shows that there was no significant relationship between age and WTP.

Table 12: Age and Willingness to Pay

Age	Frequency	Percentage	WTP (Mean Ksh.)
Below 40 years	62	65.96	373
Above 40 years	32	34.04	450
Total	94	100	

Source: Field data

62 of the respondents were said to be below the age of 40 years making a percentage of about 66%. 34% of the respondents were noted as being above 40 years of age. The correlation value was computed to determine the mean willingness to pay for the conservation of the swamp. The correlation value was positive one (+1) indicating that there was a strong relationship between the mean willingness to pay for the conservation of the swamp and the respondents age. The partial regression plot indicated that there was no significant relationship between age and WTP as is shown in Figure 10.

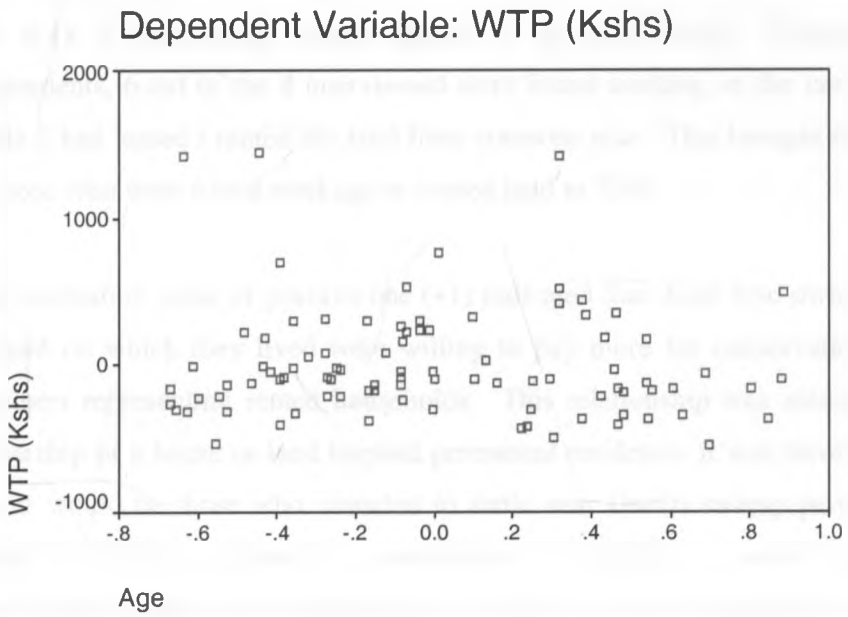

Figure 10: Partial Regression Plot of Age and WTP

Source: Field data

4.6.5 Home/Land Ownership

Respondents from the rural and urban household groups were expected to say whether the houses they lived in were owned by them or were rented. Respondents found at the site of Ondiri Swamp were to declare whether they owned the land adjacent to the swamp or had rented / leased it. Table 13 shows a summary of WTP and the age of the respondent.

Table 13: Home / Land ownership and Willingness to Pay

Type of ownership	Group	Frequency	WTP (Mean Ksh.)
Owned	Urban	14	456
	Rural	34	
Rented	Urban	29	400
	Rural	9	
Total		86	

Source: Field data

The survey found out that more people in the rural area lived in houses they owned as opposed to their counterparts in the urban areas with figures being 34 and 14 respectively. On the contrary, 29 respondents in the urban area lived in rented houses and only 9 respondents rented houses in the rural areas. Among the onsite respondents, 6 out of the 8 interviewed were found working on the land they owned while 2 had leased / rented the land from someone else. This brought the percentage of those who were found working on owned land to 75%.

The correlation value of positive one (+1) indicated that those who owned the houses or land on which they lived were willing to pay more for conservation than those members representing rented households. This relationship was anticipated in that ownership of a house or land implied permanent residence. It was therefore expected that it would be those who intended to settle near Ondiri swamp permanently that would be willing to ensure its conservation for posterity. A partial regression plot revealed that there was no significant relationship between home/land ownership and WTP as is shown in Figure 11.

