ECONOMIC VALUATION AND GREEN ACCOUNTING OF WETLAND RESOURCES OF THE KILOMBERO VALLEY, RAMSAR SITE, TANZANIA

BY

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EXTENDED ABSTRACT

Wetland ecosystems in Tanzania are historically important for the well being of human communities, biodiversity conservation and other environmental values. These cover about 88 300 km^2 which is about 10% of the land surface. However, in recent years, they have gone through ecological changes. The major reason is increased unsustainable utilization of wetland resources, which may result into losses of livelihoods. Under Ecosystem Services Framework (ESF), the role played by healthy ecosystem in sustainable provision of human wellbeing, poverty alleviation and economic development potential. It has been established that sustainable management of wetland ecosystem and associated resources depends on among other factors, the understanding of their economic value. Furthermore, in order to have a sustained economic growth, there is a need to capture fluctuations in the resources base values and include them in national accounts. Such practice help send signals on the performance of the resource base, with corresponding effects on human welfare and the national economy at large. This information is missing in Tanzania which subjects wetlands into undue degradation. In this study, guided by the Ecosystem Services Framework, Kilombero Valley Flood Plain Ramsar Site (KVFPRS) was used to provide an understanding of the level of household utilization of wetland resources and economic benefits derived from direct utilization, how to capture non-marketed benefits of regulating and biodiversity, green accounting of wetland values by accounting for wetland degradation in the national accounting system. The overall objective of the study was to estimate the Total Economic Value (TEV) of the KVFPRS and account for these values in the national accounting system. Specific objectives were to assess: 1) direct use values, 2) indirect use values, 3) non-use existance biodiversity values, and 4) contribution of wetland resources in the national accounting system to include also degradation. Data were collected through: i) discussions with officials working in the KVFPRS ii) household contigent valuation questionnaire, iii)

literature searches, iv) expert evaluation, v) focus group discussions and vi) market surveys. The study involved 10 purposely sampled villages, which were selected based on economic activities and exposure to altered ecological characteristics. In these villages, a 5 percent of randomly selected households which resulted in a total sample of 490 households in KVFPRS. For direct economic activities, a Market Price Method was used. In this method, direct activities from agriculture (paddy, sugarcane), fishing, forest products, thatch grass, livestock keeping, water for domestic use and bushmeat hunting were valued. For each activity, the percentage of participating households was identified; information on what they produce, the cost of production and the net benefit was calculated. It was observed that 90% of households engaged in paddy production. The annual population benefit was estimated at a lower bound of Tshs 21.6 billion and higher bound of Tshs 86.4 billion. Sugarcane growing was practiced by 11 percent of the sampled population as outgrowers. Estimated benefit for the population was Tshs 31.6 billion. Thatch grass collection was done by 5 percent of the population. Estimated value stood at 3.2 billion. About 6% of the population wre engaged in forestry related business, however, the dependence for charcoal was about 70 percent and 90 percent for firewood. Estimated value of wood based products was Tshs 20 billion. Fishing was carried out by 22% of population mostly in fishing camps. Average price per fish was Tshs 2 000 and cost of production per trip was Tshs 22 000. Total net benefit was Tshs 4.4 billion. Brick making was carried out by 5 percent of the population. Net benefit was estimated at Tshs 1.6 billion. Livestock keeping especially free ranging cattle was carried out by 22 percent of the population with price per cattle of Tshs 500 000. Sold cattle brought annual benefit of Tshs 4 billion. Hunting for bush meat was carried out by 5 percent of the population with a price of Tshs 2 000 – 5 000 per kg, the earnings from this activity translated to Tshs 800 million per year. Water for domestic use was estimated at 6 billion litres in a year with total value of Tshs 336 million. The total aggregate value for direct economic value

for studied activities stood at Tshs 152 billion indicating the significant contribution of KVFPRS in supporting direct economic activities. The largest contribution came from agriculture; lead by paddy production (56.6 percent), sugarcane production (20.8 percent), followed by forest products (13.2 percent), fishing (2.9 percent), livestock sale (2.6 percent) , bush meat (0.5 percent), brick making (1 percent) and thatch grass (2.1 percent). Contigent valuation of willingness to contribute was used to value non-marketed goods. This was done by asking households' their Willingness to Contribute (WTC) and Willingness to Accept compensation to valuation scenarios that would prevent biodiversity loss, improve water quantity and quality and control floods in order to avoid losses households face in KVFPRS. Household could contribute in terms of labour, cash, or a combination of the two. Willing to Contribute (WTC) in cash is equivalent to asking the usual Willingness-to-Pay question in CV surveys. The value was at Tshs 3 billion for Biodiversity, Tshs 6 billion for Flood control and Tshs 4 billion for water quantity and quality. Contribution in labour was highest in value for all ecosystem services constituting about 80 percent of the total value. Noted also was that most contribution in cash was less than 10 percent of the average annual household income. In terms of Willingness- To-Accept (WTA) compensation for the next five years, results indicated that 92 percent of respondents voted for it and about eight percent of the respondents were against it. The respondents stated a mean WTA of Tshs 2 709 500 per year and the maximum amount stated was Tshs 100 000 000. However, some of the very high amounts could be a way of protesting though the threshold for what can be viewed as a protest could not be established. A logistic regression analysis was conducted to explain the variation in annual WTC per household for All services, biodiversity, flood control, water quality and quantity; respectively. Willing to Contribute (WTC) was regressed on household size, gender, age of respondent, marital status, education, activities carried out in KVFPRS, income of household and total area owned. The value of wetland based on contingent

valuation of WTC was significant at Tshs 14 billion. The study shows that it is possible to value non-marketed goods and services provided by the KVFPRS. These findings and the approach used can be used to devise strategies for maintaining ecological health of the KVFPRS. In respect of green accounting of wetland values, both marketed and non marketed wetlands values, wetland services from crop levy, registration fees and royalties and degradation were used to show contribution of wetland resources in the national accounting system. Economic contribution of direct economic values was Tshs 152 billion and non marketed goods which accounts for Tshs 14 billion, wetland services was Tshs 75 million bringing the total value of Kilombero Ramsar site to about Tshs 167 billion in the national account. Furthermore, calculated degradation was reduced as a cost in the national accounting. The study observed overfishing of about 98 000 kg valued at Tshs 196 million, for livestock grazing extra of 200 livestock units required valued at 10 billion and for forests a deforestation rate of 52.2 ha/year valued at Tshs 30 million. This results into degradation value of Tshs 10.1 billion. Thus, green contribution of wetland into the national accounts to amounts Tshs 157 billion. This portrays how economic growth and ecological health of wetland resources sustain each other. It is concluded that sustainable management of wetland ecosystems can not be attained if consideration of direct use, indirect use and existence biodiversity values are ignored when planning for sustainable wetland management.

DECLARATION

I, Siima Salome Bakengesa, do hereby declare to the Senate of the Sokoine University of Agriculture, that this thesis is my own original work and that it has neither been submitted nor concurrently being submitted in any other institution.

_____ _____

Siima Salome Bakengesa **Date**

PhD Candidate

The above declaration is confirmed

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(Main Supervisor)

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DEDICATION

To my parents: My mother, Ma Georgina Kokwijuka Mutashaga Bakengesa and My father, Ta. Samson Samuel Bakengesa and. Your Wish is being fulfilled by coming to this level. May the Almighty God rest your souls in eternal Peace. For sure, you are much treasured for your love, guidance and prayers.

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LIST OF ABBREVIATIONS AND ACRONYMS

AMSDP	Agricultural Marketing Systems Development Programme
CBFM	Community Based Forest Management
CDM	Clean Development Mechanism
CPRs	Common Pool Resources
FAO	Food and Agriculture Organisation of the United Nations
FGD	Focus Group Discussion
GDP	Gross Domestic Product
GIS	Global Information System
GNP	Gross National Product
GPS	Global Pisitioning System
HDI	Human Development Index
HSB	Household Survey Budget
IGAs	Income Generating Activities
IPCC	Intergovernmental Panel on Climate Change
ISIC	International Standard Industrial Classification
JFM	Joint Forest Management
KVFPRS	Kilombero Valley Flood Plain Ramsar Site
MDGs	Millennium Development Goals
NBS	National Bureau of Statistics
NRA	Natural Resources Account
NSGRP	National Strategy for Growth and Reduction of Poverty
PAC	Percentage of accurate classification
PADEP	Participatory Agricultural Development and Empowerment Project

PES	Payment for Ecosystem Services
PFM	Participatory Forest Management
REDD+	Reduced Emission from Deforestation and Forest Degradation Plus Conservation, Sustainable Forest Management and Enhancement of Carbon Stocks
SUA	Sokoine University of Agriculture
TAFORI	Tanzania Forestry Research Institute
TASAF	Tanzania Social Action Fund
TFCG	Tanzania Forest Conservation Group
Tshs	Tanzania Shillings
UMB	University of Life Science, As, Norway
UNCED	United Nations Conference on Environment and Development
URT	United Republic of Tanzania
VLFR	Village Land Forest Reserve
VNRC	Village Natural Resource Committee
VPO	Vice President's Office
WCED	World Commission on Environment and Development
WSSD	World Summit on Sustainable Development
WTA	Willingness to Accept
WTC	Willingness to Contribute
WTP	Willingness to Pay

CHAPTER ONE

1.0 GENERAL INTRODUCTION

1.1 Wetland Resources in Tanzania

Tanzania is endowed with exceptional wetland resources which include lake systems, river floodplains, and deltaic mangrove formations that, m cover about 88 300 km^2 which is about 10 percent of the area of Tanzania mainland. Wetland ecosystems in Tanzania are historically important for the well being of human communities, biodiversity conservation and other environmental values (Kamukala and Crafter, 1993). Broadly, wetlands are classified into six categories namely: marine and coastal wetlands, highland headwater wetlands, freshwater estuarine wetlands, internal drainage wetlands, river and inland floodplain wetlands and man made wetlands.

(i) Marine and coastal wetlands: These are formed by wave action and tidal influence along the shoreline. They include mud flats, marshes, mangrove swamps, estuaries and deltas. They are predominant in Tanga near the Kenyan boarder and support 16.2 km^2 of mangrove swamps in Mtwara and 62 km^2 in Lindi in the South. Coastal wetlands are characterized by heavy saline soils. The main rivers that form marine and coastal wetlands are Rufiji, Ruvu, Wami, Matandu and Ruvuma with Rufiji delta accounting for about 50% of all mangrove in the country.

