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The KENYA INSTITUTE for PUBLIC POLICY RESEARCH and ANALYSIS

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THE KENYA INSTITUTE FOR PUBLIC POLICY RESEARCH AND ANALYSIS (KIPPRA)

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Productive Sector Division
Kenya Institute for Public Policy
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Abstract

Yala wetland is one of the major wetlands in Kenya that not only supports a huge species of ecosystem, but also acts as a reservoir to Lake Victoria fisheries. Also, the swamp supports livelihood of the community by the economic activities they engage in. There have been efforts to convert the swamp into a large-scale commercial agricultural activity, the recent one being leasing the wetland to Dominion Farms Limited. This has led to disruptions of the local communities' lifestyle through relocation from their homes and destruction of the ecological ecosystem. The heavy agricultural use is also likely to threaten the fisheries in the swamp and those of Lake Victoria, which rely on the swamp as a breeding ground. With the swamp destruction likely to go on with expansion of the Dominion farm activities, it is necessary to establish whether converting the use of the wetland is viable and more beneficial than conserving it.

This study evaluates the change in the Total Economic Value (TEV) of Yala wetland as a result of degradation by identifying the type of existing resources, their use values and importance in people's every day life. The main objective of valuing wetland resources is to identify their uses, hence their importance to the livelihoods of communities as well as their environmental and functional usefulness. Economic valuation helps in avoiding the loss of environmental resources, especially those with irreversible outcomes. This assists in managing their sustainable use and in making conservation decisions.

The TEV of the wetland is estimated at Ksh 8.31 billion per annum, which translates to Ksh 475 million per hectare per year (US$ 120.4 million) with a present value of US$1.20 billion (1US$=Ksh 69). The value of Yala wetland derives mainly from agriculture produce and fisheries accounting for 64.7 per cent of the total wetland value, which forms the major economic activities of the people around the wetlands. Fisheries provide the highest proportion of the economic value (37.0%), while agriculture provides 27.7 per cent. Compared to an estimated value to be derived from the activities of Dominion Farm of Ksh 3.8 billion (Ksh 330 million per hectare per year-US$ 55.1 million), TEV is high and thus the wetland should be conserved rather than converted.

Despite limitations of the methodology, the study provides valuable information to policy makers. They point out the need for renegotiations of the terms and conditions of the present lease agreement between

the Dominion Farms Ltd and the Government of Kenya or suspending it altogether until a more carefully and thorough study is conducted.

Abbreviations and Acronyms

CV	Compensating Variation
CVM	Contingent Valuation Method
EV	Equivalent Variation
JICA	Japan International Cooperation Agency
KMFRI	Kenya Marine and Fisheries Research Institute
NTFP	Non-Timber Forestry Products
OLS	Ordinary Least Squares
TEV	Total Economic Value
WTA	Willingness to Accept
WTP	Willingness to Pay

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1. Introduction

Wetlands[1] have not been given due importance and value in development policy planning, hence the unfair attention they have received when they are being managed and conserved. This state of affairs has come about because in most cases, the values understood by people are the direct use values, which offer tangible benefits when consumed or used, and not the non-use values that are equally important in sustaining the normally tangible direct use values that people enjoy from wetlands' resources. Failure to account fully for the economic costs of conversion or degradation of environmental resources is a major factor behind the design of inappropriate development policies and wetlands reclamation programmes.

In fact, the problem is not that wetlands are deemed to have a lower economic value, but that this value is poorly understood, rarely articulated, and as a result is frequently omitted from decision making. The most efficient allocation of resources is one that maximizes economic returns. However, calculations of the returns to different land, resource and investment options have, for the most part, failed to deal adequately with wetland values.[2]

Given this tendency for under-valuation, it is hardly surprising that wetlands are being rapidly modified, converted, over-exploited and degraded in the interests of other more 'productive' land and resource management options that appear to yield much higher and more immediate profits. Dam construction, irrigation schemes, agricultural production, housing developments and industrial activities have all had devastating impacts on wetlands integrity and status, and economic policies have often hastened these processes of wetland degradation and loss. Decisions have tended to be made on partial information and this has favoured short-term (and often unsustainable) development imperatives, or led to conservation regimes that generate few financial

[1] Wetlands are defined by the Ramsar convention 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 metres". In addition, the Convention (Article 2.1) provides that wetlands: "may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six metres at low tide lying within the wetlands" (Barbier, Acreman and Knowlar, 1997).

[2] http://cmsdata.iucn.org/downloads/issuespaper01wetlandvaluationanddecisionmaking.pdf. Accessed on July 29, 2009.

or economic benefits. In the absence of information about wetlands values, substantial misallocation of resources has occurred and gone unrecognized, and immense economic costs have often been incurred. As Kotze, Breen and Queen (1995) argue, lack of appreciation for the broad range of wetlands values, in particular functional values, results in little action from the government.

The Yala swamp[3] is by far the largest papyrus swamp in the Kenyan section of Lake Victoria, making up more than 90 per cent of the total papyrus in the country (Nasirwa and Njoroge, 1997). This wetland has undergone considerable decline and degradation. Past studies on the Yala swamp recommended reclamation to establish a smallholder settlement scheme that would provide increased food and cash crop production (Gibb, 1954 and Ilaco, 1975). This has been an issue of great controversy particularly between the 'pro-development', mainly government officers who regard the swamp as a potentially rich agricultural ground, and the 'environmentalists', who see the swamp as an important ecosystem for various species of plants and animals (Osienala, 1998 and Aloo, 2003). Some of these studies have further suggested that the reclaimed land could support commercial fish production in fish ponds and cages in running water channels, which are estimated could produce upto 60 mettic tonnes of fish per year (Japan International Cooperation Agency, 1987).

The first reported reclamation involved one part of the swamp from the mid 1960s to early 1970s, in which 2,300ha were drained (Government of Kenya, 1987 and Osienala, 1998). Studies indicate that the swamp reclamation resulted in ecological problems such as lower water quality in Lake Kanyaboli, decreased species diversity and increased pressure on resources of the remaining wetland (Osienala, 1998). Investigations by Schuijt (2002) and Abila (1998) further indicated that the local community was the net loser from the reclamation; the benefits foregone from their use of wetlands far outweighed what they obtained. Despite this, new proposals have been developed and feasibility studies conducted for further reclamation and development of parts of the remaining wetland (Government of Kenya, 1987 and Osienala, 1998).

In 2003, the Kenya government leased part of the Yala wetlands for 25 years to Dominion Farm Ltd to undertake farming activities. Initially, the farm was restricted to Area I (Figure 1.1) but has now been moving to area II, which is ecologically vulnerable. On one hand, there are benefits

[3] This is third largest in the country after Lorian Swamp and the Tana River Delta.

to the local people, such as employment and development of roads, electricity and water supply in the area. However, there are great risks and uncertainties of losing the natural values that the wetland provides. Once lost, these values will be difficult to recover.

In general, wetlands control floods and filter toxicants, pollutants and sediments before they are introduced into major water bodies. They are also important habitats, providing feeding grounds and refuge for certain species and resting stations for migrating birds. Many wetlands are rich biodiversity areas with unique landscapes, providing aesthetic values of tourist significance. Traditional communities around wetlands have depended on them for water and nutritional supply of fish, traditional buildings, craft materials and extraction of resources for economic benefits, for example fish and papyrus for making mats and chairs. Traditional ceremonies and cultural practices are performed in wetlands as some communities have a lot of attachment to them. These values would be lost if the Yala swamp is converted. Currently, the Yala swamp is rapidly declining due to conversion to agriculture.

Despite the natural benefits that the Yala swamp provides, there is a great temptation, due to political pressure, to convert more of the swamp land to agriculture. It is therefore important to consider, determine and compare the benefits accrued from the conserved swamp and that of the converted land to inform policy. To address the problem of wetland loss, improved information and awareness is needed (Creemers and van den Berg, 1998). This implies valuation of direct, indirect and non-use benefits generated by wetlands (Dugan, 1990).

Attempts have been made in the past to put a monetary measure on the value of wetlands (Barbier, 1993; Batie and Shabman, 1982; Dixon, 1989; Lynne, Conroy and Prochaska, 1981 and Turner, 1991). Some studies have explicitly valued life-support functions such as flood and storm protection, nitrogen purification and water buffering in monetary terms (Thibodeau and Ostro, 1981; Faber, 1987; Folke, 1991 and Gren, 1992). Other studies have tried to estimate the aggregate value of a wetland, applying a direct valuation method such as the contingent valuation method (Bateman *et al.*, 1993 and Bergström *et al.*, 1990). Less frequently, attempts have been made to establish the life support value of entire wetland ecosystems (Gosselink, Odum and Pope, 1974; and Constanza, Farber and Maxwell, 1989). Some of the valuation studies carried out in Kenya are on Lake Nakuru National Park (Navrud and Mungata, 1994) and Tana Delta (Emerton, 1994). This study not only adds to an existing literature on wetland valuation, but also investigates whether it is more valuable to conserve the Yala wetland rather than convert it into an alternative use.

1.1 Rationale of the Study

The rationale for valuing environmental resources is to ensure use that will make them more beneficial and sustainable. Many environmental resources are complex and have multiple ecological functions. Generally, it is desirable to 'hold on' to these resources undegraded, as opposed to depleting, degrading or converting them to another use. Economic valuation provides us with tools to assist with the difficult decisions involved in the utilization of our environmental resources. The major application of economic valuation is to avoid the loss of environmental resources, especially those with irreversible outcomes. Thus, estimates of economic value of environmental and resource services form a valuable part of the information base, supporting resource and environmental management decisions.

Each choice or option for the environmental resource, either for leaving it in its natural state, allowing it to degrade or converting 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 analysed and evaluated. This requires that all the values gained and lost under each resource use option are carefully considered. For example, to preserve an area in its natural state requires that direct costs of preservation for setting up a protected area including monitoring and enforcement costs, and development benefits foregone, which are additional costs associated with the preservation option, be identified through the market.

A similar approach may be taken in evaluating the development options for the environmental resource. If the environmental resource is to be converted to some other use, not only should the direct costs of conversion be included as part of the costs of this development option, but also the foregone values that the converted resource can no longer provide (such as the loss of both important environmental functions, biological resources and amenity values).

Unfortunately, many of these values of the natural or managed environmental resource are not bought and sold on markets, and are thus generally ignored in private and public development decisions. Moreover, economic valuation of environmental resources is relatively new. Most of the valuation work in the world has been done since 1980 (Georgiou *et al*., 1997).

The main goal of valuation in assisting wetland management decisions is to indicate the overall economic efficiency of the various competing uses of wetland resources, thus answering the question of how we can best make use of the natural resource in order to improve welfare now and in the future. The underlying assumption is that wetland resources should be allocated to those uses that yield an overall net gain/benefit to society, as measured through valuation in terms of the economic benefits of each use less its costs. Who actually gains or loses from a particular wetland is not part of the efficiency criterion per se. Thus, a wetland use showing a substantial net benefit would be deemed highly desirable in efficiency terms, even though the principal beneficiaries may not necessarily be the ones who bear the burden of the costs arising from the use (Barbier *et al*., 1997). If this is the case, wetland use may be efficient and may have significant negative distributional consequences. It should be noted that economic valuation, which provides the efficient allocation aspects of resource use, is one aspect of the decision making process for managing wetlands. Others include equity and distributional aspects, and political and ecological considerations.