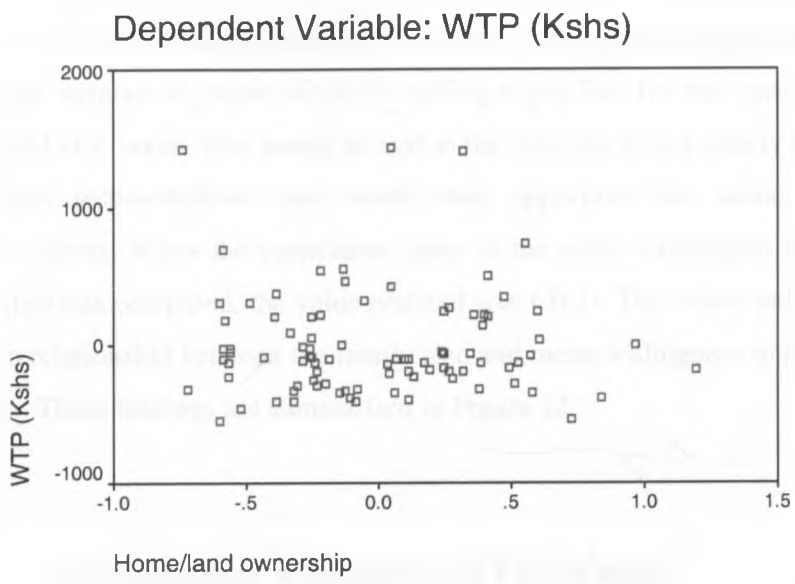

Figure 11: Partial Regression of Home/Land Ownership and WTP

Source: Field data

4.6.6 Family Size

This referred to the number of people living within a household. The family size ranged from between 1 and 10 people. The details are shown in table 14.

Table 14: Family Size and Willingness to Pay

NUMBER OF PEOPLE HOUSEHOLD	FREQUENCY	PERCENTAGE	WTP (MEAN KSh.)
1	1	1.06	500
2	6	6.38	283
3	23	24.47	296
4	22	23.40	405
5	13	13.83	354
6	20	21.28	520
7	6	6.38	567
8	2	2.13	600
10	1	1.06	0
Total	**94**	**100**	

Source: Field data

Among those interviewed, it was noted that 23 households had a family size of three people, one household had I person and 10 people respectively. The average number of people per household was estimated at 5 people. It was assumed that the household having a larger number of people would be willing to pay less for the conservation of the swamp and vice versa. This would be tied to the fact that such a family was likely to have more responsibilities and would thus apportion less money towards conservation efforts. When the correlation value of the mean willingness to pay and the family size was computed, the value realized was (-0.2). This value indicates that there was no relationship between the family size and mean willingness to pay for the conservation. These findings are summarised in Figure 12.