(ii) Highland headwater wetlands: These are usually located at the spring of river systems. Usually they are associated with rainforests and high rainfall. Their waters are usually associated with low temperature and dissolved oxygen. Examples of these are the North- Eastern and South- Western highland systems.

(ii) Freshwater estuarine wetlands: These are formed alond the Lake shores up to 6 metres depth. They are associated with meandering of rivers depositing sediments as they enter the Lakes. These wetlands cover approximately 305 km of Lake Nyasa, 650 km of Lake Tanganyika and 142 km of Lake Victoria.

(iii) Internal drainage wetlands: These wetlands are found in areas with rainfall ranging from 400 mm- 600 mm with high evaporation and high concentration of caustic soda making difficult using water for domestic use. These include Lake Eyasi (116 000 ha), Lake Natron (85 500 ha), Lake Babati, Lake Singida among others.

(iv) Rivers and inland floodplain wetlands: These comprise of those plains usually formed in low altitudes whereby the river floods seasonally during rain seasons. Soils in these wetlands are more fertile. These include Rufiji, Wami, Kilombero, Usangu, Pangani, Ruvu, Kagera and Katavi. The permanent and seasonal freshwater swamps and marshes associated with these floodplains covers about 2.7 million ha.

(v) Man-made wetlands: These are over 85 000 ha of man-made wetlands in the country. They include Mtera (610 km^2), Nyumba ya Mungu (180 km^2) to mention few. These provide hydropower as well as habitat for various wildlife.

Another classification is according to where they drain. Under this classification the country is divided into five major drainage basins, according to the recipient of water. The Indian Ocean (Pangani, Wami, Ruvu, Rufiji and Ruvuma Rivers, and Lake Nyasa); internal drainage to Lake Eyasi and Bubu depression complex; internal drainage to Lake

Rukwa; drainage to the Atlantic Ocean; and drainage to the Mediterranean Sea (via Lake Victoria). Each of these basins includes a network of rivers, lakes and wetlands as shown in Fig. 1.

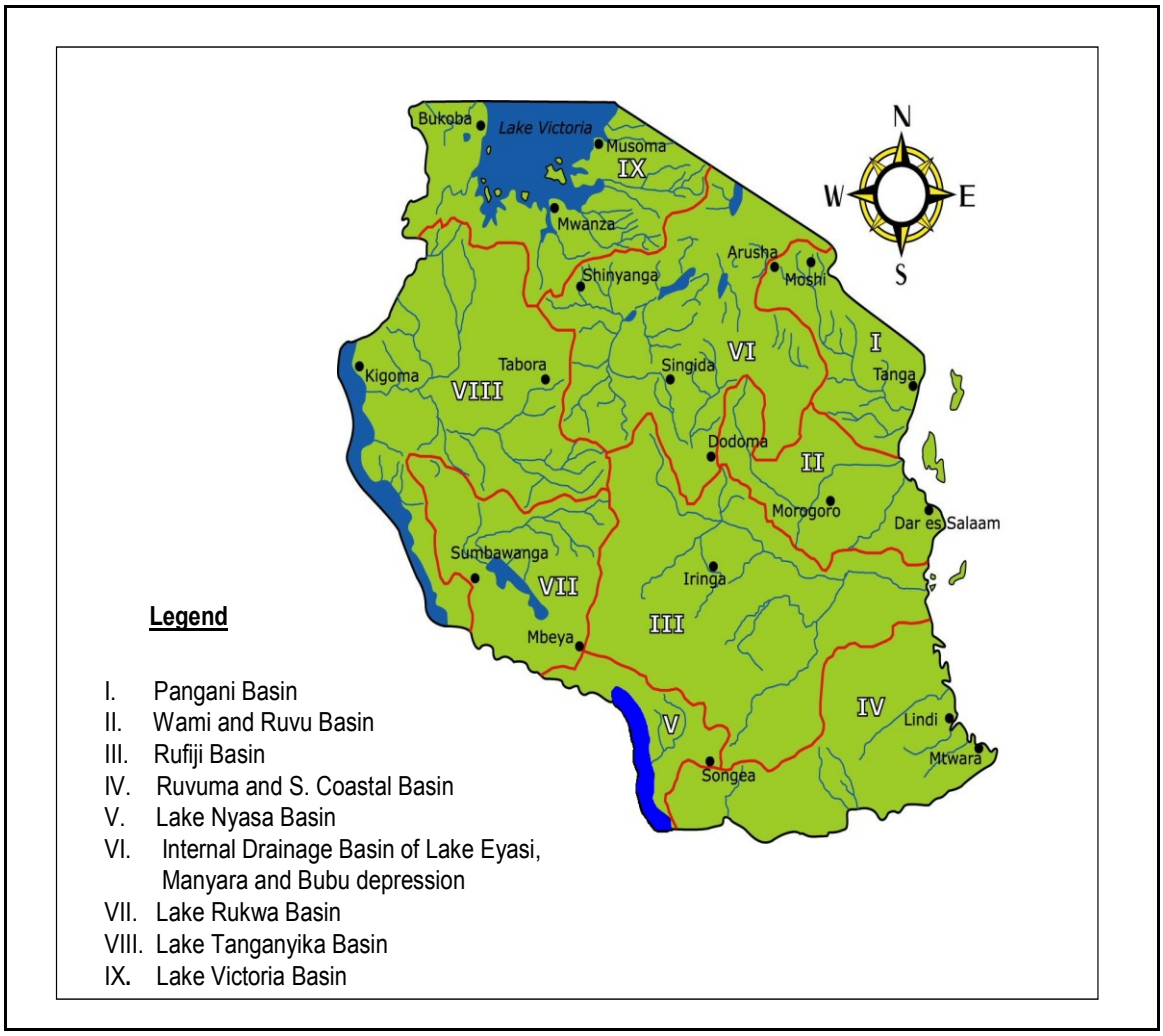

Figure 1: Major drainage basins classified according to recipient of water.

Source: URT, 2004

1.2 The Ramsar Convention and Sites in Tanzania

The Ramsar Convention is an intergovernmental treaty that provides a framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. It has its name after the town of *Ramsar* in Iran, where the signing was made in 1971 (Ramsar Convention, 1971). Though the first concerns were on

waterfowls, the Convention has evolved encompassing in its mission the conservation and wise use of wetlands by national action and international corporations as means to achieve sustainable development throughout the world. On signing to the Convention, the contracting parties are obliged to:

(i) Designate wetlands for inclusion in the list of wetlands of international importance and maintain their ecological character

(ii) Develop national wetland policies, to include wetland considerations within their national land use planning,

(iii) Establish wetland reserves, promote research, management and wardening and;

(iv) Undertake consultations with other contracting parties on shared resources.

In fostering common understanding, the convention defines wetlands as areas of "*marsh,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 tides does not exceed six meters"* (Ramsar Convention, 1975).

The Government of Tanzania ratified to the Ramsar Convention in 2000 and Wildlife Division in the Ministry of Natural Resources and Tourism (MNRT) has a facilitating role in implementing the Ramsar convention on the wise use of wetlands. Currently, Tanzamia has four Ramsar Sites namely Malagarasi-Moyovosi (3.25 million ha), Lake Natron (224 781 ha), Kilombero Valley Flood Plains (796 735 ha) and Rufiji-Mafia-Kilwa Marine Ramsar Site (59 697 ha). These cover about five million ha constituting 5.5% of the total

land, of which about one million is KVFPRS. Lake Nyasa is a proposed Ramsar Site and efforts are being made for designation (MNRT, 2004). Kilombero Valley Flood Plain Ramsar site (KVFPRS) was designated in 2002. These resources contribute significantly to economic development of the country.

1.3 Potential and Management Challenges of Wetland Resources

Life support services provided by wetlands in meeting household's basic needs cannot be overemphasized (de Groot *et al*., 2006, Turner and Daily, 2008). These ecosystems provide food, fuel wood, fish, wildlife and many other benefits which form an important part of the economy. The capacity of wetlands to support livelihood is based on complex interaction between ecological processes as highlighted in the Ecosystem Services Framework. Through ecological process, they control flooding water, enhance ground water recharge, controls river eutrophication and support specific biota (Pearce and Turner, 1990). Based on their productive potential, they have attracted a number of users. The conversions to settlelment, agricultural lands, and fishing, as well as livestock keeping areas have risen to the level that interferes with ecological process, leading to wetland degradation. At global level, more than 60% of world's ecosystem are being degraded or used unsustainably (MA, 2005). In Tanzania, while most of the wetlands are still in fairly natural condition, a few wetlands such as the Kilombero, the Pangani River have undergone ecological change (MNRT, 2004). These resources are a key to economic development and can assist the government to achieve its development targets (TEEB, 2012, Munishi *et al*., 2010). The major challenges which need to be accomplished by the government are:

(i) Realization of its development vision 2025 which strives to see to it that by the end of 2025 Tanzania will be free from poverty and will have graduated from a group

of least developed countries to that of middle-income countries, with high level of human development (Tandari, 2004; www.tanzania.go.tz/vision.html).

(ii) Achieve 8 Millenium Development Goals (MDGs) by 2015: eradication of extreme poverty and hunger, achieve universal primary education, promote gender equality and empowering women, reduction of child mortality, improve maternal health; combat HIV/AIDS, malaria and other diseases; ensure environmental sustainability and develope global partnership for development.

(iii) Fulfilling the international commitments which Tanzania has acceded to, signed and/or ratified to include conventions on biological diversity, biological diversity, Convention on international trade of endangered flora and fauna species (CITES) and Conventions on wetland Ramsar within Africa.