1.2 Research Objectives

The general objective of the study is to compare the value of Yala wetland if it remained unconverted, with its converted state for agriculture in order to inform policy. The specific objectives include to:

(i) Identify and assess the use of Yala wetland resources

(ii) Generate an estimate of the total economic value of Yala wetland due to conversion to agriculture use

1.3 Research Hypotheses

The hypotheses are:

- There is a significant positive relationship between Yala wetland resources and livelihoods of adjacent communities

- It is more valuable to conserve Yala wetland than to convert it into an alternative use

1.4 Yala Swamp

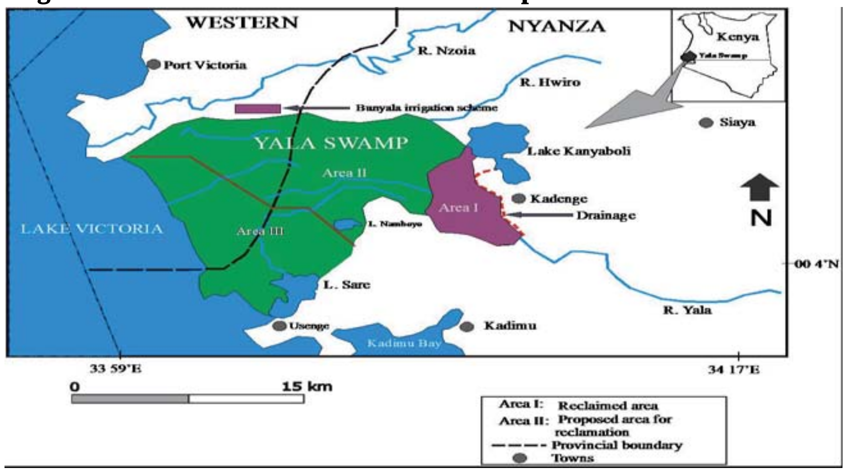
The Yala swamp, measuring 17,500ha, is a trust land entrusted to Siaya and Bondo county councils. It is an expansive wetland at the mouth of Rivers Yala and Nzoia and is located in Bondo, Siaya and Busia districts. It was formed by the deposition of silt from the Yala River at the point where the river flows into Lake Victoria (Government of Kenya, 1987). Hiro River also flows into the swamp although it is seasonal, while Nzoia River flows through the swamp at the Northern part. Rainfall in the region is low at 1,100mm per year. The swamp is a fresh water wetland, which is a combination of seasonally and permanently covered grasslands and marshes dominated by a wide range of herbaceous plants. The wetland is mainly sustained by water sources other than direct rainfall.

Yala swamp is divided into three main areas (Figure 1.1). Area I, measuring 2,300ha, was reclaimed in 1970 by the Lake Basin Development Authority. It forms about 13 per cent of the wetland and has been leased to the Dominion Group of Companies for a multi-billion rice project. Area II, measuring 9,200ha, forms the main body of the swamp. Area III, measuring 6,000ha, is the swamp and is generally below the level of Lake Victoria and can only be reclaimed by constructing polders and pumping the water out.

Within the Yala swamp system, there are three lakes namely Kanyaboli, Namboyo and Sare. Lake Sare occupies an area of 5km^2 and has a maximum depth of 5m; Lake Kanyaboli occupies an area of 10.5km^2 and has mean (maximum) depth of 3m and a catchment area of 175km^2; while Lake Namboyo occupies an area of 1km^2 and has a maximum depth of 10-11m.

The Lakes Kanyaboli, Sare and Namboyo have a diversity of flora and fauna (Aloo, 2003). Population increase and the need to supply adequate food resources puts a lot of pressure on the biological resources of the three lakes, hence overstretching the rate of harvesting of these resources. The lakes support a variety of diversity of economic importance to man. The unique species of antelopes around the lake is often hunted for game meat to supplement the rare protein provided by scarce fish resources available in the lakes. Fish species in Lake Namboyo provide crucial nutritional requirements despite the high conductivity and salinity

Figure 1.1: Location of the Yala Swamp



experienced from the lake. Masai, Ojuok and Ojwang (2003) report on the fish species available in the Yala swamp wetland lakes as Kanyaboli (16 species), Sare (22 species) and Namboyo (4 species).

Lake Sare has a direct connection with Lake Victoria. In the late afternoon as the winds change, the Lake Victoria water flows into Lake Sare, which is rich in flora and is influenced by the flow of River Yala. The water in the lake is very clear, with little suspended matter due to the filtering effect of the adjoining wetland as the water passes through.

The Yala wetland has undergone considerable decline as a result of clearance for agriculture and over-use of its resources. The Dominion Farm Ltd (Box 1) has fenced off part of the swamp and built a weir (Bob Green weir) on River Yala, creating a man made lake known as Bob Green. The Dominion Farm Ltd has also constructed an airstrip, road, dykes and weirs that are going to make use of an estimated 9,200ha, leaving only 6,000ha (35%) to balance the ecosystem of the Swamp (Voster, 2008).

If the wetland is converted, certain functional uses (or values) such as water for livestock, domestic use and fisheries will remain, although this will be degraded to some extent. However, a number of values such as papyrus, wood for fuel and construction, medicinal, stimulants and indigenous fruits, and grass for thatching and grazing, will be replaced or lost if the wetland is converted to agriculture. This means that certain ecological functions of the wetland will cease. Crop production will rise, which will come at a higher cost to the environment due to use of heavy machinery and pesticides. Animal production, on the other hand, will

Box 1: Usage of Yala wetland[4]

The Dominion Farm Ltd, having obtained leasehold of 25 years from the government, has occupied a big chunk of the Yala swamp and fenced it. Initially, the firm was restricted to Area I, but is now going to Area II which is ecologically fragile. The small holder farmers have been displaced, and have little access to the swamp. Moreover, the firm has cleared off a lot of papyrus to create room for rice and other crops that the firm wants to grow. The growing of crops which will lead to use of fertilizers and agricultural chemicals, has a bearing on pollution. A course way has been built across Lake Kanyaboli, preventing fish that breed in the papyrus to go back to the lake. Fisher folk, especially in Kadenge and Gangu, complain of the decreased number of fish in the lake. Moreover, the firm has constructed a weir across river Yala for irrigation. This has affected the ecosystem downstream, due to the decreased flow of the river Yala into Lake Victoria. Moreover, a man-made lake has been created because of the weir. As a result of these changes, the swamp's buffering capacity and as a nursery and refugee for tilapia is severely being threatened. The Dominion investment plan proposes to build a number of processing plants, feed mill, cotton ginnery, fuel storage and dispensing station, and hydro electric power generators, among others. Questions are being raised as to why the firm cannot make use of already built processing, milling and ginnery infrastructure in nearby centres of Ndere, Siaya town less than 10kms from the site, or fish processing firms in Kisumu city. The firm also intends to put upto 800 fish culture cages in Lake Kanyaboli as part of its aquaculture initiative. This is a venture that is likely to lock out fishermen who depend on the lake for livelihood, as the cages would have to be protected. Further to that, the lake, by virtue of being surrounded by land that the firm has leased, is likely to be fenced off and taken as property of the firm and not the community.

decline because grazing land will be converted for crop agriculture and also due to resulting water pollution.

1.5 Literature Review

Wetlands are ecosystems that hold immense benefits to human beings. Some studies on wetlands have been carried out in various parts of the East African region. For example, Mdamo (2003) reported on the buffering capacity of wetlands at Kagondo wetlands in Bukoba, Tanzania. It was observed that the water flowing into the wetlands had low mineral content, which was evident from low electrical conductivity that ranged between 9.7 and 64.4 µs/cm. A limnological study was conducted on Nakivubo wetland mainly on levels of dissolved oxygen, alkalinity, pH, total coliforms and nutrient loads (Kizito, 1986). It was reported that there was a high level of pollution mainly from organic materials, including faecal material.

A study has also been carried out investigating buffering capacity of River Nyando from Muhoroni to the mouth of Nyakach Bay (Handa *et al.,* 2002). The results showed that the bigger the wetland, the greater

[4] Kenya Land Alliance (2006), A survey into the management and use of wetlands in Kenya, *Land Update* Vol. 5, No. 1, January-March.

its ability to sieve suspended solids and absorb chemicals and nutrients in the river water. Mwanuzi (2002) in his wetland research in the Lake Victoria basin (Tanzania) pointed out that wetlands were important for social welfare and ecological purposes.

Studies on biodiversity in small lakes (wetlands) surrounding Lake Victoria have shown that the lakes harbour high species diversity, including fish, phytoplankton and macro-invertebrates (Katunzi, 2003; Mwambungu, 2003 and Lyimo and Sekadende, 2003). It is further reported that the lakes are used as refugia for the endangered fish species, including *Oreochromis esculentus O. variabilis*.

Studies have also been conducted on the distribution of macrophytes in the wetlands. For example, Katende, Bailwa and Lubega (2002) reported on plant diversity in the Nabugabo and confirmed that the area supports different unique species. A study was also conducted on macrophytes with medicinal potential in Lake Victoria, Tanzania and its surrounding wetlands (Lyaruu and Eliapenda, 2003). The results showed that 132 plant species, including macrophytes were recorded. Out of these, 31 were found to have a great economic value entho-botanically either for medicinal or other domestic uses. Katende, Bailwa and Lubega (2002) made surveys of plant diversity in the Nabugabo and confirmed that the area supports different unique species.

Brouwer (2002) indicated that the importance of processes in biodiversity is well illustrated by wetlands. Wetlands are areas where water and nutrients are concentrated. The process of concentration makes the wetlands the most productive and valuable ecosystems in the world. Because of this productiveness, wetlands play a very important role in poverty alleviation. At present, they play a role in agriculture, livestock, rearing fisheries, and the production of natural products.

Shechambo *et al* (2002) indicated that sustainability as a concept is becoming a basic tenet of development, implying that ignoring or underestimating the immense contribution of the environmental resources to the economies of East African countries is tantamount to creating conditions for destroying the foundation upon which these economies are built. It was further reported that many activities in wetlands are carried out haphazardly, without taking their long-term productivity into account. In many places, local brick makers and sand miners leave behind gaping holes, a danger and health hazard to both humans and animals in addition to depositing clay and sand into the wetlands, and making it inaccessible.

The economic valuation of constructed wetlands potential in waste water treatment was carried out in Uganda. It was reported that they were technically and economically viable in tropical environments than stabilization pond system (Okurut, Rijs and Van, 1999). On the economic valuation of wetlands resources, authors have reported various methods such as Contigent Valuation Method, travel costs and replacement costs among others, which have been used (United Republic of Tanzania, 2003; Sinden *et al*., 1995; Turner *et al.,* 1994; Georgiou, 1997; Perman, Yue and James, 1996; Babier, 1997 and Okurut *et al*., 1999).