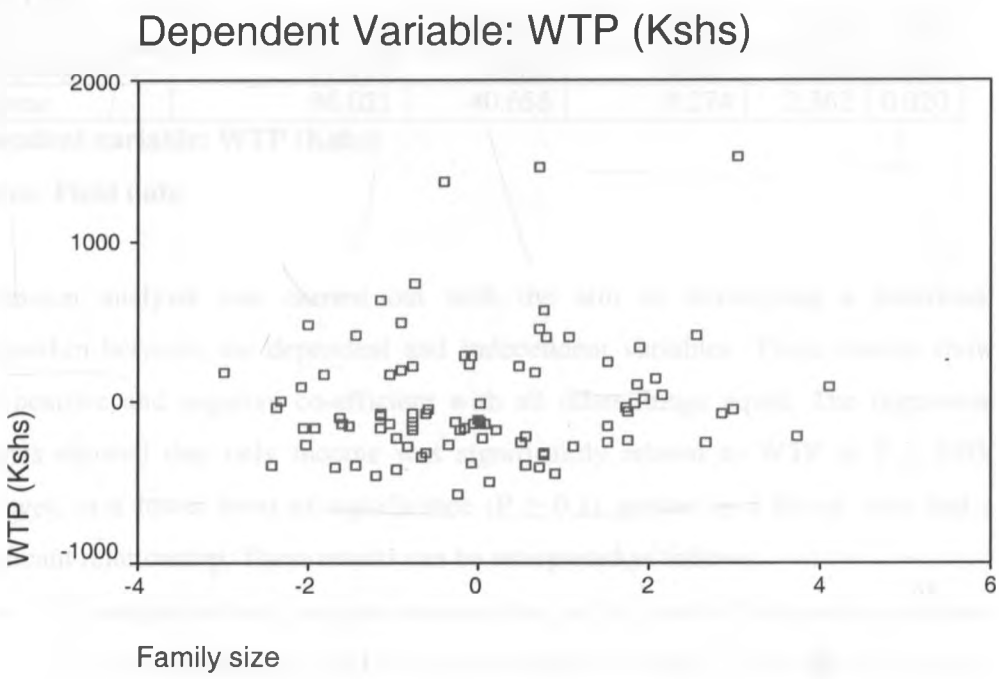

Figure 12: Partial Regression Plot of Family size and WTP

Source: Field data

4.7 Regression Analysis

A regression analysis was used to analyse the relationships between WTP and the socio-economic characteristics of the respondents as discussed in section 4.6. The analysis is shown in table 15.

Table 15: Regression analysis

Predictor	Unstandardized Co-efficient	Standard error	Standard co-efficient	T	P
Constant	378.910	368.244	0.000	1.029	0.306
Education Level	-43.744	54.837	-0.094	-0.798	0.427
Gender	-171.838	97.745	-0.182	-1.758	0.082
Age	-57.146	99.844	-0.068	-0.572	0.569
Home/land ownership	-43.527	101.707	-0.053	-0.428	0.670
Family size	33.356	27.932	0.133	1.194	0.236
Sampling zone	-17.016	73.876	-0.027	-0.230	0.818
Income	96.021	40.656	0.274	2.362	0.020

Dependent variable: WTP (Kshs)

Source: Field data

Regression analysis was carried out with the aim of developing a functional relationship between the dependent and independent variables. These results show both positive and negative co-efficient with all other things equal. The regression analysis showed that only income was significantly related to WTP at $P \geq 0.05$. However, at a lower level of significance ($P \geq 0.1$) gender as a factor, also had a significant relationship. These results can be interpreted as follows;

- The education level variable showed that as the level of education increased there was a decrease in WTP for conservation of 0.094. This was not expected considering that the increase in literacy levels was to reflect the desire for conservation in that the higher the level of education one attains, the higher they are expected to appreciate the need for conservation of natural resources.

- As the probability of one being a female increases by one unit there is an inverse relationship as this will mean the decrease in WTP for conservation of 0.182

- Age also has an inverse relationship. As the probability one being 40 years of age increases by one unit there is a decrease in WTP for conservation of 0.068

- There exists an inverse relationship of the variable home/land ownership and WTP for conservation of Ondiri swamp. As the probability of one owning a home/land increases by one unit the WTP decreases by about 0.053.

- There is a direct relationship between family size and WTP. As family size increases by one unit, there is an increase of 0.131 in WTP for conservation.

- As the sampling zone increases by one unit, there is a decrease of 0.027 in WTP for the conservation of Ondiri swamp.

- The increase of income by one level means the probability of WTP for the conservation of the swamp increasing by 0.274

4.8 Estimation of the WTP Function

Generally economic theory predicts a positive relationship between individuals' income and their WTP amount. Studies by Whittington *et al* (1993) indicated that WTP of individuals is also related to other socio-economic, demographic and environmental factors. This study looked at how explanatory variables influenced individuals WTP. According to Belhaj (1996) factors thought a prior (with modification) likely to affect individuals valuation hence WTP for an improvement of the environment include;

The general functional form for the WTP, given the described variables (WTP determinants), is:

WTP = f(Y, Ag, Fs, Ed, Ge, Ho,Sa)

Where:

WTP- Willingness to pay

y – Income

Ag - Age

Fs - Family size

Ed - Educational level

Ge - Gender

Ho - Home

Sa - Sampling zone

A simple linear model was assumed for the regression procedure because most of the explanatory (independent) variables were dummy variables and the dependant variable was continuous. This implies the maintenance of basic principles for linear model regression.

To estimate the parameters of the WTP function, a linear regression of the variable WTP (dependant variable) on all the other sample variables (independent ones) was determined independently and the result of the regression showed that not all of the explanatory variables had significant relations with the WTP variable. The mean was considered appropriate in estimating the amount of money the households were willing to pay per year for conservation. This was arrived at by adding up the entire total amount of money proposed in the sampled households divided by the total number of households sampled. This gave a figure of Kshs. 399 as mean willingness to pay for conservation of Ondiri Swamp per year.