According to MNRT (2004), among the management challenges facing Tanzania's wetlands and wetland ecosystems include unsustainable agricultural practices, soil erosion, overgrazing, water pollution, deforestation and overexploitation of forests/woodlands, siltation of lakes, dams and other wetlands. Others include degradation of fishery resources, inappropriate use of water resources, bushfires and vegetation burning, illegal hunting and encroachment into wetlands, lack of baseline information and poor monitoring of wetlands, unsustainable investments in wetland areas, unsustainable mining and natural disasters. Other challenges include poverty, population pressure and lack of alternative livelihoods. There is also inadequate institutional capacity to manage wetlands, absence of legal framework for wetland management and lack of awareness among local communities on wetland values. According to, de Groot *et al*. (2006) the wetlands are still under valued and overused due to public good nature, presence of externalities, perverse incentives, unequal distribution of cost and benefits and devolution of decision making away from local people. The presence of externalities fails to benefit

the society as a whole. This situation is described as tragedy of commons- in which the value of the common property resource (CPRs) is lost (Hardin 1985; WRI, 2005). Absence of effective rules limiting access to CPRs has also been associated to tragedy of common (Ostrom *et al*., 1999)and the defining rights and duties in two folds (i) CPRs overexploitation without consider the negative effects on others and (ii) lack of contributed resources for maintaining and improving the CPR itself. Turner and Daily (2008) and TEEB (2012), suggests that effective management of ecosystem can sustain the provision of the vital ecosystem services responsible for bringing up development.

Development is being defined in this thesis as positive quality change of human capabilities and which depends on sound ecological environment. The concept of human capabilities is being considered by United Nations Development Program (UNDP) in development indices like Human Poverty Index (HPI), Gender related Development (GDI) and Human Development Index (HDI). Economic growth involves modifications in physical ecosystems that have to be utilized at sustainable levels for the benefit of the present and future generations. However, in recent years due to increased population, economic activities and increased consumption, the environment is being threatened. For this reason in 1983, the United Nations convened a World Commission on Environment and Development (WCED) which was chaired by Grow. H. Brundtland, to address issues of deteriorating human environment and natural resources. The commission published a report in 1987, “our common future” which brought sustainable development on international agenda (WCED, 1987). Since the Brundtland report, there are other international conventions and agreements like the Rio Earth Summit and adoption of the Agenda 21, Kyoto Protocol on Climate Change, Stockholm Convention on persistent organic pollutants, World Summit on Sustainable Development where Millennium

Development Goals were passed and whose 7th Development goal is to ensure environmental sustainability by sustaining health and productivity of world ecosystems.

The link between environment and development applies to wetland resources (Schyut, 2005; Pearce, 1996). As much of the wetlands are used for unsustainable agriculture, hunting, fishing, grazing, illegal logging, the consequences have been loss of resource base. Based on the fact that drivers for resource degradation are economic in nature, it is considered appropriate that the solution also be of economic nature taking into account new economic thinking of considering marketed and non marketed goods as advocated by MA, 2005. Despite the importance of these non-marketed values, no empirical study has been carried to quantify them.

In the national resource accounting, the cost of depleting and damaging common property are included as part of internal costs of doing business instead of being regarded as externalities. When such accounting methods are used, the value of maintaining natural resources is often higher than the short term benefits which are realized through resource extraction (Primark, 2006). Few studies have been so far done on green accounting to wetlands in Africa. The inclusion of environmental degradation in national accounting system is part of addressing the issue of sustainability of resource. Repetto *et al*. (1989) cited by Perman *et al.* (2003) observed that low-income countries, which are typically most dependent on natural resources for employment, revenues and foreign exchange earnings are instructed to use a system for national accounting and macroeconomic analysis that almost completely ignores their principal assets. As Barbier *et al.* (2007) suggests, in order to make properly plan for wetland resources, all degradation drivers should be approached from economic point of view.

1.4 The Importance of Economic Valuation of Wetland Resources

Economic valuation not only helps to raise awareness about wetland benefits in decision-making, but it also helps to improve local institutions that manage resources; identify better markets and resource management options for wetlands and their products; and investigate people's livelihood strategies and how these determine the constraints and options for making wise use of wetlands (Guijt & Hinchcliffe 1998). Wetland management activities can affect welfare in terms of change in price of wetland products; goods and risks individuals face Freeman (1993).

In 1999, 84 percent of Ramsar-listed wetlands had undergone or were threatened by ecological change, mainly caused by drainage for agriculture, settlement and urbanisation, pollution, and hunting, and it has been estimated that in some locations 50 percent of wetlands have been lost since 1900 (Finlayson *et al.,* 2005). This is based on many services and multiple values of wetlands, leading to many different stakeholders involvement in wetland use (and abuse), often leading to conflicting interests and over-exploitation of the some services (*e.g.* fisheries or waste disposal) at the expense of others (*e.g.* biodiversity conservation and flood-control).

1.5 Study Area

According to Ramsar Information sheets, KVFPRS is covering approximately an area of 796 735 ha. The central point coordinates are 8 °40' S and 36 °10' E. KVFPRS lies between 210 and 400 m.asl with the main part of it lying between 210 and 250 m.asl. KVFPRS is the largest inland fresh water wetland in low altitude and is divided by the Kilombero River and located into two districts namely Kilombero and Ulanga.

KVFPRS boundary is watershed boundary rather than administrative boundary; as such KVFPRS is treated as one entity. KVFPRS is situated between the forested escarpments of the Udzungwa Mountains up to 2580 m. asl at the North Western side and the Mahenge Mountains 1520 m on the South side. In the North Western part the boundary follows the Tanzania- Zambia Railway Line (TAZARA) from Mwaya South of Mang'ula in the North to Mlimba in the South. The boundary borders the rapids on Mnyera river in the West and it touches rapids of the Ruhudji River in the South and includes land in both districts. On the Southern side the boundary runs along the road to Lupiro village and then along the borders of Selous Game Reserve to Msolwa river and encompasses the Southern part of Msolwa Station. These boundaries are as shown in Fig. 2. The Ramsar site has a total of 108 villages with 72 villages in Kilombero and 36 villages in Ulanga.

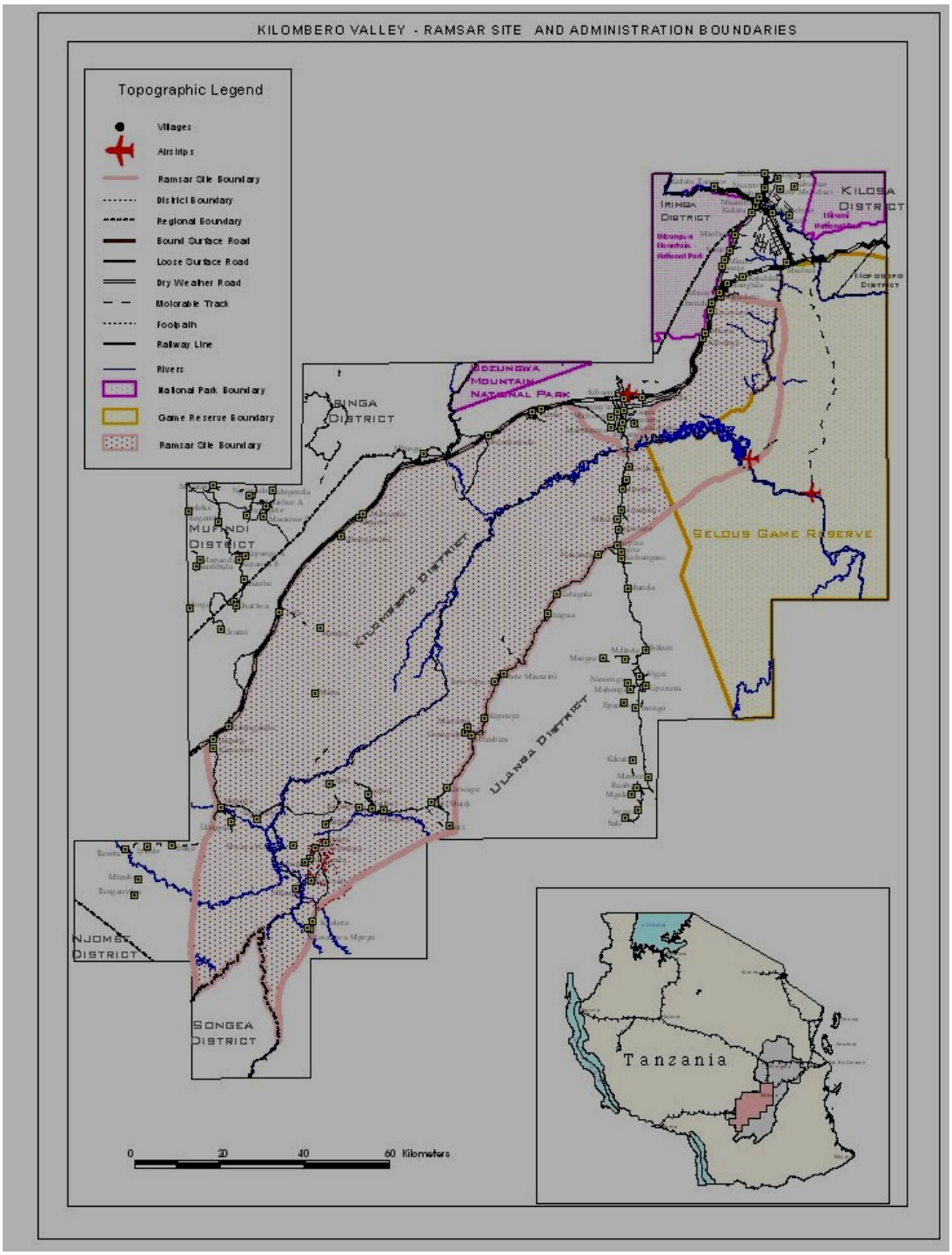

Figure 2: Map showing Kilombero Valley Ramsar site administrative boundaries.

Source: KFPRSP document (2008)

The KVFPRS comprises of a myriad of rivers, which make up the largest seasonally freshwater lowland floodplain in East Africa (FBD, 2000). The Kilombero river system with catchment approximate area of 40,000 km^2 contributes about 62 percent of the annual runoff of Rufiji Basin, regulates the flow of the Rufiji River and supplies nutrients up to Mafia- Rufiji mangrove, sea grass and coral reef complex (FBD, 2007).

Based on hydrological factors, the catchment forests and the surrounding environments in KVFPRS represent a convenient and the cheapest source of water for all needs. The evergreen forest areas to the North and South act as important catchments with the Miombo zone also being an integral part of the wetland ecosystem, harbouring wildlife in the wet season and acting as a source of water and nutrients for the wetland. The combination of evergreen forest, Miombo and wetland is a key feature in regulating water flow throughout the Rufiji River maintaining the characteristic slow rate or rise and fall of its water levels. The minimum flow in the Rufiji basin is 50m^3/sec in the lower catchment and a maximum of 14 000m^3/sec in the wet season (FBD, 2007). Any disruption to this combination would result into a reduction in regulation of water flow.