The total economic valuation has been widely used as a framework for valuation considering both direct and indirect use values. The framework is not without its practical pitfalls. United Republic of Tanzania-URT (2003) points out that data collection of actual use is difficult and time consuming, especially if the use is illegal, making data difficult to obtain. Contingent Valuation Method (CVM), travel costs and replacement costs, among others, have been among the most used valuation methods. Sinden (1994) while pointing out the limitations faced by the CVM as being the inaccuracies of peoples' valuations said: "it is an attempt to gain a more or less objective valuation of a benefit which in the past has best been valued subjectively by politicians".

There are other important studies on valuation of environmental resources that have been done apart from wetlands. These studies include that of Mkanta and Chimtembo (2002), a catchment forest study by the Ministry of Natural Resources of URT (2003) and IUCN study on economic assessment of water resources of Pangani River Basin, Tanzania. Mkanta and Chitembo (2002) estimated non-timber forestry products (NTFP) for fuel wood, building soil, grazing, thatch, timber, edible fruits, edible vegetables and herbs, curving wood, and bees products in the tobacco growing area of Urambo District, Tabora region, Central Tanzania. These values were significant when extrapolated for the whole country. The IUCN study focused on the Pangani River Basin, which has relevant information on the value of water in different uses such as for irrigation, livestock, domestic, hydropower generation and ecosystem use. The catchment forest study provides a wealth of information about the value of these forests, using the total economic value (TEV) approach. The study provides estimates of the potential TEV of US$ 620.4 million, while the actual TEV was estimated at US$ 496 million. It points out that significant contributions to the TEV are also made by values for water, carbon sequestration and NTFPs. However, timber and NTFPs dominate the TEV by accounting for 70 per cent of it.

The important flood attenuation services of wetlands around the Tana River and Delta for nearby infrastructure and surrounding human settlements were partially valued by modelling the impact of wetland loss on the frequency and severity of flooding, and assessing the costs of damage avoided to roads, buildings and other infrastructure (Emerton, 1994). The travel cost method was applied to value the recreational costs of wildlife viewing in Lake Nakuru National Park, Kenya. This was done by administering a questionnaire to visitors to collect data on origin, distance travelled, income and expenses. Demand curves were constructed using regression analysis to describe the relationship between travel costs and number of visits, and individual and aggregate willingness to pay for wetland recreational services were estimated (Navrud and Mungatana, 1994).

1.6 Research Gaps

There is a general consensus about the dearth of studies on the valuation of environmental goods and services in the East African region (Shechambo *et al.*, 2002; Kasoma, 2003; Mwanuzi, 2004; and Githui, 2003, among others). There is little quantitative data and information about the economic value of environmental resources or the costs associated with their loss and how this affects national economies and people's livelihoods (Shechambo *et al.*, 2002). Research on wetland ecological services is inadequate, and there is very little appreciation of the non-tangible benefits of wetlands among communities (Kasoma, 2003). There is thus a gap in information about non-consumptive uses of wetlands such as eco-tourism.

Gaps are also on studies on conservation status, dynamics and biodiversity of wetlands. Some of these include species richness, abundance and diversity of wetland flora and birds and identification and quantification of economic benefits from macrophyte products (Mwanuzi, 2004). Generally, socio-economic studies of wetlands in the Lake Victoria region are fragmented and not linked to ecosystem values of wetland (Githuki, 2003). Thus, the sustainability of human activities was not linked to wetland health.

2. Research Methodology

2.1 Conceptual Framework

The overall framework adopted by this study is the concept of Total Economic Value (TEV), which provides an estimate of the economic value of Yala wetland. This approach distinguishes between *use* values and *non-use* values. The latter refers to those current or future (potential) values associated with an environmental resource, which relies merely on its continued existence and are unrelated to use (Pearce and Warford, 1993). Typically, use values involve some human 'interaction' with the resource, whereas non-use values do not.

TEV is a monetary measure of a change in an individual's well being due to a change in environmental quality. It measures people's preferences for that quality and, thus, it is anthropocentric because it relates to preferences held by people. The economic value is therefore established by an actual or hypothetical exchange transaction (Georgiou *et al.*, 1997). The Total Economic Value (TEV) of change due to degradation or reduction is given as:

$$TEV = UV + NUV$$

$$= DUV + IUV + OPV + BV$$

where *UV* is Use Value, *NUV* is Non Use Value, *DUV* is Direct Use Value, *IUV* is Indirect Use Value, *OPV* is Option Use Value and *BV* is Bequest Value. These values are further explained in Table 2.1.

2.1.1 Use values

Use values can be direct or indirect:

Direct use values are those uses that are most familiar to everyone, for example harvesting fish, collecting fuel wood, use of the wetlands for recreation, and involvement in both commercial and non-commercial activities. Since most of the direct use values in this study are marketed, the study uses their market prices.

Indirect use values are derived from supporting or protecting economic activities that have direct measurable values. It is related to the change in the value of production or consumption of the activity or property that it is protecting or supporting. The indirect use values are difficult to quantify, and are generally ignored in wetland management decisions as they are unmarketed, and financially unrewarded. In this study,

Table 2.1: Classification of total economic value of wetlands

Use Values (UV)			NON-USE VALUES (NUV)
Direct Use Value (DUV)	Indirect Use Value (IUV)	Option and Quasi-Option Value (OV)	Existence Value (EV)
Fish Agriculture Fuel wood Recreation Transport Wildlife Harvesting Peat/energy Medicine Wild foods (fruits, honey, vegetables e.g. mushrooms, insects, roots and shoots etc)	Nutrient retention Flood control Storm protection Groundwater recharge External ecosys-tem support Micro-climatic stabilization Shoreline stabilization, etc	Potential future uses (as per direct and indirect uses) Future value of information	Biodiversity culture, heritage Bequest values

Source: Barbier et al (1997)

these values are captured through the directly measurable outputs from economic activities.

Option value arises because an individual may be uncertain about his or her future demand for a resource and/or its availability. Quasi-option value is simply the expected value of the information derived from delaying exploitation and conversion of the wetland today. The study attempts to capture the option value using Contingent Valuation Method (CVM), which is reflected in the willingness to pay responses.

2.1.2 Non-use values

Existence value: In contrast, there are individuals who do not currently make use of wetlands or expect to use them in future, but nevertheless wish to see them preserved 'in their own right'. Such an 'intrinsic' value is often referred to as existence value. This form of non-use value is extremely difficult to measure, as existence values involve subjective valuations by individuals unrelated to either their own or others' use, whether current or future. An important subset of non-use or preservation values is bequest value, which results from individuals placing a high value on the conservation of wetlands for future generations to use. CVM has been used to capture the existence value of the wetland.

[5] This represents the gross total economic value (TEV) of the Yala wetland resources. This has been seen as a workable approach given the paucity of data on wetland resources at Yala.

With regard to the Yala wetland, the concept of TEV is captured by estimating the benefits[5] that the people derive from the wetland. Viewed differently, this can be looked at as the opportunity cost of destroying the Yala wetland. Thus, the appropriate question to ask is counterfactual, "what if this wetland was not there?" The non-existence of the wetland in the area provokes a line of thought that aims at bringing out what people will miss or lose in terms of the benefits derived from the known wetland resources. The TEV of the Yala wetland is calculated as the sum of discounted net benefit streams from extracted wetland products, environmental services and non-use values. This will capture the change due to conversion of the swamp, thus degrading the environmental resource.

2.1.3 Valuation techniques

Different valuation techniques have been used to assign values to various environmental goods and services. A number of measures are used to value goods and services, including market valuation methods (travel cost, hedonic pricing, productivity methods) damage cost avoided/ replacement costs and substitute costs methods, benefit transfer method and contingency valuation method (CVM). As shown in Table 2.1, revealed preference methods are the best as they depend on the market. However, with the non-marketed based use values, the only method that could be used is CVM. This is critical especially when non-use values are significant.

With CVM, the compensated (Hicksian) demand can be estimated by asking willingness to pay (WTP) or willingness to accept (WTA) compensation questions for a particular change in the supply of the good. The interest is generally in a Hicksian measure, because the Marshallian consumer surplus of a specified change in utility will vary depending on the path chosen to adjust quantities or prices. There is no such path-dependency problem when using the Hicksian demand concept.

The WTP measure can be either of the compensating variation (*CV*) or equivalent variation (*EV*) type (Johansson, 1993). The choice depends on whether the interest is in WTP for an environmental improvement or WTP for avoidance of an environmental deterioration. In most cases, it is the latter, as it allows one to evaluate deteriorations in environmental quality relative to a path (e.g. a policy plan) approaching Bliss. The reference level of utility (the Bliss path) does not change between accounting years, as would for example the utility from the "current" environmental quality. Using the Bliss path as the reference utility level allows for welfare comparisons between accounting years through repeated surveys.

The CVM method has a range of limitations that include hypothetical bias, strategic bias, payment vehicle bias, embedding effect bias, and starting bid bias, amongst others (Mitchell and Carson, 1989). But with no other method to use, this study was left with no choice but to use CVM.[6] It remains the only technique capable of placing a value on commodities that have a large non-use component of value, and when the environmental improvements to be valued are outside the range of available data.

The Arrow-Solow panel, established specifically by the US National Oceanic and Atmospheric Administration to pass judgement on CVM as a valuation technique for use in litigation, found that when used in appropriate situations and with carefully designed surveys, CVM can provide reliable and relevant information (Arrow *et al.,* 1993). Thus, in this study, the Direct Use Values[7] are based on market transactions and are measured through the market-determined prices; while the non-market-based use values are determined through CVM. In this regard, the Willingness to Pay (WTP)[8] technique was used to determine the value the communities around the wetland put on the various environmental resources within the wetland.

The economic value of environmental resource can be defined as the sum of the discounted present values of the flows of all services. For an

[6] Estimates are contingent. They will differ across different versions of the same questionnaire and across time. No CVM-generated estimate is definitive. However, this is no different from any market-based estimate that is contingent upon the conditions prevailing in the relevant market at the time of valuation. Of course, the difference between a contingent value and a market value is that under the latter, a budget constraint is enforced and actual preferences are revealed. CVM can impose neither, and its successful application depends on a successful initiation of both conditions.

[7] An attempt has been made to value most of the direct and indirect use values listed.