Considering that the population of Kikuyu township sub-location lives in 2987 households, then it can be further estimated that it is expected that annually a sum of Kshs 1,191,813 would be collected from residents within the sub-location towards the conservation of Ondiri swamp.

4.9 Overall Wetland Value

The mean WTP value, of the 94 respondents was used in the estimation of the economic value of Ondiri swamp. Considering that the population of Kikuyu Township sub-location lives in 2987 households, then it can be further estimated that it is expected that an annual sum of Kshs. 1,191,813 would be collected from the residents within the sub-location towards the conservation of Ondiri swamp.

4.10 Discussion

Many respondents agreed that Ondiri swamp had many resources. Water was considered the main resource. Residents were supplied with water from pumps or boreholes fed by the swamp. This water was used for domestic purpose, in industries and irrigation of crops as shown in Plate 2.

Plate 2: Irrigation farming at Ondiri swamp

Grass was also considered a key resource. Some people were seen at the swamp site with carts loaded with grass. Others were found harvesting grass using pangas and patches of harvested areas in the middle of the swamp were visible as shown in Plate 3.

Most of the respondents noted that water supply was the key direct use of the swamp followed by agricultural resources derived from irrigation farming using swamp water. Notably the people found at the swamp site most appreciated pasture/grass as a resource. The grass collected was sold to far places. Residents

claimed that the grass was poisonous to livestock and preferred to sell it to unsuspecting buyers. This was however not confirmed by the researcher.

Plate 3: Fodder harvesting at Ondiri Swamp

The need for conservation of the swamp was determined by the peoples' perception of its environmental quality. When asked what their opinion of the swamps quality was, more than 50% recorded that there was need to improve the quality.

The photographs taken at the swamp clearly indicated that quality of the environment was declining as is shown in Plate 3. There was litter at the swamp site there was an upcoming residential area on the slopes facing the swamp. This was likely to compromise the quality of the swamp. There was need to conserve the swamp. Out of 94 respondents all of them registered that it was important to conserve the swamp. However when asked whether they were willing to pay for the conservation a few declined to take up the responsibility.

Plate 4: Littered swamp-site

When the model used during the study was tested the following results were reported; The R squared value was 0.128. This was interpreted to mean that the social economic factors (variables) used in the study contributed 12.8% towards explaining the WTP value leaving unexplained variables at 87.2%. This therefore means that apart from the variables highlighted in model there are other factors which also determine WTP. In this respect there is need for another study to look in to factors that significantly influence peoples WTP or economic value of Ondiri swamp.

The computed value of F using ANOVA was 1.566 and was in the non rejection region. The null hypothesis that all the multiple regression coefficients are zero was therefore not rejected. From a practical stand point this means that the independent variables mean(education level, gender, age, family size, sampling size and income) did not have the ability to explain the variation in the dependent variable (WTP).

Education raises an individual's awareness to environmental issues. Generally an educated person is likely to be more aware of the need to conserve the natural

environment than one with a lower level of education. As per the hypothesis of the study, it was also important to test the variable education level to determine whether the regression co-efficient was 0 or not. The hypothesis was stated as follows;

Education level:

$H_o : \beta = 0$ (The regression co-efficient for education level is equal to zero)

$H_1 : \beta \neq 0$ (The regression co-efficient for education level is not equal to zero)

The hypothesis was tested at the 0.05 level. The way the alternate hypothesis was stated indicated that the test was two tailed. The student t test statistic was used. The critical value of t for a 2 tailed test using 0.5 significance level showed that H_o is rejected if t is less than (-1.980 - -2.000) or greater than (1.980 - 2.000). The computed t value for education level was -0.8 which is greater than -1.980 hence do not reject H_o. This means that we conclude that β could equal 0. The independent variable education level was therefore not a significant predictor of WTP.

Whereas variables within the model added up to determine the WTP (multiplicative effect) income was considered a key factor in determining WTP. When a step wise regression was done it was noted that income contributed 6.6% which was more than half of the 12.8%. This was expected considering that one's income is likely to determine how much money one can spend on conservation activities.