The KVFPRS supports population of plant and/or animal species which are important in maintaining the biological diversity of the site. The valley contains almost 75 percent of the world's population of the wetland dependent Puku Antelope (*Kobus vardoni*) (East, 1998). It supports Crocodile population which also links with that of the Selous, to form one of the most significant populations of Nile crocodile in Africa (Games and Severe, 1999). The valley contains considerable population of hippos, elephants and lions. There are several populations of endemic Udzungwa Colobus (Dinesen *et al*, 2001). The KVPRS is also as an Endemic Bird Area. Three endemic birds are known: The Kilombero Weaver and two undescribed species of *cisticola.* In terms of water birds, KVFPRS supports 20

000 or more water birds. The valley is known for its fish species and has two endemic species of *Cithannus congicus* and *Alestes stuhimanni (*Jenkins *et al*., 2000).

Maintenance of the wetland habitats and the fertility of the soils for vegetation (including crops) and fisheries are supported by annual floods. Maintenance of hydroperiods is a very important key factor in productivity and species composition of wetland community. Flooding, draining and rebuilding of KVFPRS supports livelihood activities. Flood peaks tend to occur during March-April but can happen as early as January and as late as May. The smooth rise and fall of the Kilombero river influences the same pattern on the Rufiji River as a whole and is important in maintaining ecological balance along the whole length of that river including its delta and the marine systems adjacent to the river mouth.

1.6 Problem Statement

There is so far no evidence from literature of any valuation studies on Ramsar sites in Tanzania to establish economic values in terms of both use and non-use values. Furthermore, no attempt has been made to account for non-marketed and degradation values in the national accounting system. Despite the extensive work on environmental valuation and benefit-cost analysis, the work of valuation of natural resources in developing countries is being challenged by methodological problems and socio economic aspects. Several authors on general assessment of methods to capture value emerged with skepticism on the concept of willingness to pay in developing countries, the main one being the level of poverty and lack of cash (Whittington, 1998). This methodological challenge has reduced a number of studies on the value wetland resources in the country to be minimum. Few valuation studies in Africa are on the flood plains of the Zambezi basin, Hadeijia-Nguru, Nakivubo and Lake Chilwa wetlands and have concentrated on direct use values mainly fish, agriculture, livestock farming, natural products and medicine (Schuyt,

2005) with little attention to wetland services. There is much focus on raw materials and physical production and on commercial activities and profits. The result is the undervaluation of wetlands (Turpie *et al*., 2003). Few valuation studies in Tanzania, include Kadigi *et al.* (2010) who worked on the total economic value of water utilization in the Great Ruaha catchment, FBD (2003) that attempted to value catchment forest reserves, and FBD (2006) that estimated mechanism of payment for environmental services in the Rufiji Basin. All these authors valued marketed goods and if not marketed goods, the mode of payment was through cash money. In conventional financial and economic profitability assessment, environmental and other non-market impacts are usually neglected.

Sustainable management of these resources depends among other factors understanding their economic values consisting of both use and non-use values. Such economic values have been ignored in most of valuation studies (de Groot *et al*., 2006; Schuyt, 2005, MA, 2005). This study tries to address the gap. As Munishi *et al.* (2005) observed inadequate data and information on the status of the existing wetland resources including lack of data base with regard to collection and monitoring system for wetland resources. This seem to have constrained the development of policy on wetland resources utilization in the country. This formed the basis for this valuation and accounting for KVFPRS resources study where by both direct, indirect and non use values and degradation were studied.

1.7 Study Justification

The findings of this study will help policy and decision makers to devise short, medium and long term strategies for sustainable management of KVFPRS and other wetlands and hence delivering Government Ramsar obligation. Furthermore, thet will help in creating awareness to the public of the situation on the ground, and facilitating positive changes

towards conservation. For planners, will be helped on how to capture ecosystem services and the importance of incorporating environmental services in the national accounts in which economic growth and the ecological health of wetland resources sustain each other using KVFPRS as a case study.

1.8 Study Overall Objective

The overall objective of the study was to valuate KVFPRS wetland resources and establish their contribution in the national accounts.

1.8.1 Specific objectives

Specific objectives of the study were to assess:

i. Direct use values
ii. Indirect use values
iii. Non use biodiversity values
iv. Contribution of wetland resources in the national accounting system to include also degradation.

1.8.2 Research questions

The focus of the research questions that guided the current study was on the economic values and accounting of wetlands resources as described below:-

Economic Valuation of Wetland Resources

i. What are the existing and potential direct values of the Kilombero valley flood plain and how they are valued by communities in the study area?
ii. What are the indirect use values of Kilombero Valley Flood Plain, Ramsar site? and how they are valued by communities in the study area?

iii. What are the non use biodiversity values of Kilombero Valley Flood Plain, Ramsar site? and how are they valued by communities in the study area?

Accounting for Wetland resources and degradation in the national accounting system

i. What is the present contribution of KVFPRS wetland resources into the national accounting system?

ii. What is the degradation value of KVFPRS wetland resources that can be costed in the national accounts?

1.9 Sampling Procedure

The data for the valuation exercise were collected from a representative sample of households in Ramsar site. A total of 10 purposely selected villages were used for the study in Kilombero Ramsar site. The selection was based on economic activities being carried out, exposure to hydrological impact and representation of district wise. In the selected villages, a random sampling to households was employed and had representation from each sub-village using village register. Then, with the help of village leaders, the researcher identified selected households for the interview. Usually, the head of household responded to the questionnaire, sometimes with help of family members. The sampling intensity of 5 percent as recommended by Boyd *et al.*, 2001 was employed. A total of 490 households were used for the study. The interviews were performed face to face in the respondents' home.

1.10 Conceptual Framework of Total Economic Value of Wetland Resource

Total economic value was the framework which was adopted for this study ref. Fig. 3. The value of wetland ecosystem is unequivocal and cannot be overemphasized. Broadly

speaking, values of wetland ecosystem can be put into two groups: human values and non-human values. Human values refer to what people consider to be the values of the wetland to them, and include (a) *use value*: direct use value, indirect use value (ecological values), quasi-option values, and (b) *passive (non-use) value:* existence value (satisfaction that the resource is there), quasi-option values, and vicarious values i.e.future use for the present generation, and use by the future generation-also called bequest value (Bennett, 1998; Bateman *et al.,* 2003; Pearce and Özdemiroglu, 2002; Barrow, 1999).

Direct use value is further subdivided into *direct extractive use value* that is agriculture, fishing, forest products, thatch grass; and *direct non-extractive use value*, Indirect use values (ecological values) include: flood control, water catchment, and waste assimilation. The quasi-option value (which is more frequently confused with "option value") refers to the value the *society* would place on the forest if all new its complex functions. On the other hand, "option value" refers to a future *personal* value due to uncertainity (Bateman *et al.,* 2003). A further distinction between these two concepts (whose difference is rather fuzzy) is made by Fackler *et al.* (2007): Some defines *option value* as a risk premium due to the uncertainty in future value of environmental goods. A *quasi-option value* defines a measure that highlilights irreversibility and incorporates the possibility that useful information will arrive over time". The authors (ibid) also introduced a new concept called *real option value* which, according to them, is equivalent to quasi-option value, and is concerned with the value of the resource contingent on whether decion making on the resource use is now or delayed. As Bateman *et al.* (2003) posit, the forest/woodland resources have their intrinsic value (non-human values)-value of the resource in its own right.

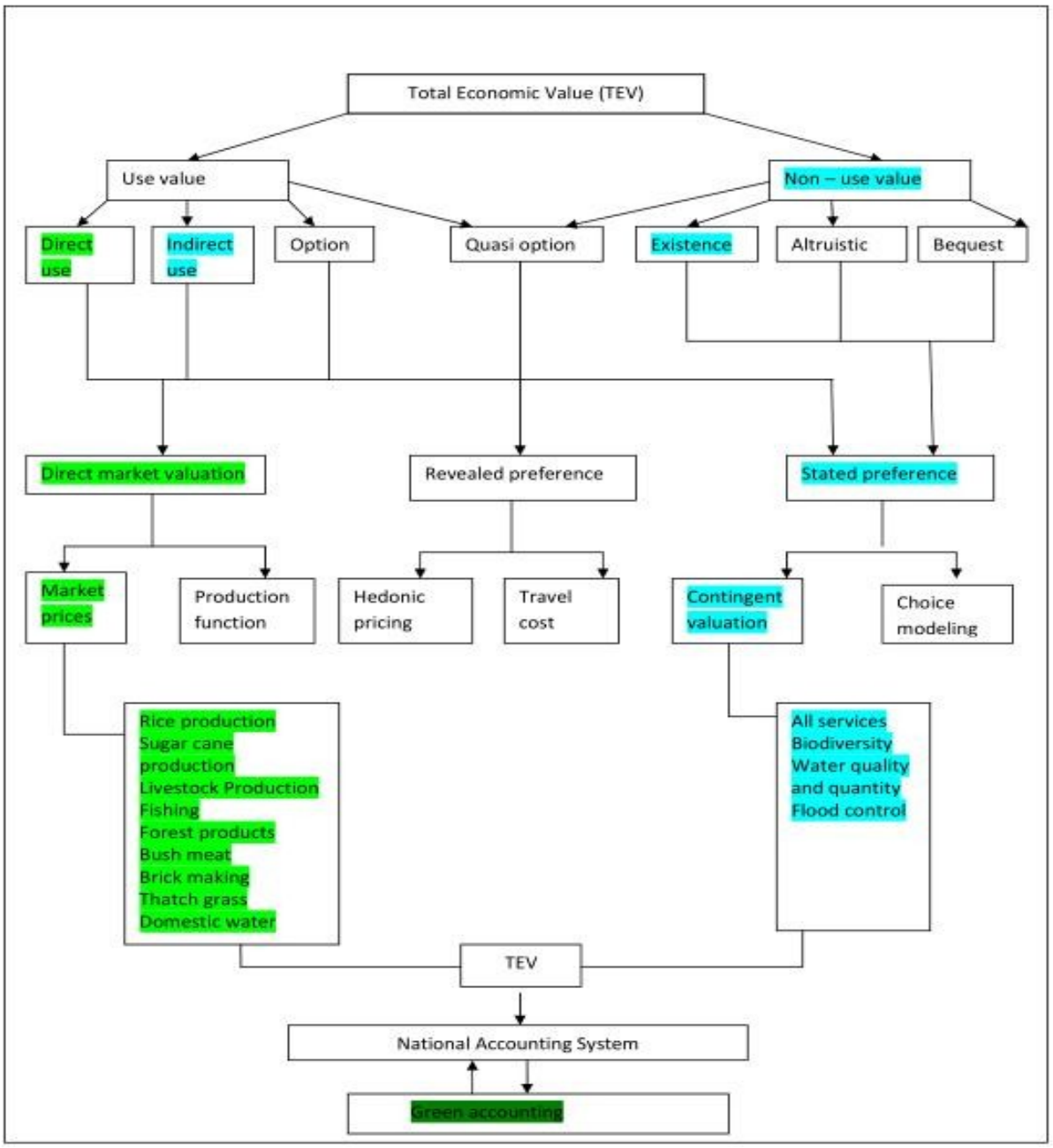

Figure 3: Components of total economic value of KVFPRS.