[8] Willingness to Accept (WTA) was not used in this study due to loss aversion (Kahneman *et al.*, 1990) and risk aversion (Zhao and Kling, 2001). WTA measure is subject to a much higher degree of inaccuracy as compared to WTP measures (Goldar and Misra, 2001; and Coursey, Hovis, and Schulze, 1987). Since WTA is not directly constrained by income, chances are WTA is greater than WTP, which is constrained by income (Loomis and Walsh, 1997; and Bishop and Heberlein, 1979) and therefore leads to an over-estimation of benefits. The NOAA panel (Arrow *et al.*, 1993) while reviewing CVM, was strongly against the use of the WTA measure.

estimation of the wetland's present value of finite annual streams of environmental net benefits, the following formula is used:

$$PV = \beta/(1+r)^n$$

where β is a stream of annual environmental benefits, r the discount rate, and n the number of years under consideration. For the infinite annual streams of environmental goods and services case, the assumption is that the stream of benefits will flow constantly in the future due to sustainable utilization. In this case, the PV of these future benefits will be obtained through a simple expression that emerges when n approaches infinity (URT, 2003 and Pearce, Atkinson and Mourato, 2006). That is:

$$PV = \beta/r \qquad n\text{-}\infty$$

The benefit streams arise largely from the existence of aquatic and terrestrial resources in the wetland. This study therefore makes a brief assessment and characterisation of aquatic and terrestrial resources in the Yala wetland and later assigns an economic value to them.

2.2 Data Collection

Through discussions with key stakeholders, 8 villages were selected on the basis of intensity of harvesting of Yala wetland products and proximity to satellite lakes Kanyaboli, Namboyo and Sare. The villages selected were two each from Kadenge, Got Ramogi and Gangu sub-location; and one each from Got Alila and Rukala sub-location. A list of the names of all the households in the eight villages was generated with the help of administration officials and local leaders, and 40 households were randomly selected in each village. During the selection of villages, parts of the Yala swamp got flooded due to the dykes break down in some sections along Nzoia River (Figure 2.2).

Data was obtained through a household survey using a structured questionnaire, which had questions to capture the direct use values as well as willingness to pay for some indirect use and non-use values of the wetland. The questionnaire captured household composition covering the household characteristics, willingness to pay for natural resources, land ownership, farming activities and characteristics, labour and non-labour inputs, extraction of natural resources and distance to facility. A total of 315 households were interviewed.

[9] To be run by people of integrity comprising churches and technical people.

The willingness to pay was elicited by first establishing whether households are aware of and enjoy environmental benefits from the Yala wetland. The payment vehicle was a fund[9] that would be set up to conserve and rehabilitate the wetland. Households were asked how much they were willing to contribute per month to such a fund. The amounts to be contributed started from a high of Ksh 500, declining gradually upto Ksh 10 per month. This is the bidding game (Davis, 1964) which is based on real-life situations in which individuals are asked to state a price for a specific good. Respondents answer yes or no to an iteration of monetary amounts, and this process goes on until the respondent changes his answer. The last (or first) price a respondent accepts is his maximum WTP. The advantage is that this elicitation format directly gives the highest WTP (Cummings *et al.,* 1986). Moreover, due to the iterative nature of the approach, a respondent has more time to carefully consider his valuation (Hoehn and Randall, 1987). Efforts were made to reduce biases that are common in CVM studies, such as hypothetical bias, strategic bias, and payment vehicle bias amongst others (Mitchell and Carson, 1989; Loomis and Walsh, 1997; and Roberts, Thompson and Pawlyk, 1985).

2.3 Data Analysis

Descriptive statistics such as measures of central tendencies and cross-tabulations, among others, were carried out to explore the characteristics of sampled households. A censored tobit and Ordinary Least Squares (OLS) estimations were both carried out to establish the determinants of willingness to pay for conservation of the Yala wetland. This was necessitated by the need to get a deeper understanding of the level of households' willingness to pay.

The general model was specified as follows:

WTP = f (MHEAD, MARRIED, XTIAN, ROTHER, PREDUC, SECEDUC, HHS, AREA_01, AGE_HEAD, AGEHEAD2, DFWO_COL, EXPEND)

where *MHEAD* is dummy for male-headed household, *MARRIED* is dummy for married household head, *XTIAN* is dummy for Christian household head, *ROTHER* is dummy for household from other religions, *PREDUC* is dummy for head with primary education, *SECEDUC* is dummy for head with secondary education, HHS is household size, *AREA_01* is size of land in acres, *AGE_HEAD* is age of household head, *AGEHEAD2* is age squared of household head, *DFWO_CO* is dummy for wood collected for firewood from the village commons, and *EXPEND* is household expenditure as a proxy for household income.

Figure 2.2: Flooding menace in Budalangi division, Bunyala district

3. Socio-economic Characteristics, Livelihood Activities and Wetland Resources

3.1 Socio-economic Characteristics of Sampled Households

About 63.2 per cent of the sampled household heads are male, while 36.8 per cent are female (Table 3.1). Also, in the village level analysis, most of the sample comprises of male-headed households. Most of the household heads who are women are widows with the highest being from Gendro (30.8%). Ureje village has the highest proportion of single household heads (over 50% of the sampled households) compared to the rest of the villages.

School attendance is generally low around the Yala swamp. The fraction of those who have not gone to school is substantial (about 20%) and very few household heads have gone past primary school level. The level of education may determine the ability of the household heads to understand the benefits that can be derived from a wetland resource, and may thus impact on their willingness to pay to conserve such environmental resources (Table 3.2).

In spite of the Yala wetland being a major fishing zone, the main occupation of the heads of households is farming (about 60%). The household heads who engage in fishing as their main occupation are hardly over 10 per cent. On the other hand, fishing turns out to be a major secondary occupation of the households (11%) after farming (49%).

Table 3.1: Sex of household head and the marital status

Village	Gendro	Kanyamaji	Mukha-dungu	Muriengo	Nyadheho	Nyalaji	Ureje	Urima
Sex of head of household								
Male	51.3	56.1	64.1	88.1	45.7	76.3	52.4	69.0
Female	48.7	43.9	35.9	11.9	54.3	23.7	47.6	31.0
Marital status								
Single	2.6	7.3	2.6	2.4	0.0	2.6	59.5	2.4
Married monogamous	53.8	48.8	64.1	57.1	60.0	68.4	7.1	61.9
Married polygamous	10.3	19.5	10.3	19.0	17.1	7.9	2.4	14.3
Divorced	2.6	24.4	2.6	21.4	2.9	21.1	31.0	0.0
Widowed	30.8	0.0	20.5	0.0	20.0	0.0	0.0	21.4

Table 3.2: Household education levels and the average monthly expenditure

Village	Gendro	Kanyamaji	Mukha-dungu	Muriengo	Nyadheho	Nyalaji	Ureje	Urima
Education level								
None	36.8	32.5	23.1	2.4	22.9	7.9	28.6	14.6
Primary complete	21.1	22.5	7.7	42.9	22.9	39.5	28.6	31.7
Primary incomplete	31.6	40.0	48.7	31.0	31.4	21.1	28.6	36.6
Secondary compete	5.3	5.0	10.3	7.1	11.4	2.6	9.5	14.6
Secondary incomplete	5.3	-	5.1	9.5	5.7	13.2	4.8	2.4
Diploma college	0.0	0.0	5.1	7.1	2.9	0.0	0.0	0.0
University complete	0.0	0.0	0.0	0.0	2.9	13.2	0.0	0.0
Postgraduate	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0
Average expenditure in the last month (Ksh)	3,204	3,614	3,700	3,865	4,129	4,009	3,621	1,901

The population with temporary formal employment is 13 per cent, while formal employment is 8 per cent. The average monthly expenditure for the villages around Yala wetland in December 2006 is Ksh 3,344. It is important to note that since the survey was done in January 2007, the expenditures captured are for December 2006, which is a high spending month on consumables due to the festivities. Thus, the expenditure levels reported are likely to be higher than expected.

Most of the heads of households were born in the area (56.3%), suggesting little mobility of people. The age of household heads ranges from 17 to 99, with a mean of 49.4 years and a standard deviation of 17.2. The mean number of years lived in the village is 38.8 years and a standard deviation of 19. The number of years lived signifies mobility, thus the lower the mobility, the higher the likelihood of conservativeness.

The average area of plot is between 0.5 acres and 2.2 acres, while the dominant forms of tenure are private title deeds (28.1% of all the plots) and traditional rights/non-demarcated (26.5%). The proportion of land tenure was about the same during the acquisition of these plots. The majority of the plots were acquired through inheritance (83%). At the village level, it is evident that most of the land is either held under

Table 3.3: Mean area of plot and the land tenure

Village	Total sample	Gendro	Kanyamaji	Mukha-dundu	Muriengo	Nyadheho	Nyalaji	Ureje	Urima
Mean area of plot		0.9	0.8	0.9	0.6	1.9	0.5	1.4	2.2
Land tenure (percentage)									
Private title deed	28.1	28.6	22.6	6.1	19.7	32.5	22.4	30.0	88.1
Still obtaining title deed/ demarcated	22.4	17.1	35.8	12.1	8.2	32.5	33.6	42.0	-
Traditional private rights/non-demarcated	26.5	25.7	30.2	57.6	32.8	10.0	28.0	16.0	7.1
Communal rights	7.2	17.1	5.7	6.1	9.0	20.0		10.0	-
Rented in	10.3	11.4	3.8	15.2	16.4	5.0	10.3	2.0	-
Rented out	0.8	-	-	-	0.8	-	2.8	-	-
Other	4.7	-	1.9	3.0	13.1	-	2.8	-	4.8

private title deed, the holders are still obtaining title deed/demarcated, or they are held under traditional private rights/non-demarcated (Table 3.3). Land improvements such as terracing and soil bunds on the plots were done before the last two seasons by 56.6 per cent of the households that owned land. In most of these plots, private food crop (61%) had been grown and the proportion had increased further to 77 per cent by the time of the field survey.

Another important key characteristic is the distance of the households to certain facilities such as wetland, food market, health centre and dispensary. The distance depicts the ease of access to such facilities by the villagers. Visits to more distant facilities will be made in instances where either the value attached to the resource is more or where there is no alternative. Shorter distance to food market signifies that the villagers can easily access a place to trade their produce or to obtain their daily food requirements (Table 3.4). Nearness to dispensary and/or health centre, on the other hand, shows immediate access to health facilities and thus ensuring good health of the villagers (though nearness to health facilities does not necessarily lead to increased visits to the health facilites). It is expected that the villages that are nearer the wetlands (e.g. Muriengo) will enjoy more benefits, compared to those that are far away and may be willing to incur expenses to access the wetland. Thus, distance may be a determinant of the willingness to pay to conserve the wetland.

Table 3.4: Average distance to facility (Kilometres)

	Gendro	Kanyamaji	Mukhadungu	Muriengo	Nyadheho	Nyalaji	Ureje	Urima
Wetland	0.54	2.04	0.56	0.46	2.11	0.65	0.57	1.33
Food market	2.07	0.73	1.12	2.30	1.93	1.83	2.40	1.16
Health centre	2.01	0.85	5.67	2.37	4.38	1.98	6.78	1.27
Dispensary	1.65	0.77	0.42	2.37	4.40	1.98	7.97	1.27

3.2 Livelihood Activities

The Yala swamp is a source of livelihood for the extant local communities. The swamp provides papyrus, which is used for building or making handicrafts. Papyrus is the dominant macrophyte in the Yala swamp. The other macrophytes are Cyperus latifolius (typha), Phragmites mauritianus (reeds), sedges, and wetland grasses. A large proportion of the people involved in papyrus activities are women (60%), which is in contrast to fishing where men are predominant. There are also no taboos in papyrus harvesting with regard to women as opposed to fishing.