The mean WTP per household was fair considering the income level of the people. This could be explained by the fact that the residents realised the importance of the swamp's quality in their well-being. The idea of community participation in conservation was appreciated as this was common practice in other fields of development.

CHAPTER FIVE

SUMMARY OF RESULTS, CONCLUSION AND RECOMMENDATIONS

5.0 Introduction

This chapter highlights the summary of results of the study. It further makes a conclusion and recommendations to policy makers. It also points out areas for further research.

5.1 Summary of Findings

Water is a key resource of Ondiri swamp. The local people use it for domestic purposes. It is also used by nearby industries. Water is used to irrigate farms that border the swamp. This includes both small scale and large scale farming. The swamp is used in various ways by the residents of Kikuyu Township sub-location.

There is no control regarding the use of resources and services of Ondiri swamp. The direct uses include water supply, agricultural resources and recreational/educational services. The swamp is a key source of underground water storage that is taped by the area surrounding it. Option value in respect to economic valuation, is considered as important to the people living near the swamp.

The quality of the swamp is declining and needs to be improved. The swamp is littered. Some people have encroached on the swamp in form of residential settlement areas and a living on the slope facing the swamp. These settlements do not have a clear sewerage and waste disposal system. Their activities are likely to endanger the wetlands eco-system. Some of the swamp land is used for agricultural purposes especially during the dry season which is a threat to the existence of the swamp.

Conservation is important if sustainability is to be achieved. There are no programmes to this effect. There are no restrictions as concerns the use of and access to the swamp. Residents however realize the need to conserve the natural environment. They too appreciate the importance to participate in conservation as key stakeholders. This is because residents value the swamp and recognise that the decline in swamp quality is likely to impact negatively on them.

The residents of the area attach an economic value to the swamp. They are therefore willing to pay for its conservation. This is at a mean of Kshs. 399 per household per annum. This can be inferred to the 2987 households within Kikuyu township sub location to an annual amount of Kshs 1,191,813 for the conservation of the swamp.

WTP for conservation of Ondiri swamp is mainly determined by the income levels of the residents of Kikuyu Township sub-location. Other socio-economic factors namely gender, age, education level, family size and home/land ownership do not have a significant effect on WTP. A strong economic base and an increase in income will therefore mean that more money can be made available by residents towards conservation.

5.2 Conclusion

Ondiri swamp has a great economic value. Although it has mostly been exploited for direct and indirect uses, it also has non-use values. The option value of Ondiri Swamp can be estimated at about 1.2 million per annum. The resources of the swamp can be exploited for the welfare of the residents of Kikuyu Township sub-location.

The swamp's resources are however considered public goods with open access. If environmental quality of Ondiri swamp is to be maintained, then sustainable use of its resources must be ensured. Conservation of the swamp and it's resources need to be considered a priority in order to avert threats to environmental quality.

Conservation of the wetland is only possible if people value the resource. It is therefore important to understand the components, functions and attributes of Ondiri Swamp as this increases the value people have of the wetland and consequently reflect in the WTP for conservation.

Income level is a main factor that determines the WTP for conservation of Ondiri swamp among the residents of Kikuyu Township Sublocation. It is clear that the higher the income one earns the more money they are willing to pay towards the conservation of Ondiri Swamp.

The hypothesis that there is a relationship between education level and WTP for the conservation of Ondiri swamp was rejected. This means education level does not determine the people's value for Ondiri swamp. This can be attributed to weaknesses in the education curriculum in relation to environmental education. The lack of emphasis on environmental issues within the curriculum particularly at higher levels of education has meant low appreciation of the environment. This explains why those who had attained university education did not highly value the swamp as should be the case.