Source: Adapted from: MA (2005), Bateman *et al.* (2003), Barbier *et al.* (1997)

According to Price (1993), biodiversity values are conveniently treated under three categories: *instrumental values* (production of goods and services that support human life), *interest values* (pleasure given to humanity by the existence of the nature), and *intrinsic value* (which has nothing to do with human satisfaction – the good resides in the existence of nature in itself).

Although it is not intended to describe in detail the techniques used to determine the above-mentioned values, it is worth highlighting the salient methods used. The methods used in determining the economic value of ecosystems may include one or more of the following (e.g. Pearce and Özdemiroglu, 2002; Barrow, 1999; Gowdy and Erickson, 2005; Veisten, 2006, Gasparatos *et al.,* 2008): direct market valuation, stated preference and revealed preference method. The former use survey to elicit directly from individuals the economic value they assign to non-market ecosystem services. The later relies on observations of the choice that people make to infer values of the resources they use.

(i) **Market Price Method** – This estimates economic values for ecosystem products or services that are bought and sold in commercial markets. The market price method can be used to value changes in either the quantity or quality of a good or service. It uses standard economic techniques for measuring the economic benefits from marketed goods, based on the quantity people purchase at different prices, and the quantity supplied at different prices.

(ii) **Productivity Methods** – These estimates economic values for ecosystem products or services that contribute to the production of commercially marketed goods. The productivity method, also referred to as the net factor income or derived value method, is used to estimate the economic value of ecosystem

products or services that contribute to the production of commercially marketed goods. It is applied in cases where the products or services of an ecosystem are used, along with other inputs, to produce a marketed good.

Revealed Preference Techniques

(i) Hedonic Pricing Method – This method is used to estimate economic values for ecosystem or environmental services that directly affect market prices. It is most commonly applied to variations in housing prices that reflect the value of local environmental attributes. The basic premise of the hedonic pricing method is that the price of a marketed good is related to its characteristics, or the services it provides.

(ii) Travel Cost Method – This method is used to estimate economic use values associated with ecosystems or sites that are used for recreation. The basic premise of the travel cost method is that the time and travel cost expenses that people incur to visit a site represent the "price" of access to the site. Thus, people's willingness to pay to visit the site can be estimated based on the number of trips that they make at different travel costs. This is analogous to estimating people's willingness to pay for a marketed good based on the quantity demanded at different prices.

(iii) Damage Cost Avoided, Replacement Cost, and Substitute Cost Methods - These methods do not provide strict measures of economic values, which are based on people's willingness to pay for a product or service. Instead, they assume that the costs of avoiding damages or replacing ecosystems or their services provide useful estimates of the value of these ecosystems or services.

This is based on the assumption that, if people incur costs to avoid damages caused by lost ecosystem services, or to replace the services of ecosystems, then those services must be worth at least what people paid to replace them. Thus, the methods are most appropriately applied in cases where damage avoidance or replacement expenditures have actually been, or will actually be, made.

Stated Preference Techniques

(i) **Contingent Valuation Method** – The contingent valuation method (CVM) is used to estimate economic values for all kinds of ecosystem and environmental services. It can be used to estimate both *use* and *non-use values,* and it is the most widely used method for estimating non-use values. It is also the most controversial of the non-market valuation methods. The contingent valuation method involves directly asking people, in a survey, how much they would be willing to pay for specific environmental services. In some cases, people are asked for the amount of compensation they would be willing to accept to give up specific environmental services. It is called "contingent" valuation, because people are asked to state their willingness to pay, *contingent* on a specific hypothetical scenario and description of the environmental service (Carson *et al.*, 1993, Shiferaw *et al*., 2004).

Willingness to pay (WTP) is defined as the amount that must be taken from person's income while keeping his/her utility constant ref equation 1 and Willingness to Accept (WTA) is the amount given to an individual experiencing environmental degradation to keep his utility constant refer equation 2. These are expressed as follows:

$V(Y\text{-}WTP, p, q_0, :Z) = V(Y,p , q_1: Z)$……..(1)

$V(Y+ WTA, p\ q,:Z) = V(Y, p, q_1:Z)$……..……..…….(2)

Where:

V = indirect utility

Y = Income.

P = a vector of prices faced by individual

q_0, q_1 = alternative level of the good where by $q_1 > q_0$

q_1 = is improved environmental quality

The valuation function serves as a test of theoretical validity by assessing whether WTP varies with a set of variables as predicted by economic theory and empirical findings (Arrow *et al*., 2003, Mitchel and Carson, 1989). Contigent Valuation is mainly used for valuation of non-marketed ecosystem services and the non-use values associated with non-excludable and non-divisible resource and environmental flows. Unlike the indirect methods that use observed or revealed behavior, the CV method relies on stated or potential behavior as expressed in hypothetical markets.

(ii) **Choice Modelling** – Contingent valuation concentrates on the non-market good or service as a whole, while choice modelling seeks people's preferences for the individual *characteristics* or *attributes* of these goods and services. It is suitable for finding willingness to pay for or accept changes in *characteristics* of the item in question.

1.11 Study Methods

The study was carried out in two phases. The first phase was a reconnaissance survey and the second was the main survey for data collection.

1.11.1 Reconnaissance survey

This phase was used to build rapport with local authorities in KVFPRS, form and train study team on carrying out contigent valuation studies. This was so in order to make research team conversant with the study objectives and they are able to use the data collection questionnaire in the same way, there by improving both validity and reliability of data collected. Furthermore, this phase was used to identify study villages and do both pre-testing and pilot testing of data collection tools. In pilot testing, a total of 30 randomly selected households was used. These households did not participate in the final survey.

1.11.2 Main survey for data collection

Market price method, contigent valuation survey, and green natural resources accounting, key informants and focus group discusions were used to capture study objectives as presented below:

1.11.2.1 The market price

Market price method was used to determine total direct benefit of the economic activities taking place in the wetland (Barbier *et al.*, 1997) For each studied activity, the quantity produced (units), the quantity consumed at home (units), the overall cost of production (units) and quantity sold in the market (unit price) were determined. Then aggregation of net benefit of studied activities was done based on affected population in the KVFPRS. This method estimates the economic value of ecosystem products or services that are bought and sold in commercial markets. The market price method can be used to value changes in either the quantity or quality of a good or service. It uses standard economic techniques for measuring the economic benefits from marketed goods, based on the quantity people purchase at different prices, and the quantity supplied at different prices. Hence, the calculation of gross income.

The focus of this thesis was on the following representative economic activities carried out in KVFPRS by local communities: Agriculture focusing on paddy and sugarcane production, livestock grazing, fishing, harvesting of forest product, bush meat, brick making, thatch grass and water use. These were determined by the following formulae 3 and 4 below:

Local direct use value = $\sum (P_i Q_i - C_i)$ ..... (3)

Where:

P_i = Prices of products i

Q_i = Amount of product i

C_i = Cost involved in producing product i

Therefore, the value of direct benefit derived from KVFPRS:

$$\sum \%hh_{DAi} \times HHXV_{DAi} \quad \text{..... (4)}$$

Where:

D_{Ai} = Direct activity i

%hh = Percentage of households surveyed engaged in direct activity

HH = Total household in the KVFPRS

XV = Mean income earned from activity i.

1.11.2.2 Contingent Valuation survey

It is a market creation and it was seen as impossible to be carried out to low income countries posing hypothetical questions to low income and illiterate respondents (Whittington, 1998). In this thesis, the challenge was being overcomed through introducing the willingness to contribute (WTC) in which labour was introduced valued at opportunity cost of labour. CV in developing countries has been suffering a major issue of

the so-called zero-bids, that is, the respondents that state to have no willingness-to-pay at all. In some cases, such an occurrence can be explained by economic theory - the service in question is not valued by the respondent or his/her budget restrictions are too tight. However, zero-bids can also reflect protest the respondents who do not agreethat they should pay for the service in question and who consider someone else for instance the Government or the polluter as being responsible. A zero-response may also be given when no trade-offs for the service are accepted at all (so-called lexicographic preferences). Finally, protest bids can also occur when the survey itself is rejected as a methodology, or payment vessels are not accepted. Exaggerated willingness-to-pay statements are possible as well, for different reasons: (i) The phenomenon of "yea-saying" has been shown to occur sometimes - respondents will agree to a proposal or bid to please the interviewer or avoid further questions. (ii) The existence of a "warm glow" can also have an influence; respondents tend to feel good about giving, about being "good"or "nice", and will initially offer higher a willingness-to-pay than after thorough consideration. (iii) Strategic behaviour can also occur: participants will state unrealistic willingness-to-pay numbers in an attempt to influence the outcome of the study. (iv) Willingness-to-pay statements tend to also be elevated due to a lack of awareness of possible substitutes. Another source of bias can be through the interviewer giving information that is not fully neutral, or formulating questions to favour certain answers.

A "blue-ribbon" panel was organized in the United States following controversy over the use of contingent valuation to value damages from the 1989 *Exxon Valdez* oil spill. The report of this so-called NOAA panel (NOOA, 1996) concluded that contingent valuation can provide useful and reliable information when used carefully, and it provided guidance that can help to reduce or avoid many of the biases described above. This report is generally regarded as authoritative on appropriate use of the technique.