In the past, the exploitation of papyrus biomass has been on small scale and at subsistence level, mainly for the reeds for use in production of various handicrafts and for building materials (Gichuki *et al.*, 2001 and Kaggwa *et al.*, 2001). Cyperus papyrus is especially significant in production of wetland products such as mats. The main markets for the various macrophyte products are Bumala, Port Victoria and Sio Port in Busia district. In Siaya District, the major markets are Aram, Ngiya, Akala, Nyadorera, Uhaya and Ugunja. However, there is a distinct difference between the markets in the two districts. Baskets and mats are predominant in Busia, while thatch and reeds are major products in Siaya District (Otieno *et al.*, 1998). Mats and baskets are popular as they are utility products that need continual replacement in households.

Households own a variety of farm tools and equipment as well as other inventories that ease the work effort. The main farm inventories used within the swamp are panga (77%), jembe (78%), bucket (59%), axe (41%) and wheelbarrow (21%). These farm inventories assist households in carrying out farming activities. Certain inventories are expensive and their ownership by the households is limited. Fishing nets and boats for example, are necessary for any household to harvest fish from the wetland. However, fishing lines are used at a lower scale, mainly to harvest fish for household consumption.

The households also keep livestock, poultry and other farm animals. Though keeping of livestock may be a traditional practise mainly for paying dowry and as a sign of wealth, some are also traded in the local markets to provide household income. They may also be used for consumption smoothening, especially with poultry and goats. Poultry is the most popular among households living near the wetland, and this may be because small-scale poultry farming does not require a lot of investment. Among the livestock, goats are the most prevalent followed by cattle, sheep and bulls (Table 3.5). The livestock kept also determines the livestock products owned by the households, and thus has an influence on household nutrition.

Fishing is also among the major livelihood activities in the area. About 20 per cent of the households engage in fishing in Lakes Namboyo, Sare and Kanyaboli. This may be due to a number of factors such as access to fishing waters, fishing gears and the availability of fish stocks.

There are also a number of indirect use values of the wetland that determine the livelihood activities. These indirect use values of the wetland enable the household to meet their energy, housing, health and nutritional requirements. These include collection of wood for firewood, charcoal or construction; collection of herbs; game meat; collection of indigenous fruits; and thatching materials.

Table 3.5: Livestock levels in Yala wetland villages

Village	Number of cattle	Number of bulls	Number of goats	Number of sheep	Number of pigs	Number of oxen	Number of donkeys	Number of chicken
Gendro	216	86	220	73	0	45	8	1036
Kanyamaji	463	122	579	232	0	0	0	1768
Mukhadungu	14	21	39	9	5	0	0	305
Muriengo	128	38	173	71	2	2	8	634
Nyadheho	62	50	104	64	0	24	2	544
Nyalaji	88	19	141	72	2	0	0	591
Ureje	146	11	139	91	0	9	4	576
Urima	631	333	774	196	0	60	0	2786
Total	1749	680	2169	810	8	139	22	8238

4. Economic Values of Yala Wetland Resources

4.1 Direct Use Values

Wetlands provide an ecosystem that inhabitants benefit from directly. Virtually all the households in the Yala wetland derive a number of direct uses for their livelihoods. The wetland provides the households with a number of services such as fertile areas for cultivation of various crops; fishing grounds; papyrus which is used to make various artifacts, among them mats (jamvis); source of water for human and livestock consumption; grazing land for cattle; source of wood for fuel, building and construction, and charcoal; grass for thatching and other activities; and source of medicinal herbs and roots, among others.

(i) Crop production

Most of the households are predominantly engaged in farming, with 84 per cent of the sampled households engaging in farming in the past year and an almost equal proportion engaged in livestock keeping. The type of crop cultivated differs from one village to another. The main crop produced in the wetlands is sorghum, which is grown by slightly over half of the villages. Ureje village is mainly engaged in farming, with mean acreage for most crops in this village being larger than those in other villages around Yala wetland. Maize production is mainly carried out in a third of the villages, while all fruit production is mainly undertaken in one village (Nyadheho). Other crops in production include beans, cassava, finger millet, potatoes and millet.

The farming practice in the villages mainly relies on traditional farming technologies and tools such as hand hoes, pangas, machetes and ploughs. In spite of this, the kind of traditional technology used determines farm sizes being put under crop, as some of the traditional technologies are more efficient than others. The use of oxen drawn plough, for instance, enables the villages to cultivate bigger farm sizes compared to those who use hand hoe. This determines the farm output. While the use of traditional farming technologies may be inefficient, it may be effective for the villages owing to the small size of land they cultivate, and given that most of the farming is not meant for commercial purposes.

Table 4.1: Direct use value of agricultural production

Village	Maize	Beans	Cassava	Sorghum	Millet	Finger millet	Potatoes	Vegetables	All fruit	Total Agricultural Value (Ksh)
Gendro	5,362,274	2,058,588	371,225	236,792	126,712	0	0	1,567,396	0	9,722,987
Kanyamaji	12,402,465	4,827,142	370,143	361,852	387,871	0	0	3,084,527	0	21,434,001
Mukhadungu	1,326,885	1,308,596	0	205,129	11,954	0	0	466,950	0	3,319,514
Muriengo	2,056,234	421,251	5,284,269	0	101,565	0	583,842	0	0	8,447,160
Nyadheho	2,788,670	1,185,088	0	210,102	64,647	6,630	0	566,566	0	4,821,703
Nyalaji	2,267,695	412,182	5,310,758	40,537	105,904	0	621,050	730,838	259,854	9,748,818
Ureje	2,252,447	921,583	346,877	179,402	53,280	0	0	1,156,257	0	4,909,847
Urima	5,353,037	189,626	0	0	55,500	6,167	421,552	602,217	0	6,628,100
Total	33,809,708	11,324,055	11,683,272	1,233,815	907,433	12,797	1,626,445	8,174,752	259,854	69,032,129

The use of other farm inputs such as fertilizers is also low, and some villagers use organic manure instead. This may be due to a number of factors such as the cost of acquiring fertilizers, compared to the ease of accessing organic manure and the fact that soil fertility around the wetland is still high. There are two planting seasons for most of the crops, determined by the long and the short rains.

Computations for the value of each crop have been done, considering the number of hectares under the crop by each village in question, their yield per hectare,[10] and the respective prices. The market prices[11] used are those obtained from the Siaya District Food Situation Report of September 2006 by the Siaya District Agricultural Officer, and the Farm Management Guidelines of Siaya District 2005. It is assumed that the prices are standard across all the villages in the Yala wetland. The value of each crop has been computed in the two seasons in order to obtain the annual value.

Maize is the most dominant crop at the village level and around the swamp, followed by cassava and beans, respectively, except in two villages (Muriengo and Nyalaji) where the dominant crop is cassava. The value of maize output accounts for 49 per cent of the total agricultural value. This is because maize is the main staple food crop grown for consumption, while extra output is sold in the market. Kanyamaji has the highest level of crop production amounting to almost 31 per cent of the total agricultural output of all the sampled villages, followed by Nyalaji with 14 per cent. Horticultural production is only practised in Nyalaji, and expansion and intensification of horticulture farming can provide a source of income to the community. The total annual agricultural value of the wetland is estimated at Ksh 69,032,129.

(ii) Livestock production

Livestock production is practised mainly as a cultural activity, although some economic benefit is also derived. The highest average number of livestock is found in Urima village. Field discussions revealed that

[10] Given the geological conditions around the wetland, the crop yields may vary but not to a large extent. Data from the District Agricultural Office (Ministry of Agriculture, 2005) indicates that the potential yield per hectare is as follows: sorghum (between 50 and 1,500kgs), maize (between 40 and 85 bags), cassava (about 20 tonnes), beans (about 24 bags), rain fed rice (60 bags), groundnuts (15 to 20 bags), cabbages (125 tonnes), sunflower (between 2,000 and 3,000kgs)

and groundnuts (between 15 and 20 bags).

[11] Since the information on land size was collected in acres, we use a conversion factor of 0.40469 to convert acres into hectares

the most affluent households are the ones that have livestock, moreso those with oxen. These are in turn the most successful farmers since they are more advantaged in land preparation, cultivation, weeding and harvesting. It was, however, observed that some livestock keepers who maintain large herds of cattle do keep cattle for those people living in areas away from the wetland because of good and reliable pasture available in the wetland. This shows that the importance and the benefit of the wetland is not only to area residents, but also to those leaving further away from it. Benefits are thus shared with other regions.

The livestock kept includes cattle, sheep, goats, chicken, donkeys and pigs. Livestock provides a source of income, and a store of wealth and nutrition to their owners. They are also held for social reasons, as they are symbols of social status and are used for paying dowry. Moreso, cattle droppings provide organic manure, while oxen are used for cultivation. The wetland provides pasture for these herbivores throughout the year.

Goats are the most common type of livestock kept after chicken. This is because goats are more adaptable to the environment as they can feed on the vegetation around the wetland. The number of cattle is also considerably high. Most of the animals kept are of indigenous species and are more immune to most animal diseases. The least common livestock are pigs, which are only kept in small numbers in Mukhadungu, Muriengo and Nyalaji (Table 3.5).

(iii) Fodder/grass provision

Most cattle in the villages are the local breeds. For a few people that keep dairy cattle, the households collect some fodder and grass as mixed grazing is practised. The following parameters were used to estimate quantity and value of fodder from the wetland consumed by livestock. Cattle consume 1.5 bundles of grass/day/cattle at Ksh 6/bundle, while goat and sheep consume 0.75 bundles of grass/goat or sheep at Ksh 6/bundle (URT, 2003).

The highest amount of livestock fodder/grass is recorded for cattle followed by goats and then bulls. The highest fodder/grass use is observed in villages where the largest number of livestock is kept. Thus, across the board, Urima has the highest direct use value for fodder/grass followed by Kanyamaji. The direct use value for the livestock fodder/grass in Yala wetland is Ksh 12,437,596 (US$ 180,255) per year (Table 4.2).