5.3 Recommendations

Following the results realized during the study, the following recommendation were advanced;

- There is an urgent need to develop a management plan for the swamp. In the same respect clear boundaries should be drawn to delineate the swamp for effective management. A management plan would promote sustainable utilization of the swamp.
- NEMA to enforce legislation that regards environmental quality of Ondiri swamp and its immediate environs. These should target the dumping or littering of the swamp, harvesting grass and water extraction. Similarly, the Kikuyu Town Council enforce its By-laws to guard against encroachment onto the swamp during the dry season.
- There is need for better planning of the Kikuyu Township. An elaborate sewerage system should be put in place as a matter of urgency. Residential areas on the slope facing the swamp should be relocated immediately to avoid compromising on the quality of the wetland environment. The placement of these residential quarters, encourage littering of the swamp while at the same time promote leakage of sewer into the swamp.
- NEMA to enforce the regulation of ensuring a mandatory EIA for projects likely to impact on the wellbeing of the swamp in regard to EMCA 1999. The swamp has both use and non-use values which need to be safeguarded to ensure inter-generational equity and sustainability. An EIA is consequently required for the construction of the southern by-pass so as to determine its impact on the swamp and the possible mitigation measures.

- Residents living around Ondiri swamp should be involved in the conservation of the wetland. Any conservation measures should encourage the participation of the people living in its environs, as key stakeholders. Community participation will ensure sustainability of any conservation programmes. Community participation will also include the use of indigenous knowledge and consequently, the people's value of the swamp may improve.
- Environmental and natural resources should be accorded the priority they deserve in the national economic planning process. The full value of the environment should be reflected in economic policies and development plans. Government decisions need to take into account economic benefits of environmental conservation and economic costs of environmental loss.
- There is need to review the education curriculum in regard to establishing the relevance and effectiveness of environmental studies at different levels of the education system.

5.4 Further Research

Considering the findings of the current study, there is suggestion that further research be undertaken.

- Whereas this study has only considered the option value of Ondiri swamp, it is necessary that the assets of the swamp be valued under the Total Economic Valuation Framework to determine the approximate value of the swamp.
- An elaborate study be undertaken to establish the ecological functions and services of the swamp. This will be beneficial in attempting a study on the Total Economic Value of Ondiri swamp.
- An economic valuation of Ondiri swamp should be carried out using another valuation technique namely market price in order to establish the direct value of key resources of the swamp in order to compare results with this report.
- Similarly, a comparison study should be carried out using the various elicitation methods namely open ended, and dichotomous choice method and bids from the study be compared with those of this study that used the payment card.
- A larger sample size can also be used and the results compared with those of this study in order to confirm the reliability and validity of the Contingent

Valuation Method in valuing wetland ecosystems in developing countries. The value for the swamp should be extended to the people of a large geographical extent preferably the district.

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APPENDICES

Appendix 1 Questionnaire:

1. Date of Interview _____
2. Time taken _____
3. Research Assistant_____

INTORDUCTION REMARKS

A research team is currently conducting research in Kikuyu Township Sub-location. This is aimed at establishing the Economic value of Ondiri swamp as is perceived by the people in its environs.

The objectives of this study are:

a. To determine the available resources and services.
b. To identify the use of resources and ecological services
c. To estimate the community's minimum willingness to pay (WTP) for the conservation of Ondiri swamp.

Any information collected will be for research only and will be treated with confidentiality. You are therefore encouraged to answer questions as this information will give guidance as concerns conservation policies in regard to community participation in the management of wetland areas in Kenya.

Background information wetland user.

1. i) Name (optional) _____ date of interview:_____
   ii) Sex: Male [ ] Female [ ]
   iii) Age: below 40 [ ] and Above 40 [ ]
   iv) Village: _____

2. Occupation: (main source of income)
   i) Civil servant [ ]
   ii) Teacher [ ]
   iii) Farmer [ ]
   iv) Wage earner [ ]

v) Other specify _____

3. What is your educational level?
   i) University [ ]
   ii) College [ ]
   iii) Secondary [ ]
   iv) Primary [ ]
   v) Other specify
   _____

4. What is the average family income per month? (In Kshs.)
   i) Less than 1000
   ii) 1001 – 3000
   iii) 3001 – 6000
   iv) 6001 – 9000
   v) 9001 and above

5. Put a tick at the type of your home/ land ownership
   i) Rented
   ii) Owned

6. How many people live in your household? [ ]

Wetland use information.