In this thesis, 4 valuation scenario were developed to value flood control, water quality and quantity and non-use existence biodiversity values as part of All services provided by KVFPRS. The payment vehicle was in terms of contribution to the valuation scenario in cash or through labour (Labour being defined as 1 working day of 8 hours with payment of Tshs 2 500 in 2010). A lumpsum payment method was adopted on a yearly basis. These valuations were guided by equation 5.

Aggregate WTCa = $\sum i [(\theta i) \times (\eta j) \times (\theta i \text{ wtp})]$……equation 5

Where:

WTCa = WTC for environmental services

θi = percentage of the willing households to participate in valuation scenario i

η_j = total number of households in the area

θ_i wtp = Average contribution of individual household (Cash and Labour)

Data Cleaning:

Willing participants but not able and not willing = true *zeros.*

1.11.2.3 Green accounting for wetland values in the National Accounting system

This involved estimated direct use value, indirect and existance values as determined through WTC and degradation as summarized in equation 6.

$$GDP_G = \sum_{i=1}^{n} (X_i P_i) + \text{IUV} + \text{EBV} - \text{RD}$$……equation. 6

Where:

GDP_G = Green GDP

IUV = Indirect use values

BEV = Existance Biodiversity value

RD = Degradation resulting from resource over-exploitation/use

1.11.2.4 Key informant interview/Focus group discussion

I personally carried out the interview of key informants. The key informants in the present study were: District forest officers, fishermen, livestock keepers and village leaders.

(i) District forest officers and village leaders

They provided the information on the condition of the wetland resources in different villages for the study in their districts (Kilombero and ulanga) which formed basis upon which sampling of village to be studied. They also provided information on trend and experiences in terms of provision of goods and ecological services of wetlands, wetland management and provided opinion on what should be done to improve services provision by wetlands.

(ii) Fishermen

Fishermen in their fishing camps provided valuable information on fishing industry. Information on prices of fish, costs of inputs, what they considered as challenges to the demand and supply aspects of fishing industry in the Kilombero River. The information sought from these people also shed light on changes of fish availability over time and preference of consumers between different fish species and their fishing styles.

(iii) Livestock keepers

Livestock keepers in identified villages were interviewed in aspects of grazing pattern, productivity, sale of livestock and livestock products, challenges faced in the livestock production value chains for local and export markets and challenges facing livestock production.

1.12 Thesis organization

The details of the study objectives are organized in the form of chapters starting in Chapter 2. The thesis is guided by Ecosystem Services Framework. Direct interaction of local communities to wetland resources and respective values are described in Chapter 2. Non-marketed ecosystem values are as described in Chapter 3. Chapter 4, examines how the the communities are settled in KFVPRS in relation to investiment opportunities. Chapter 5 shows how climate change can affect wetland resources especially wildlife resources in KVFPR. Finally in chapter 6 initiation of green accounting for wetland resources capturing indirect and non-use values of wetland resources and accounting for wetland degradation in the concept of sustainability.

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CHAPTER TWO

2.0 DIRECT USE ECONOMIC VALUE OF KILOMBERO VALLEY FLOODPLAINS RAMSAR SITE

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2.1 Abstract

Kilombero Valley Flood Plain Ramsar Site (KVFPRS) with an area of 796 735 ha supports about 400 000 inhabitants. The valley is subjected to extensive expansion in direct resource based extractions. There are increased agricultural activities, uncontrolled fishing, and increasing free range grazing of herds of cattle, increased illegal hunting, and increased water abstractions to the extent of threatening its productive capabilities to continue supporting life in the wetland. Thus, this chapter presents direct use value of KVFPRS based on the market price method. Sources of information were household questionnaire in which a sample of 490 households were used to to identify percentage of households engaged in different economic activities, wetland resources used and their extent. Other sources of information were from literature searches, focus group discussions and visits to local markets. The analysis showed presence of an array of economic transaction activities. Estimated direct values are those derived from agriculture, fisheries, forest products, bushmeat, thatch grass, brick making, livestock keeping, bushmeat and domestic water. The total aggregate value for direct economic value for studied activities stands at Tshs 152 billion. The largest contribution came from agriculture; lead by paddy production (56.6 percent), sugarcane production (20.8 percent), followed by forest products (13.2 percent), fishing (2.9 percent), livestock sale (2.6 percent) , bush meat (0.5 percent), brick making (1 percent) and thatch grass (2.1 percent). The identification of economic activities undertaken by communities within the Kilombero Valley Ramsar Site helped to understand how surrounding communities use the wetland resources to produce and transact between themselves, to predict and understand the economic activities which impact on the resource integrity and status and to guide policy makers to make right when making trading off among different resource based on direct economic activities.

2.2 Introduction

Wetlands are among the world's biological productive ecosystems that supports life. They provide food, fuel wood, fish, wildlife and many more benefits which represent important part of the economy. But these resources are continually being degraded (de Groot *et al.*, 2006). In Tanzania, 10 percent of the total land area comprises river flood plains, lake systems and deltaic mangroves (MNRT, 2004).

Based on their productivity potential wetlands resources attract different users whose utilization if not valued and regulated may lead to the failure of other related economic activities. In the KVFPRS, a there is noted popupation increase of 3% per annum (Popn census, 2008), poverty levels of about 60% (NBS, 2011), up stream activities which impact negatively on KVFPR. The intergration approach in the valley is being supported by the Beligium Technical Cooperation (BTC) whose functioning and effectiveness was rated at 20.83 percent using the Management Effectiveness Tracking Tool, Munishi *et al.* (2012). Critical areas which call for attention are development of general management plan, resource inventory, demarcation of protected area, and legislation. Institutionally, the Wildlife Division in the Ministry of Natural Resources and Tourism (MNRT) has a facilitating role in implementing the Ramsar Convention on wise use of wetlands. There are different policies governing utilization of KVFPRS resources. These are National Environmental Policy (1997), The National Land Act 1999, the National Land Policy (1995), the National Water Policy (1997), the National Forest Policy (1998), the National Wetland managemet strategy to mention few.

The fact that economic activities are based on complex ecological ecosystems providing goods and services which involve utilization of one or more characteristics (Costanza, *et al*., 1998). Based on the economic nature of activities being carried out in the wetlands,

Barbier *et al.* (2007) suggest for economic valuation to be undertaken in order to sustainably manage the resources for the present and future generation through providing the extent to which the resource is being exploited and be able to advise on effective management options. Based on Brutland report, there is no development that can be achieved on deteriorating environmental base while the environment can not be protected when growth leaves out of account the cost of environmental protection (WCED, 1987). In other cases, the economic activities may cause irreversible destruction to both human and natural communities.

In terms of institutional arrangement, there seems to be misunderstanding within the staff who works in Ulanga and Kilombero Districts in terms of roles and responsibilities of the "Ramsar Office" and other line Ministries such as Water, Agriculture, catchment forests, Energy on what seems to be like the formation of parallel organizations. According to Vatn, (2009) there are advantages and disadvantages of segmentation of natural resource management vis-a-vis the intergrated approach.

Despite being a declared Ramsar site, KVFPRS is still under degradation. Currently, there is lack of information on direct wetland values in Tanzania. Literature search on Tanzania indicate few valuation studies have been conducted so far to valuate wetland resources, but none has been done on the KVFPRS. Absence of valuation information is among the constraint to sustainable management of KVFPRS. This study therefore, aimed at estimating the direct use values of KVFPRS based on resource economic activites using a market price method.

2.3 Methodology

2.3.1 Study area

According to Ramsar Information sheets, KVFPRS covers an area of approximately 796 735 ha. The central point coordinates are 8 °40' S and 36 °10' E. KVFPRS lies between 210 and 400 m.asl with the main part of it lying at 210 - 250 m.asl. KVFPRS is the largest inland fresh water wetland in low altitude and is divided by the Kilombero River and falls into two districts: Kilombero and Ulanga.

KVFPRS boundary is watershed based boundary rather than administrative boundaries; as such KVFPRS is treated as one entity. KVFPRS is situated between the forested escarpments of the Udzungwa Mountains up to 2580 m at the North Western side and the Mahenge Mountains 1520 m on the South side. In the North Western part the boundary follows the Tanzania- Zambia Railway Line (TAZARA) from Mwaya South of Mang'ula in the North to Mlimba in the South. The boundary borders the rapids on Mnyera River in the West and it touches rapids of the Ruhudji River in the South and includes land in both districts. On the Southern side the boundary runs along the road to Lupiro village and then along the borders of Selous Game Reserve to Msolwa River and encompasses the Southern part of Msolwa Station. These boundaries are as shown in Fig. 2. The Ramsar site has a total of 108 villages with 72 villages in Kilombero and 36 villages in Ulanga. This means not all the villages in Ulanga and Kilombero Districts are covered in Ramsar boundaries. The map showing wetland resources is as indicated in Fig. 1.