Table 4.2: Wetland direct use values for the livestock fodder/grass

Village	Number of cattle	Livestock fodder value (Ksh)	Number of bulls	Livestock fodder value (Ksh)	Number of goats	Livestock fodder value (Ksh)	Number of sheep	Livestock fodder value (Ksh)	Number of oxen	Livestock fodder value (Ksh)
Gendro	216	662,492	86	262,497	220	337,496	73	112,499	45	137,498
Kanyamaji	463	1,420,829	122	373,902	579	888,018	232	355,207	0	-
Mukhadungu	14	42,452	21	63,678	39	60,141	9	14,151	0	-
Muriengo	128	392,156	38	115,340	173	265,282	71	109,573	2	5,767
Nyadheho	62	191,318	50	152,074	104	159,432	64	98,112	24	73,584
Nyalaji	88	270,696	19	59,061	141	216,556	72	110,739	0	-
Ureje	146	446,760	11	35,040	139	212,430	91	140,160	9	26,280
Urima	631	1,934,500	333	1,022,000	774	1,186,250	196	301,125	60	182,500
Total	1,749	5,361,203	680	2,083,592	2,169	3,325,605	810	1,241,566	139	425,629

Table 4.3: Direct use value of water for domestic use in Yala wetlands

Village	No. of households	No. of people	Water use per day (litres)	Value of water per day (Ksh)	Value of water per year (Ksh)
Gendro	159	795	23,850	5,963	2,176,313
Kanyamaji	250	1250	37,500	9,375	3,421,875
Mukhadungu	90	450	13,500	3,375	1,231,875
Muriengo	79	395	11,850	2,963	1,081,313
Nyadheho	56	280	8,400	2,100	766,500
Nyalaji	61	305	9,150	2,288	834,938
Ureje	60	300	9,000	2,250	821,250
Urima	250	1250	37,500	9,375	3,421,875
Total	1,005	5,025	150,750	37,688	13,755,938

(iv) Water provision

Water forms a major component of life, both for the people and livestock, as it supports the existence of fauna and flora. An estimate of the domestic and livestock use value of water is given in Tables 4.3 and 4.4, respectively.

In estimating the value of water per year, it is assumed that a person uses 30 litres of water per day (average water consumption obtained from Table 4.3) for 365 days in a year. A litre of water costs Ksh 0.25 (or Ksh 5 per 20-litre bucket) based on the average cost of obtaining a 20-litre bucket of water in Siaya. The total current use value of water for domestic use in the Yala wetland is estimated at Ksh 13,755,938 (US$ 199,361.40) per year.

Livestock water use, just like fodder/grass, depends on the number of livestock kept. In calculating livestock water use, we use the average water intake per animal per day (44 litres/day/cattle and 7 litres/day/goat or/sheep), and a price per litre of Ksh 0.25. Across the various livestock categories, the largest amount of water consumption is by cattle, followed by bulls and goats. The total current annual use value of water for livestock in the Yala wetland adds up to Ksh 12,209,497 (US$ 176,949).

(v) Fishing

Yala swamp provides access to fishing waters for some of the villagers, thus making fishing an important activity carried out in the wetland. Fishing activities are conducted in Lake Kanyaboli and Lake Sare. There

Table 4.4: Livestock water use

Village	No. of cattle	Drinking water value	No. of bulls	Drinking water value	No. of goats	Drinking water value	No. of sheep	Drinking water value	No. of oxen	Drinking water value	Total livestock water value
Gendro	216	867,549	86	343,746	220	140,623	73	46,874	45	180,057	1,578,850
Kanyamaji	463	1,860,610	122	489,634	579	370,008	232	148,003	0	0	2,868,255
Mukhadungu	14	55,592	21	83,388	39	25,059	9	5,896	0	0	169,936
Muriengo	128	513,538	38	151,040	173	110,534	71	45,655	2	7,552	828,320
Nyadheho	62	250,536	50	199,144	104	66,430	64	40,880	24	96,360	653,350
Nyalaji	88	354,482	19	77,342	141	90,232	72	46,141	0	0	568,197
Ureje	146	585,043	11	45,886	139	88,513	91	58,400	9	34,414	812,255
Urima	631	2,533,274	333	1,338,333	774	494,271	196	125,469	60	238,988	4,730,335
Total	1,749	7,020,623	680	2,728,513	2,169	1,385,669	810	517,319	139	557,372	12,209,497

are two landing sites in Lake Kanyaboli, namely Kadenge beach with 9 boats, and Gangu beach where about 20 boats land. In Lake Sare, there are three landing beaches: Goye beach with 15 boats, Kupondo beach with 5 boats, and Komwok beach where 10 boats land. In both lakes, the fishing gears used include gillnets, traps, hook and line, longline and weir constructed by macrophytes, mainly phragmites.

Tables 4.5 and 4.6 show the fish species, composition and catch rates (based on gillnet catches) for Lake Kanyaboli and Lake Sare, respectively. Generally, the relative abundance or catch rates were very low for all species. On average, Lake Kanyaboli recorded 180.30 g/net/day while Lake Sare recorded 181.43 g/net/day.

Fishing is carried out mainly for subsistence, while some is taken to the local market to earn income. The proportion of households engaged in fishing around the wetland stands at about 20 per cent. Low engagement in fishing as an economic activity may be due to the low stock of fish in the wetland, and this may change if fish stock is improved. Fishing is mainly done at the Yala swamp, which acts as the major reservoir for the wetland within Lake Kanyaboli and Lake Sare.

Since the fish-catch experiments were done in one season only, the assumption is that this gives an average representation of fish catch over the two fishing seasons (low and high season), though it may be practical to get the estimates of fish-catch rates for low and high season, given that fish stock is likely to vary depending on the water levels. From the survey, a fishing household has an average of 10 nets. The daily catch average price estimate is Ksh 83 per kilogram of fish for the low and high season. The average price per kilogram is estimated from the average price per kilogram of three fish species that form the highest percentage of catch rates; these are Haplochromines (Ksh 30 per kg), Tilapia zilli (Ksh 106 per kg) and Lates niloticus (Ksh 112 per kg). These prices are based on the 2006 Annual Report on Fisheries Catch and Effort Assessment Survey (CAS) for Lake Victoria prepared by Kenya Marine and Fisheries Research Institute (KMFRI) and Fisheries Department. The estimated catch rates also do not vary much for Lake Kanyaboli and Lake Sare (i.e. 180.30 g/net/day and 181.43 g/net/day, respectively), hence the catch rates for Lake Kanyaboli are used to estimate the direct use value of fish. A 25 days month has been used to calculate the catch rate per year, as it is possible that fishing is not done daily by the households. The direct use value for fish in Yala wetland is estimated at Ksh 92,238,347 (US$ 1,307,802).

(vi) Other direct use values

(a) Wood

Firewood: This is the main source of cooking fuel for all the households with majority of them collecting it at least once every week. The highest number of trips in the village is made to collect firewood, which is mostly a preserve of female members of the household. There are instances

Table 4.5: Percentage (by no. & wt.) of fish species composition and catch rate (g/net/day) of Lake Kanyaboli in January, 2007

Fish species	No.	% by No.	Wt. (g)	% by wt.	Catch rate (g/net/day)
Haplochromines	706	95.15	7100	70.32	126.79
Tilapia zillii	24	3.24	1663	16.47	29.69
Oreochromis niloticus	1	0.13	325	3.22	5.80
O. leucostictus	7	0.95	273	2.70	4.88
Marcusenius rheni	1	0.13	32	0.32	0.57
Protopterus aethiopicus	1	0.13	700	6.93	12.50
Barbus sp.	2	0.27	4	0.04	0.07
Total	742		10,097		180.30

Source: Kulindwa et al (2007)

Table 4.6: Percent (by no. & wt.) of fish species composition and catch rate (g/net/day) of Lake Sare in January, 2007

Fish species	No.	% by No.	Wt. (g)	% by wt.	Catch rate (g/net/day)
Lates niloticus	30	15.54	2048	25.65	46.55
Haplochromines	80	41.44	1707	21.37	38.79
Labeo victorianus	1	0.52	30	0.38	0.68
Brycinus sadleri	15	7.77	629	7.88	14.30
B. jacksonii	1	0.52	30	0.38	0.68
Synodontis afrofischeri	8	4.15	285	3.57	6.48
S. victoriae	1	0.52	54	0.68	1.23
Hipopotamyrus grahami	23	11.91	305	3.82	6.93
M. rheni	7	3.63	343	4.30	7.80
Momyrus kanume	1	0.52	32	0.40	0.73
Gnathonemus longibarbis	15	7.77	760	9.52	17.26
O. leucostictus	8	4.15	470	5.89	10.68
P. aethiopicus	1	0.52	150	1.88	3.41
Barbus altinalis	1	0.52	710	8.89	16.14
Clarias gariepinus	1	0.52	430	5.39	9.77
Total	193		7,983		181.43

Source: Kulindwa et al (2007)

where firewood is collected for commercial purposes and is sold at the local market, though this is not done in large scale.

Charcoal: Charcoal forms an alternative to firewood as a source of fuel, though use of charcoal is not widespread. Charcoal is used in small scale for cooking and ironing, though some of it is sold as a source of income.

Wood for construction: The wetland is the source of wood that is used for building and construction of the households' structures. Majority of the household structures are made of wood and mud, therefore housing construction entirely depends on the wetland.

(b) Papyrus

Papyrus harvesting is a major activity for households within the wetland. The papyrus harvested is used to weave mats (jamvis), which are used for various purposes in the households, such as materials for beddings, ceilings, and floor mats. The mats are also sold in the neighbouring markets.

(c) Medicine

The villagers collect various herbs and plants from the wetland to be used as medicine. The wetland has a rich biodiversity and is home to several plants that have some medicinal value.

(d) Indigenous fruits/spices/nuts

A number of households reported to enjoy some of the indigenous fruits, spices and nuts obtained from the wetland. Apart from domestic consumption, some of the fruits are sold at the local markets.

(e) Withies

Withies are also collected by a number of households.

(f) Others

Other sources for direct use value include thatching materials, clay for pottery, edible insects and game meat.

To estimate other direct use value, the number of households in each of the sampled villages is used together with the proportion of households collecting a particular resource.[12] Survey results provide us with an

[12] Given that other direct use values are collected and the benefit of use derived per household rather than at the individual level, other direct use values are estimated based on the total number of households in the sampled villages, and not the total population of the village.

estimate of the percentage of households collecting a particular wetland product in the Yala wetland. To get the total use value of each product, we multiply the percentage of households collecting the product with the number of households in the sample. This is then multiplied by the mean value of product collected per trip and the mean number of trips made to collect the product, giving us the total direct use value for these wetland products. The direct use value of the Yala wetland products is calculated using the formula:

$$DUV = \sum_{i=1}^{N} \eta \left(MVP * MNT * THH \right)$$

where

DUV Direct Use Value

η Percentage of households collecting a particular wetland product

MVP Mean value of wetland product collected per trip

MNT Mean number of trips made by a household for wetland product collection per year

THH Total number of households

Table 4.7 presents the total use values for the various products in the wetland; a summation gives the total of other direct use values of the Yala wetland.

The highest percentage of households use wood for firewood (74%) compared to other environmental products. Wood is the main source of energy for the community and only in very few households is charcoal used. The community also derives some medicinal value from the various flora found in the wetland. The highest number of trips made per year in collecting the environmental products is in collecting wood for firewood, followed by indigenous fruits/species/nuts, papyrus and wood for charcoal. In terms of use value, the highest use value is realized in wood for firewood (amounting to over 50% of the total value) and papyrus (Table 4.8). The analysis shows that the Yala wetland provides other direct use value of Ksh 49,078,108 (US$ 711,277) per year. This

Table 4.7: Direct use value of fish

Total number of households in the sampled villages	20% of total households are engaged in fishing	Total fisheries value per year (1.803kgs/ fisher/day) x Ksh 83/ kg	Total fisheries value per year (US$)
1,005	201	92,238,347	1,307,802.13

value, however, excludes agriculture, fishing and water for domestic and livestock use, which are presented separately.