1. In your opinion is the wetland put to good use? Yes [ ] No [ ]
2. In what way do you directly use the swamp?
   i) _____
   ii) _____
   iii) _____
   iv) _____
   v) _____

3. Swamp areas have potential for different uses. How would you rate the following uses,
   i) Growing crops
   ii) Feeding livestock
   iii) Fishing
   iv) Water supply
   v) Brick making/ soil substrate use
   vi) Making baskets and mats

I – most important ⟶ VI – least important

4. List the order of importance of the wetland use

a. _____
b. _____
c. _____
d. _____
e. _____

Willingness to pay (WTP)

1) What would you say is the present state of Ondiri Swamp

i) Dreadful [ ]
ii) Poor [ ]
iii) Fair [ ]
iv) Good [ ]
v) Excellent [ ]

2) Ondiri Swamp like other Wetland areas in the region has been reducing in size over the years. This reduction is likely to interfere with the future existence of the swamp. Concerned residents need to take necessary precautions to ensure its conservation. If a community based organization set up an independent fund for the conservation of the swamp, how much would you be willing to pay in Kshs as an annual fee?. You would be paying to ensure that the swamp is preserved and that its current functions and resources are maintained.

(***Please circle one amount***)

0	200	300
500	600	700
800	1000	2000

3) If you bid is '0' what is your reason for not being willing to pay for the conservation of Ondiri Swamp.

i) I can not afford it
ii) The conversation of the swamp is of no value to me
iii) I do not trust community based organizations
iv) I see no reason to pay for a God given commodity
v) The government should pay or carry out conservation
vi) Others, specify _____

Appendix 2

Strata area	Respondent number	Income level	Education level	Gender	Age	Home ownership	Family size	WTP
URBAN	1	0-1000	College	Male	Below 40	Rented	3	0
	2	1001-3000	Primary	Male	Below 40	Rented	3	200
	3	1001-3000	Secondary	Female	Below 40	Rented	8	200
	4	1001-3000	Secondary	Male	Below 40	Rented	3	200
	5	1001-3000	College	Male	Above 40	Owned	4	200
	6	1001-3000	Primary	Female	Below 40	Rented	2	0
	7	3001-6000	Primary	Male	Below 40	Rented	3	200
	8	3001-6000	College	Male	Above 40	Owned	4	200
	9	3001-6000	Primary	Male	Below 40	Rented	4	200
	10	3001-6000	Secondary	Female	Below 40	Rented	4	500
	11	3001-6000	College	Female	Below 40	Owned	4	500
	12	3001-6000	Primary	Male	Below 40	Rented	4	200
	13	Above 9000	Secondary	Male	Below 40	Rented	3	500
	14	3001-6000	Secondary	Male	Above 40	Owned	6	800
	15	3001-6000	Secondary	Male	Below 40	Rented	3	300
	16	Above 9000	Primary	Male	Above 40	Rented	6	1000
	17	Above 9000	Secondary	Male	Above 40	0wned	6	200
	18	3001-6000	College	Male	Below 40	Rented	3	0
	19	3001-6000	Primary	Male	Below 40	Rented	3	0
	20	3001-6000	Secondary	Male	Below 40	Rented	3	600
	21	6001-9000	College	Male	Below 40	Owned	6	500
	22	3001-6000	Primary	Female	Below 40	Rented	6	200

	23	6001-9000	College	Male	Below 40	Rented	2	600
	24	Above 9000	Secondary	Male	Below 40	Rented	7	500
	25	Above 9000	Secondary	Female	Below 40	Rented	5	200
	26	6001-9000	College	Male	Below 40	Rented	5	2000
	27	6001-9000	College	Female	Below 40	Owned	5	500
	28	3001-6000	Secondary	Male	Below 40	Rented	3	200
	29	6001-9000	Secondary	Female	Above 40	Rented	4	200
	30	6001-9000	College	Female	Below 40	Rented	4	500
	31	6001-9000	Secondary	Male	Below 40	Rented	7	2000
	32	Above 9000	University	Male	Above 40	Owned	5	500
	33	Above 9000	College	Female	Above 40	Owned	3	0
	34	Above 9000	College	Male	Above 40	Rented	5	0
	35	3001-6000	College	Female	Below 40	Owned	6	200
	36	Above 9000	Secondary	Male	Below 40	Owned	4	2000
	37	Above 9000	University	Male	Below 40	Rented	3	200
	38	Above 9000	College	Male	Below 40	Owned	4	0
	39	3001-6000	Primary	Male	Above 40	Owned	6	0
	40	3001-6000	Secondary	Male	Above 40	Rented	4	0
	41	3001-6000	Secondary	Male	Below 40	Rented	4	200
	42	3001-6000	Primary	Male	Below 40	Rented	3	0
	43	6001-9000	Secondary	Male	Below 40	Owned	5	200
RURAL	44	0-1000	Primary	Female	Below 40	Rented	7	0
	45	Above 9000	Primary	Male	Above 40	Owned	4	500
	46	Above 9000	Secondary	Male	Above 40	Owned	4	1000