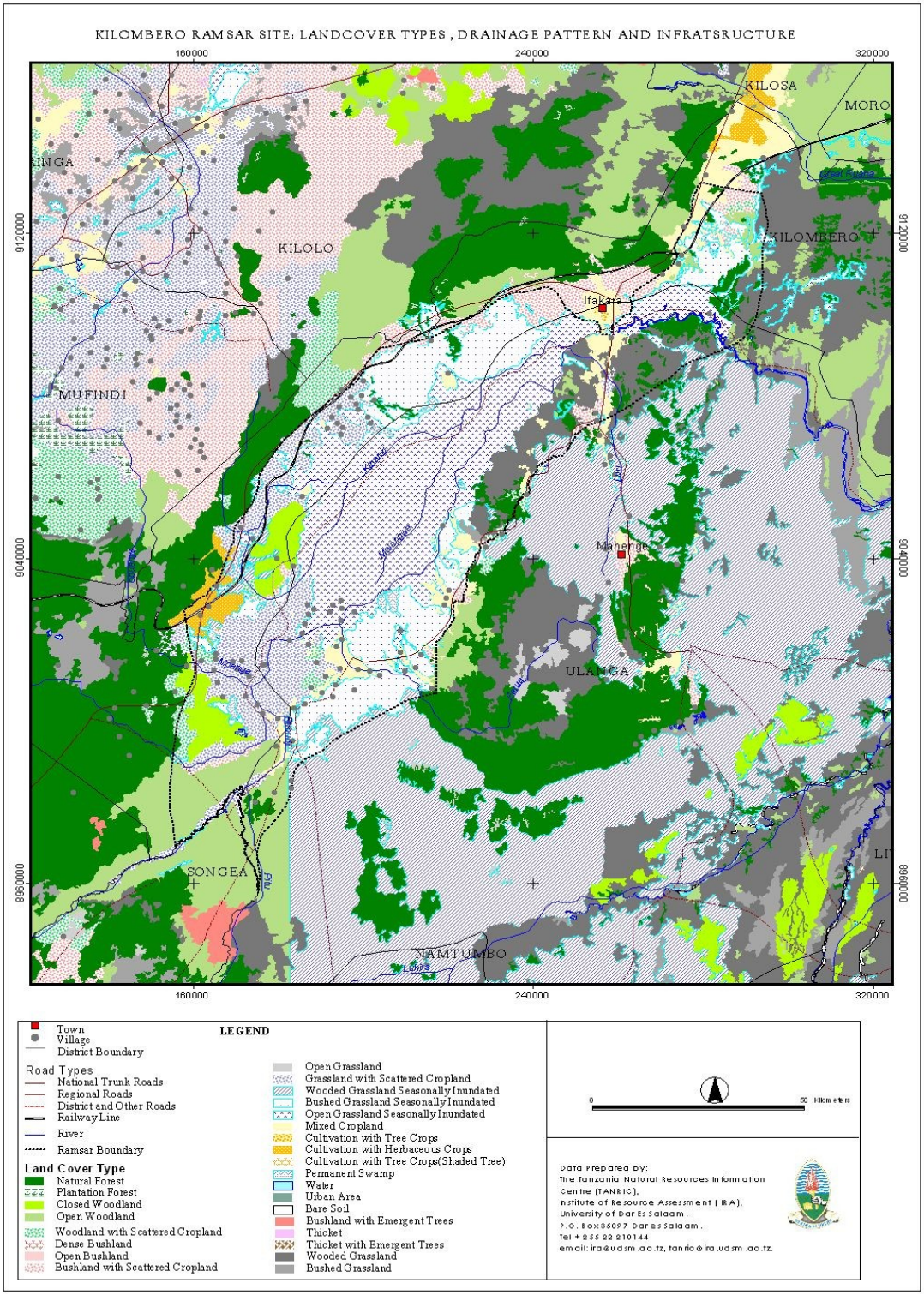

Figure 1: Map showing Ramsar site resources and infrastructure.

Source: Institute of Resource Assessment, Dar es Salaam (2008)

The KVFPRS supports human population of about 400 000 people who depend on direct and indirect ecosystem services from the wetland. Land acquisition in KVFPRS was through inheritance, allocation by village Government, purchase and renting. Most of households acquired their land used under agriculture before the designation of the Kilombero Valley as the Ramsar Site, and was guided by Village Land Act of 1999. Thus, residents have to adopt guiding rules to Ramsar mainly "wise use". The economic pressure exerted to The KVFPRS resources stems from the fact that most of the inhabitants are poor as indicated in the National Bureau of Statistics (NBS, 2010). Poverty leads to the use of low productive and sometimes destructive methods of resource extraction. Resource use conflicts among stakeholders who utilize the wetland resources for their livelihood have also been observed in the area. These are particularly between resource managers and the local people, livestock keepers and famers, and hunting block owners.

Sustainable management of these resources depends on among other factors understanding their economic values (de Groot *et al*., 2006; Schuyt, 2005). Lack of quantification of values may lead to decline of productivity of these resources. Economic valuation not only helps to raise awareness among the surrounding communities about wetland benefits in decision-making, but also awareness helps to improve local institutions that manage resources; identify better markets and resource management options for wetlands and their products; and investigate people's livelihood strategies and how these determine the constraints and options for making wise use of wetlands (Guijt and Hinchcliffe 1998).

2.3.2 Study Methods

Decisions regarding the use and management of wetlands goods and services have to be estimated. Of special importance is to show how wetland ecosystems contribute to human

welfare and its linkage to economic value. In this study we have adopted Total Economic Value (TEV) framework in carrying out these tasks.

2.3.2.1 Total economic value

The total economic value (TEV) of a change in quality or quantity of ecosystem function is measured as the aggregate of affected individual preferences stated in terms of their willingness to pay to get or avoid the change. TEV has been used as the most common framework for wetland values (Barbier *et al.*, 1997, de Groot *et al.*, 2006). Broadly speaking, values of wetland ecosystem can be grouped, as human values and non-human values. Human values refer to what people consider to be the values of the wetland to them, and include (a) *use value*: direct use value, indirect use value (ecological values), quasi-option values, and (b) *passive (non-use) value:* existence value (satisfaction that the resource is there), quasi-option values, and vicarious values i.e.future use for the present generation, and use by the future generation-also called bequest value (Bennett, 1998; Bateman *et al.,* 2003; Pearce and Özdemiroglu, 2002; Barrow, 1999).

Direct use value is further subdivided into *direct extractive use value* e.g. agriculture, fishing, forest products harvesting, thatch grass collection; and *direct non-extractive use value*, Indirect use values (ecological values) include: flood control, water catchment, and waste assimilation. The quasi-option value (which is more frequently confused with "option value") refers to the value the *society* would place on the forest if all new its complex functions. On the other hand, "option value" refers to a future *personal* value due to uncertainity according to Bateman *et al.* (2003). A further distinction between these two concepts (whose difference is rather fuzzy) is made by Fackler *et al.* (2007); some defines *option value* as a risk premium due to the uncertainty in future value of environmental goods. A *quasi-option value* defines a measure that highlilights irreversibility and

incorporates the possibility that useful information will arrive over time". The authors Fackler *et al.* (2007) also introduced a new concept called *real option value* which, according to them, is equivalent to quasi-option value, and is concerned with the value of the resource contingent on whether decion making on the resource use is now or delayed. Bateman *et al.* (2003) posit that the forest/woodland resources have their intrinsic value (non-human values)-value of the resource in its own right.

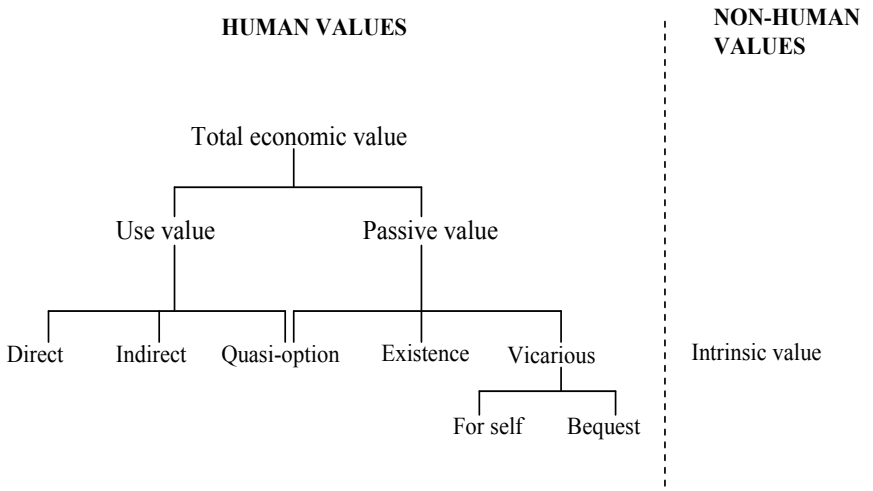

Figure 2: Components of total economic value of wetland used in KVFPRS.

Source: Adapted from Bateman *et al.* (2003)

According to Price (1993) biodiversity values are conveniently treated under three categories: *instrumental values* (production of goods and services that support human life), *interest values* (pleasure given to humanity by the existence of the nature), and *intrinsic value* (which has nothing to do with human satisfaction – the good resides in the existence of nature in itself).

2.3.2.2 The market price

Market price method was used to determine total direct benefit of the economic activities taking place in the wetland (Barbier *et al.*, 1997). Market price reflects the willingness of

household to pay for wetland product based on how they value it. For each studied activity, quantity produced (units), quantity consumed at home units), overall cost of production (units) and quantity sold in the market (unit price) was determined. Then be aggregation of net benefit of studied activities was done based on affected population in KVFPRS. This method estimates the economic value of ecosystem products or services that are bought and sold in commercial markets. Importance of this method is its usage in valuing changes in either the quantity or quality of a good or service. It uses standard economic techniques for measuring the economic benefits from marketed goods, based on the quantity people purchase at different prices, and the quantity supplied at different prices, hence calculation of gross income.

Challenges of using market price to reflect environmental costs and benefits stands from the fact that wetland resources are seen as public good and externalities. Public goods are characterised by the fact that: (i) no one can be effectively excluded from consuming them and (ii) increased consumption of the good by one individual does not diminish the amount available to another person. Where prices do not reflect all costs and benefits, however, the so called "invisible hand" of the market does not work and resources may be used inefficiently, resulting in a loss of human welfare. Externalities are uncompensated costs or benefits arising from economic activity. Thus, in determining household value we use the following formulae.

Household direct use value = Household income generated

$$D_{Ai} = \sum (P_i Q_i - C_i) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where:

D_{Ai} = Direct economic *i*

P_i = Prices of products *i*

Q_i = Amount of product *i*

C_i = Cost involved in producing product

Therefore, the direct value of income derived from KVFPRS population is:

$$\sum \%hh_{Ai} xHHxI_{Ai} \text{ .....} \quad \text{.....(2)}$$

Where:

Ai = Direct activity

% hh = Percentage of households surveyed engaged in direct activity

HH = Total household in the KVFPRS

I_{Ai} = Mean income earned from direct activity

This paper focuses on the following representative economic activities carried out by local communities in KVFPRS: Agriculture focusing on paddy and sugarcane production, livestock production, fishing, forest product harvesting, bush meat hunting, brick making, thatch grass collectin and water for domestic use.

2.3.2.3 Household survey

Data for the valuation exercise were collected from representative sample of households in Ramsar site. A total of 10 purposely selected villages were used for the study in Kilombero Ramsar site. In selecting villages, a random sampling was employed and had representation from each sub-village using village register. Then, with the help of village leaders, identified selected household for the interview. Usually, head of household responded to the questionnaire, sometimes with help of family members the sampling intensity of 5 percent. A total of 490 households were used in the study. The interviews

were carried face to face in the respondents' home. The sample was split into sampling intensity and sample size for each study village are as presented in Table 1. Household questionnaire survey was conducted and covered: identification variables, household characteristics (gender, age, marital status, education level, main occupation), Land issues (size, type of ownership, price and location), economic activities engaged, quantities produced and consumed, time used to collect their materials and their prices. The prices of different products were collected from the markets. Other means of data collection include literature search in KVFPRS offices, focus group discussions, district councils's office and Sokoine University library.