4.2 Indirect Use and Non-Use Values

We capture some of the indirect use values such as pollination services, through the directly measurable economic activities such as crop production. Both the Option Value and the Existence Value are reflected in the willingness to pay responses as estimated through the CVM.

The estimation of indirect use values and non-use values shows that the highest value attached to the wetland is by Kanyamaji village, which accounts for almost half of the total value, followed by Mukhadungu. But considering the individual WTP, Kanyamaji has the highest WTP followed by Ureje. The highest WTP for Kanyamaji follows from the previous analysis, which shows Kanyamaji having the highest agricultural value, considerably higher value from livestock water use and fodder/grass, and among the highest benefits in terms of domestic water use value given the population of the village.

Estimation of Indirect Use Values (IUV), Option Values (OP), Bequest Value (BV) and Existence Value (EV)

Box 1: WTP Estimation

Aggregate $WTP_a = \sum_i [(\theta_i) \times (\eta_j) \times (\theta_{i\,wtp})]$ --------------------------(1)

Where:

WTP_a = *Willingness to pay for wetland goods and services per annum*
θ_i = *group i's percentage of the sample and i = 1,2,...., 8 groups*
η_j = *total number of households of the area j= villages in Yala wetland*
$\theta_{i\,wtp}$ = *Amount of money group i is willing to pay for wetland goods and services per annum in order for their continuous existence as option, bequest, existence, aesthetic and functional values.*

Individual Household WTP_a = *Aggregate* WTP_a / η -------------------------(2)

N = *Aggregate number of households in the 8 villages around the Yala wetland = 1,005*

Table 4.8: Other direct use values for the wetland

Product	Percent-age of households collecting product	Mean number of trips per year	Mean value of product collected per trip	DUV (Total) (Ksh)
Wood for firewood	73.9	293.00	134.70	29,312,017.83
Wood for charcoal	6.0	136.00	394.40	3,234,395.52
Wood for construction	3.5	7.00	600.00	147,735.00
Medicine	5.0	20.00	82.90	83,314.50
Indigenous fruits/spices/nuts	1.3	218.00	212.50	605,236.13
Stimulants	0.3	1.00	120.00	361.80
Withies	0.3	1.00	3600.00	10,854.00
Papyrus	12.9	188.00	643.50	15,684,192.81
Total				49,078,107.59

4.3 Total Economic Value of the Yala Wetland

From the various use and non-use values of the wetland, we determine the Total Economic Value of the wetland of a change due to degradation by aggregating those values to get actual current values for the sampled villages and then use that to estimate the Total Economic Value of the wetland. To get the total number of households in the Yala wetland, the locations where the wetland is or areas closely bordering the wetland are identified, and then using the 1999 Population and Housing Census, the total number of households in these locations is established (Table 4.9). In Usigu Division, Bondo District, the locations are North Yimbo, Central Yimbo, and West Yimbo; Boro Division, Siaya District (Central Alego and South Central Alego); Uranga division, Siaya District (West Alego, South West Alego and Usonga); while in Budalangi Division, Busia District, the locations are Bunyala East, Bunyala Central, Khajula and Bunyala South. The total households from these locations are 36,657 from the 1999 Population and Housing Census. The number of total households in the sampled villages is 1,005, which is 3 per cent of the total wetland households[13], hence a factor of 1/0.03 is used to get the Total Economic Value of the wetland. To get the Present Value (PV) of the Total Economic

[13] Subsequent census reports have shown increase in household numbers. Since the current actual household numbers has not been established, the assumption is that the number of households has increased proportionately both within the village and the wetland, leaving the ratio of the household in the sampled villages to that in the wetland unchanged from the one of the 1999 Population and Housing Census.

Table 4.9: IUV, OPV and BV estimates of the Yala wetland

Village	Number of household (ηj) in sampled village j	Village j's current aggregate WTP (Ksh)
Gendro	159	4,588,740
Kanyamaji	250	13,485,000
Mukhadungu	90	3,470,400
Muriengo	79	1,763,280
Nyadheho	56	2,301,600
Nyalaji	61	1,166,930
Ureje	60	2,604,600
Urima	250	1,310,000
Total	1005	30,690,550
Total US$		444,790.60

Value, a sustainable utilization that will provide a perpetual constant stream of economic value per annum (n=) is assumed at a 10 per cent discount rate.[14]

The Total Economic Value of the wetland is estimated at Ksh 8.31 billion per annum (US$ 120.4 million) with a PV of US$ 1.20 billion (Table 4.10). It should be noted however, that these are values obtained locally and do not include global values such as tourism, carbon sink or national use values. Much of the economic value comes from fisheries (37.0%) and agriculture produce (27.7%). This shows that the value of Yala wetland is mainly from agriculture produce and fisheries, accounting for 64.7 per cent of the total wetland value, which forms the major economic activities of the people around the wetland (Table 4.10).

Given the estimated TEV of the wetland, it is important to establish the level of awareness of the benefits of the wetland and its sustainable utilization by the community inhabiting the wetland. From Table 4.11, the awareness of benefits from the wetland and whether the households enjoy the benefits is very high, standing at over 95 per cent. On the other hand, 84 per cent of the respondents are of the opinion that the wetland is being degraded. This shows that the community, even though enjoying the benefits from the wetland, have some environmental concerns.

[14] The Present Value in this case is perpetuity, with a stream of annual environmental benefit β equal to the annual Total Economic Value and a discount rate (r) of 10 per cent. The formula for calculating present value of perpetuity is: PV = β/r.

Table 4.10: Total economic value

SN	Value category	Current value for sampled villages (Ksh)	Current value for wetland	PV of Value (Ksh)	(%)
1	Livestock water use	12,209,497	406,983,233	4,069,832,330	4.9
2	Livestock fodder/grass consumption	12,437,596	414,586,533	4,145,865,330	5.0
3	Agriculture produce	69,032,129	2,301,070,967	23,010,709,670	27.7
4	Fisheries	92,238,347	3,074,611,567	30,746,115,670	37.0
5	Domestic water use	13,755,938	458,531,267	4,585,312,670	5.5
6	Other Direct Use Value of wetland goods	49,078,108	1,635,936,933	16,359,369,330	19.7
7	IUV, OPV, BV (WTP)	444,791	14,826,367	148,263,670	0.2
8	Total	249,196,406	8,306,546,867	83,065,468,670	100.0

Based on their awareness of wetland degradation, the willingness to contribute to conserve the wetland is evaluated. Though the households enjoy considerable benefits from the wetland and are aware of wetland degradation, the level of willingness to contribute to conserve the wetland is rather low. The maximum amount that most respondents (18.1%) are willing to contribute per month is Ksh 50.

As shown in Table 4.12, a big proportion of the respondents (about 60%) are willing to pay at least Ksh 10 per month towards the conservation of the Yala wetland. Out of those who are not willing to pay, a big proportion mentioned inability to pay (58.8%), lack of adequate information to place a value (11.8%), and government responsibility to protect the wetland (11.8%). The fact that the Dominion Farm Ltd has fenced off part of the wetland also contributes to this unwillingness. As to why those willing to pay stated lower amounts rather than higher

Table 4.11: Responses on awareness of benefits, utilization and wetlands degradation

	Responses	Frequency	%
Awareness of benefits	Yes	314	98.7
	No	4	1.3
Enjoying benefits	Yes	310	97.5
	No	8	2.5
Agree wetlands are being degraded	Yes	267	84.0
	No	51	16.0

figures, responses are varied, with about 81 per cent of the respondents mentioning budgetary problems. The average amount the respondents are willing to pay per year to conserve the wetland is Ksh 421, with a maximum of Ksh 6,000. In terms of the various wetland products, maximum willingness to pay per year is highest for papyrus (handicrafts), water and grass for roofing and weaving. The mean willingness to pay is, however, highest for spiritual/cultural ceremonial places (Table 4.13).

The Yala wetland environment is very important to all villages that are close and far from the wetland. Almost all people in the wetland depend on the environmental resources directly or indirectly. However, the high demand for wetland resources due to increasing human and livestock populations is threatening the well being of the wetland environment. As a result, some of the wetland's resources such as wild animals, trees and grazing grass have already disappeared. The villagers benefit in different ways depending on their location. The close ones benefit directly, while those located outside the wetland benefit indirectly in some ways. Generally, the value of wetland environment is almost similar. For instance, each village enjoys good environmental services of the wetland, such as good weather condition, abundance pasture for feeding their livestock, water for animals and domestic use, papyrus for making mats, fish for own consumption and income generation, and thatching grass, among others.

To some extent, the wetland environment resources reduce the level of poverty around the area. Without this wetland, the level of poverty in

Table 4.12: Willingness to pay towards conservation of Yala wetlands

	Responses	Frequency	Percentage
Willing to contribute Ksh 500 per month	Yes	13	4.2
	No	296	93.1
Willing to contribute Ksh 400 per month	Yes	7	2.3
	No	298	97.7
Willing to contribute Ksh 300 per month	Yes	11	3.6
	No	294	96.4
Willing to contribute Ksh 200 per month	Yes	18	5.9
	No	287	94.1
Willing to contribute Ksh 150 per month	Yes	2	0.7
	No	301	99.3
Willing to contribute Ksh 100 per month	Yes	18	5.9
	No	285	94.1
Willing to contribute Ksh 50 per month	Yes	54	18.1
	No	245	81.9
Willing to contribute Ksh 20 per month	Yes	32	11.0
	No	259	89.0
Willing to contribute Ksh 10 per month	Yes	24	8.3
	No	265	91.7

Table 4.13: Maximum amount of willingness to pay per year

	Mini-mum	Maximum	Mean	Standard Deviation
Overall per year	2.00	6000.00	420.83	858.86
Birds of different types	1.00	1000.00	76.00	157.25
Wild animals (edible and non-credible)	2.00	300.00	68.74	90.84
Grasshoppers (meat)	2.00	1000.00	68.29	200.10
Grass for roofing and weaving	1.00	2000.00	60.34	184.45
Grass for grazing	1.00	1000.00	50.42	122.12
Edible ants	1.00	500.00	53.09	100.13
Papyrus (handicrafts)	3.00	3000.00	69.47	278.73
Wild vegetables (mushrooms)	2.00	200.00	49.25	51.86
Wild fruits	3.00	20.00	10.33	6.10
Spiritual /cultural ceremonial places)	10.00	1000.00	141.67	324.11
Water	2.00	2000.00	71.95	181.42
Others	5.00	400.00	74.55	122.25

the area could be very high. However, due to the population increase in the Yala wetland, the welfare of the people in the wetland will decrease in future. With increased number of people, livestock population is also increasing. At the same time, the environmental resources base is eroding due to unsustainable exploitation practices in use.