	47	1001-3000	Primary	Male	Below 40	Rented	3	500
	48	3001-6000	Secondary	Female	Below 40	Owned	6	500
	49	3001-6000	Primary	Male	Below 40	Rented	2	500
	50	1001-3000	Secondary	Male	Below 40	Rented	3	1000
	51	Above 9000	University	Male	Below 40	Owned	5	200
	52	Above 9000	Secondary	Male	Above 40	Owned	4	200
	53	1001-3000	College	Male	Below 40	Owned	6	300
	54	3001-6000	Primary	Male	Above 40	Owned	7	200
	55	1001-3000	Primary	Male	Below 40	Owned	3	200
	56	1001 – 3000	Secondary	Male	Above 40	Owned	6	0
	57	3001-6000	Secondary	Male	Below 40	Rented	2	200
	58	Above 9000	College	Male	Above 40	Owned	6	1000
	59	Above 9000	University	Female	Below 40	Owned	3	200
	60	1001-3000	Secondary	Male	Below 40	Owned	4	200
	61	3001-6000	Primary	Male	Above 40	Owned	6	1000
	62	6001-9000	Secondary	Male	Below 40	Rented	6	800
	63	3001-6000	Secondary	Male	Below 40	Rented	6	500
	64	3001-6000	Primary	Female	Below 40	Owned	3	200
	65	1001-3000	College	Female	Below 40	Owned	6	200
	66	Above 9000	College	Female	Below 40	Owned	3	0
	67	Above 9000	College	Male	Above 40	Owned	7	500
	68	1001-3000	secondary	Male	Below 40	Owned	1	500
	69	Above 9000	secondary	Male	above 40	Owned	4	1000
	70	Above 9000	College	Male	above 40	Owned	6	2000

	71	1001-3000	Primary	Male	above 40	Owned	4	500
	72	3001-6000	Primary	Female	above 40	Owned	6	500
	73	1001 -3000	Primary	Male	Above 40	Owned	5	200
	74	3001-6000	Primary	Female	Above 40	Rented	10	0
	75	1001-3000	Primary	Male	Below 40	Owned	4	200
	76	Above 9000	Secondary	Male	Above 40	Owned	6	200
	77	1001-3000	Primary	Male	Above 40	Owned	4	200
	78	3001-6000	Primary	Male	Below 40	Owned	4	200
	79	3001-6000	College	Female	Below 40	Owned	2	200
	80	Above 9000	Secondary	Male	Above 40	Owned	8	1000
	81	1001-3000	Primary	Male	Below 40	Owned	3	1000
	82	1001-3000	Primary	Male	Below 40	Rented	3	800
	83	3001-6000	Secondary	Male	Above 40	Owned	5	0
	84	3001-6000	College	Male	Above 40	Owned	5	200
	85	0-1000	Secondary	Female	Above 40	Owned	3	500
	86	6001-9000	College	Male	Below 40	Owned	3	0
ONSITE	87	3001-6000	Secondary	Male	Above 40	Rented	5	200
	88	3001-6000	Primary	Male	Below 40	Owned	6	300
	89	3001-6000	Secondary	Male	Above 40	Owned	5	200
	90	3001-6000	Primary	Male	Below 40	Owned	6	200
	91	6001-9000	College	Male	Below 40	Owned	7	200
	92	6001-9000	College	Female	Below 40	Rented	2	200
	93	3001-6000	Primary	Male	Below 40	Owned	5	200
	94	Above 9000	Primary	Female	Above 40	Owned	4	200

Source: Field data