The inhabitants of the Yala basin adjacent to the wetland engage in numerous livelihood activities, including livestock keeping, rainfed farming, and petty trading. Some of the economic activities differ from one village to another depending on whether the village is close or far from the wetland. For instance, villages that are closer to the wetland engage in making papyrus products compared to the villages that are outside the wetland. Some people in the villages that are close to the wetland, earn good income from selling mats, which enable them to pay for their children's secondary school education.

4.4 Determinants of Willingness to Pay

Descriptive statistics show that majority of the respondents are middle aged, and the average household size has an average of six members. Majority of the households own small parcels of land, with the mean ownership being about 1 acre. Regression analysis is carried out to establish the factors that affect the willingness to pay for the residents of the wetlands to conserve it (Table 4.12).

The models are well specified as supported by the F-test statistic. The variables are tested for heteroskedasticity using the Breusch-Pagan test. Two types of regressions were carried out: ordinary least squares (assuming there are no stages in the decision making process of how much to pay) and a censored tobit (taking into account two stages of decision making process, whether willing to pay as the first stage and how much to pay after deciding to pay as the second stage). According to Table 4.14, two stage estimations with a censored tobit has better results. A total of six variables are significant out of a possible twelve.

Religion significantly determines the willingness to pay. Christianity has a positive impact, while other religions have a negative impact. Most churches preach on the "blessedness" of giving, and perhaps this explains the positive effect on willingness to pay.

The household size variable (HHSIZE) has a negative and significant effect on willingness to pay. Assuming income is constant, an increase in household size reduces the ability of households to meet the subsistence needs, especially where land pressure is high and may subsequently lead to higher amount of natural resources harvested. Thus, if a family has more members, it needs extra income to support extra subsistence requirements, hence lower willingness to pay to conserve the wetland.

The age of the household head (AGE_HEAD) is not an important determinant of willingness to pay, but as age of the household head increases, there is willingness to pay less than if younger (as depicted by the square of age of the household). Wetland products harvesting is a physically demanding activity that involves walking long distances, an inverted U relationship between harvesting and age was expected (i.e increasing with age and later on declines). Willingness to pay thus increases with age and later on declines. This may be because older household heads have fewer years to live, thus the expected benefit from the wetland for the remaining years of life is minimal. It may be also that the bequest value placed on the wetland by older heads of households is less compared to the bequest value placed by younger household heads. This is due to the fact that older people have a shorter planning horizon or have a high discount rate, thus their willingness to pay is likely to be lower than that of younger people.

The resources the households derive from the wetland, and thus the direct benefit from the wetland, determine its value.[15] Using a dummy for collecting firewood from the wetland as a proxy for the direct benefit derived from the wetland, the study establishes that households that derive direct benefit (as evidenced by resource extraction from the wetland) are willing to pay more to conserve the wetland. This shows that people who directly benefit from a wetland will be willing to conserve the wetland compared to people who do not benefit directly from it.

The household income (proxied by household expenditure, EXPEND) variable positively and significantly determines the willingness to pay. More household income may be used to access variable inputs such as labour, which may increase exploitation of the wetland resources, hence willingness to pay. It seems that higher incomes increase an agent's demand for environmental goods and services (Baland and Platteau, 2006) and is consistent to the Environmental Kuznetz curve.

Table 4.14: OLS and censored Tobit Regression results of the determinants of willingness to pay (Dependent variable = Willingness to pay (Ksh))

	OLS regression	Censored tobit regression	
Variable	Coefficient	Coefficient	Marginal effects
MHEAD	15.641	37.427	21.781
MARRIED	26.046	9.222	5.367
XTIAN	71.786***	88.946***	51.764***
ROTHER	-71.846***	-89.052***	-51.826***
PREDUCN	4.769	1.688	0.982
HHSIZE	-5.462**	-11.660***	-6.786***
SECEDUCN	-4.690	-1.613	-0.938
AREA_01	-0.011	0.037	0.022
AGE_HEAD	-0.009	0.050	0.029
AGEHEAD2	-0.004	-0.016***	-0.009***
DFWO_COL	0.026	0.045**	0.026**
EXPEND	0.005	0.011***	0.007***
SIGMA		144.968***	-
N	318	318	318
Adjusted R2	0.01664	-	-
Long likelihood function	-	-1507.266	-

***, **, * Indicates 1%, 5%, and 10% significance levels

[15] Dummy for collecting firewood is used to proxy direct benefit from the wetland because it is the most collected wetland product in terms of proportion of households and number of trips per year.

Village dummies were initially included in the estimation to control for regional differences in terms of willingness to pay. However, spatial (or area) variations were not found to be important and were thus dropped. The fact that all the sampled villages are within the wetland, and that most of the wetland resources are fairly distributed in all the villages, may explain the lack of significance in the village dummies.

4.5 Value of Output from Dominion Farm Limited

The Dominion Farm Ltd projects have an output of 100,000 tonnes of rice per annum and 20,000 tonnes of fish (tilapia-*Oreochromis esculentus*[16]) per annum when fully operational (Ohito, 2006 and Dominion Group of Companies website). This will amount to a value of about Ksh 3.0 billion (US$ 43.5 million) per year for rice and Ksh 0.8 billion (US$ 11.6 million) per year for fish (the value of fish is calculated using a price of Ksh 40/kg, while that of rice is calculated using Ksh 30/kg). The total value for the two produce will thus amount to Ksh 3.8 billion (US$ 55.1 million) per year. This amounts to Ksh 330 million/hectare/year assuming area I and II are used.

The Dominion Farm will also grow other crops such as soya and cotton, but the projected output for these crops is not available. In spite of this, the value of the wetland with the conversion will still be lower than the estimated TEV of Ksh 8.31 billion (US$ 120.4 million)[17] that has been estimated for the conservation of the wetland, given that the "costs" will be inherent due to conversion amounting to Ksh 475 million/hectare/year. The TEV for those locations within which the wetland falls was considered, which amounted to Ksh 4.98 billion (US$ 72.2 million). This is still higher than the total output for Dominion Farm Ltd. The results would be the same if Dominion uses a total of 8,000ha (area 1=2,300ha and area 2=5,700ha).

Externality of conversion of Yala swamp translates to a direct economic loss of upto US$ 0.7 million per year on both fish stocks and yields in Lake Victoria, ignoring other ecosystem services such as ground water recharge, carbon sequestration or habitat provision (Simonit and

[16] Kenya Wetlands Forum (2006).

[17] In getting the TEV of Ksh 8.31 billion, the assumption is that the number of households has not changed since the 1999 Population and Housing Census. Thus, TEV may be much higher if the number of households used for scaling reflected the current state, given that subsequent census reports have shown increase in household numbers.

Perrings, 2005). If this loss is taken into account, then the loss due to conversion will be much higher than has been derived. Yala wetland should therefore be conserved rather than converted as the value for conserving the wetland is much higher than for conversion even when it is assumed that Dominion Farm Ltd realises its full potential, which as per now, has not been achieved. Currently, the company has not even met about 25 per cent of its planned target.

While agriculture provides 22.7 per cent proportion of economic value, converting the wetland into large scale agricultural production will not be sustainable as this will have a detrimental effect on the ecosystem, given the machinery and inputs for large scale agriculture that will have a direct effect on the environment and affect, among others, the fish stocks. Livestock use values in form of grazing land, domestic water use and other direct and non-use values such as papyrus for thatching and bequest values will also be affected. Therefore, it is necessary to promote sustainable small scale agricultural production, which provides for the basic needs and a source of livelihood for the community rather than converting the wetland.

The community around the wetland also relies on fuel wood and charcoal as a source of energy. Harvesting of these resources should be brought into balance, with regeneration capacity of the wetland flora. Apart from this, the carrying capacity of the wetland should be determined to facilitate the effective control and maintenance of an acceptable level of the number of cattle. Sustainable utilization of the wetland should thus be promoted in order to maximise the Total Economic Value of the wetland.

Even with the conversion of the wetland, there are certain values that will not be completely lost, though degraded to some extent, such as water for livestock, domestic use and fisheries. With fisheries, the newly formed lake due to the weir construction is already being used for fishing by the local community. Aquaculture could even be encouraged, and this may lead to an increase in fish output. To enhance the magnitude of the type of values that are degraded but not completely lost, measures should be taken to ensure that pollution is controlled to enhance the quality of drinking water, the fish breeding grounds within the swamp are not interfered with to preserve the water species, and that some land is set aside for grazing.

4.6 Limitations of the Study

There are limitations in this study, especially with use of CVM on non-use values. The study did not use the procedure strictly according to text book requirements of a CVM procedure. Secondly, even after the wetland is converted, not all values are lost.

Nevertheless, the study has provided a lower bound of values to guide policy. The study design is conservative in the sense that it is likely to underestimate willingness to pay. It shows that before decisions are made on the conversion or otherwise of wetlands, the National Environment Management Authority (NEMA), the Kenya Wildlife Service (KWS) and any other agency should carryout a thorough study observing the required guidelines.

Although not directly linked to the methodology, the study does not answer the question on who gains and loses from degradation and loss of the Yala wetland. Although a wetland use showing a substantial net benefit is highly desirable in efficiency terms, it may have significant negative distributional consequences. This is because economic valuation, which provides the efficient allocation aspects of resource use, is one aspect of the decision making process for managing wetlands. Others will include equity and distributional aspects, and political and ecological considerations.

5. Conclusion and Recommendations

5.1 Conclusion

The Yala wetland provides a substantial benefit to the community that lives around it. Though only 20 per cent of the households are engaged in fishing, fisheries provide the highest proportion of the economic value (37.0%), while agriculture provides 27.7 per cent, a combined economic value of 64.7 per cent. These activities provide both a source of income and food, thus providing nutrients to the community. Providing sustainable environment in which these activities are carried out will lead to higher economic value to the community.

The ongoing land reclamation and conversion pose many environmental and socio-economic problems. One of the effects of land reclamation is habitat loss, which leads to buffering effects of the swamp and Lake Kanyaboli by the removal of vegetation. Given that most of the community around the Yala swamp relies on wood for firewood as a main source of energy, delineation of the swamp area and subsequent loss of source of fuel wood will result into increased pressure on surrounding forests.

Despite the limitations of the CVM method, the results can and do provide valuable information to policy makers. They point out the need for renegotiations of terms and conditions of the present lease agreement between the Dominion Farm Ltd and the Government of Kenya, or suspending it altogether until a more careful and thorough study is conducted.

5.2 Recommendations

The Total Economic Value has been derived assuming a sustainable utilization given the current conservation efforts, but more conservation efforts will lead to a higher Total Economic Value than the one estimated. The conservation efforts should be guided by a management plan under participatory/stakeholder approach. The conservation efforts should focus on a number of things, including capacity building of the community in terms of resource management and better extraction methods.

Since the present study is based on a sample of the population at a particular time, it is imperative that periodic evaluation studies be undertaken as value changes over time. Moreover, the value of a wetland can increase with human development (Mitsch, 1998). The value of a wetland can increase as the area is developed, since development of an area improves through human efforts.

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