Table 1: Sample size and sampling intensity

District	Village	Sub village	Total household	Sample
Ulanga	Kivukoni	Alamba	227	11
		Butiama	169	9
		Ngajima	239	12
		Gezaulole	210	10
		Mikoroshini	134	7
		Chikago	197	10
		Mbuyuni	130	7
		Kisiwani	205	
			1 511	**58**
	Itete Njiwa	Ipera asilia	185	9
		Mitalula	109	5
		Ibuta	80	4
		Njiwa Kati	120	6
		Kikoni	90	5
		Njiwa Juu	120	6
			704	**35**
	Iragua	Iragua Kati	368	18
		Magereza	287	14
		Igunda	270	14
			925	46
	Milola	Milola Kati	159	8
		Milola juu	115	6
		Kiningu	149	7
			423	**21**
Kilombero	Msolwa station	Msolwa Kati	1 800	36
		Nyange	947	33
		Mtukula	347	30
			2 800	99
	Signali	Mbalaji	188	10
		Ndululu	171	9
		Maili Mia	266	13
		Sululu	276	14
			901	**46**
	Lumemo	Lusapa	70	5
		Lihala	105	6
		Lumemo A	230	11
		Lumemo B	229	11
		Igombati	179	8
		Magoha	162	7
		Mnola	175	8
			1 150	**56**
	Katindiuka	Katindiuka A	250	12
		Katindiuka B	142	7
		Katindiuka C	166	9
			558	**28**
	Namawala	Bomamzinga	158	8
		Idandu	813	40
		Namwawala A	386	19
		Namwawala B	225	12
		Videnge	103	5
			1 685	**84**
	Ikwambi	Kalenga	115	7
		Imelamela	70	5
		Ijua	86	5
			271	17
			10 928	**490**

2.4 Empirical Results and Discussion on Direct Use Value on Resource Based Economic Activities

2.4.1 Economic activities in KVFPRS

The results are presented from resource based economic activity in KVFPRS. It was found that each economic activity is associated with a particular wetland resource. These resources were categorized as settlement areas, agricultural land, swamp areas, woodlands, forests (most of them reserved forests), grasslands, rivers, grazing lands and wildlife management areas. Different activities are taking place in each of these economic resources. However, different classification of land use has been identified by Institute of Resource Assessment (IRA) in Fig. 1.

2.4.1.1 Agriculture

This was the main livelihood activity of the population living in KVFPRS. In Tanzania, agriculture contributes about 30 percent of Gross Domestic Product (GDP) (NBS, 2012). Many crops both food and cash crops are grown a including paddy, maize, banana, cocoa, groundnuts, beans, sunflower, sugarcane among others. For the purpose of this study only paddy and sugar cane are studied from small holder perspective. Accordingly, the study reveals that about 90 percent of the households are engaged in agricultural activities. Land acquisition was through inheritance, allocation by village Government, purchase and renting. Most of households acquired their land used under agriculture before the designation of the Kilombero Valley as the Ramsar Site, a process that was guided by Village Land Act of 1999. Thus, residents have to adopt guiding rules to Ramsar mainly "wise use". In KVFPRS, there is official land bank, with Ulanga having about 361 865 ha.

2.4.2 Paddy production

Paddy growing was practiced by 90 percent of the population. Paddy production was mostly done in swamps and flooded alluvial fans. The production period starts in October and ends in May. Land holding under paddy mostly ranged from 0.25 to 1.6ha and differed in terms of access and size across villages. Msolwa and Lumemo have much constrained lands within vicinity of their villages. Msolwa residents migrate to Katulikila and Mgeta because the areas which were once used for paddy in Nyange were converted to sugarcane production. Lumemo residents have to travel 30-50 km to Nyamhala and Namwawala in search of paddy farms. Incidences of detrimental flooding to alluvial fans have increased to the extent that farmers call them "*Kufa basi*" meaning there is no alternative rather than using the depleted and flood prone fan which jeopardise even the security of harvesting.

The costs of paddy production included fixed and variable costs. It was found that at the start of the season a considerable number of farmers do not have sufficient financial capital to start up their farming activity. They have to borrow money from business men who in turn are paid in terms of paddy bags. In practice, for every Tshs 45 000 one has to pay back 3 rice bags. Such borrowing indicates high interest rate. The cost of production consists of land rent, farm preparations and industrial goods mainly seeds and fertilizers, sometimes these inputs are constrained by distribution issues. Most of farmers use hand hoe, and only a few can afford to hire tractor. Some farmers can afford improved seeds variety while some use left overs of the previous year. There are labour costs of various activities involved in production including seed sowing, weeding, bird/wildlife scaring, harvesting and packaging. The cost stood at Tshs 750 000/ha as indicated in Table 2. This cost does not include household labour. Average production was 2tons/ha. The average price was Tshs 50 000 per bag of paddy of 70 kg with the price decreasing further away

from town centres. The price of paddy ranged from between Tshs 30 000 to 70 000 per bag during harvesting season. Production cost per ha is as indicated in Table 2.

Table 2: Estimated cost of paddy production per ha in KVFPRS

Cost item	Unit	Cost(Tshs)/ton
Land rent	Tshs/ha	75 000
Farm preparation	Tshs/ha	88 000
Water		-
Sowing	Tshs/ha	75 000
Seeds	ha	13 000
Fertilizer	Kg	45 000
Hand hoe	-	38000
Weeding per acre	ha	63 000
Pesticide	mil	8 000
Bird scaring	-	-
Harvesting	ha	50 000
Heaping	ha	38 000
Packaging	ha	50 000
Winnowing @2 000/bag	ton	60 000
Bags@ 600/bag	ton	18 000
Winnowing mats		25 000
Transportation	tons	75 000
Crop levy	tons	15 000
Storage	tons	15 000
Total cost		**750 000**

***Include costs of transport, building hut in the field provided by household**

Benefit realized from rice production at household, sampled households and population in KVFPRS was estimated at Tshs 86 billion as indicated in Table 3.

Table 3: Direct use benefit for paddy production in KVFPRS

Unit	Measure	Tshs/yr
Household	Minimum	300 000
	Maximum	1 200 000
Sample	Minimum	132 300 000
	Maximum	529 200 000
Population	Minimum	21 600 000 000
	Maximum	86 400 000 000

Several factors that might affect this value, which include change in ecological functions of swamps and flooded alluvial fans, price of inputs, technological factors, improved seed varieties and diseases. In KVFPRS, paddy farmers were complaining of Kimianga" (Rice Yellow Mottle – virus) and aphids (?) that mostly affect paddy production.

2.4.3 Sugarcane production

According to the current study, sugarcane was only cultivated in lowlands of Msolwa Station and Ikwambi villages and is practiced by 11 percent of the sampled households as outgrowers. In this village the once known areas for paddy are now under sugarcane production and there is considerable change of the cropping landscape. Sugar cane production was increased in year 2001/02 following privatization of Kilombero Sugar Company which required much supply of sugarcane from out-growers. Thus, due to attractive price of sugarcane, the nearby villages in both Kidatu and Mang'ula Division put considerable land under sugarcane production with most of respondents producing sugarcane under 2 ha. The study found that for properly managed sugarcane farm produces between 50 and 60 tons/acre while most of farmers manage to produce between

21 and 30tons/acre and sold at 32 000 per ton depending on sucrose levels with high sucrose levels receiving high price. Among the factors affecting productivity include site quality of the farm. Cost of production for sugarcane per ha was estimated at Tshs 1 500 000. Estimated benefit at household, sample and population in KVFPRS was estimated at Tshs 32 billion as indicated in Table 4.

Table 4: Direct use benefit from sugarcane production in KVFPRS

Unit	Measure	Tshs/yr
Household	Minimum	1 440 000
	Maximum	3 600 000
Sample	Minimum	77 760 000
	Maximum	94 040 000
Population	Minimum	12 672 000 000
	Maximum	31 680 000 000

Sugar cane production is the main source of sugar for both export and domestic consumption. Currently, sugarcane is grown both by the sugar processing factories (SPF) as well as out growers (CG). In Tanzania, sugarcane production per year is 1.5 million tons. The total current sugarcane production in Tanzania is below the country's annual demand for the commodity (URT, 2009). Currently, investments in sugarcane are attracted into other villages and divisions within the floodplain. A Land bank of about 13 923 Ha has been set aside by Kilombero District for investment in Ruipa River Basin, Mofu, Mbingu, Namwawala and Ngalimila that can be used for different uses such as construction of sugar processing factory, sugarcane farming, and rice farming.

2.4.4 Thatch grass collection

In the study area, 5 percent of respondents were engaged in thatch grass business. The main grasses used are *Panicum maximum* and *Pennisetum* spp. These are found and harvested from grasslands. Grass provides roofing materials to most of the households in the study area. The business is carried out annually mostly after rain season May-June. That grass harvesting lasts for about three months before setting of wildfire by farmers when opening up new farms. The effect of grass extraction to ecological health of KVFPRS is not directly established; rather it is the conversion of grassland to agricultural lands which threatens their availability. Scarce availability may lead to shooting in local price and shift to other roofing materials like iron sheet which may not be accessed by most farmers. If so the value of thatch grass is equivalent to the value of iron sheets through a replacement cost approach. For traders, this activity usually is carried out in family or hired labour or piece work. In a day one can harvest up to 30 headloads. The production costs involve harvesting tools such as sickle and ropes, transportation and labour. The annual benefit for the household was estimated at Tshs 800 000 with a sample value of Tshs 19 600 000 and population value of Tshs 3 200 000 000.

2.4.5 Forest products

In the sampled population, a total of 6 percent of respondents carried out forestry related businessin terms of sale of various wood products including charcoal, timber, carvings, traditional medicines, withies and poles. The KVPRS is endowed with forests abd woodlands which covers about 11% of the area (MNRT, 2005). There are sixteen forest reserves in the catchments of the Kilombero valley with ungazetted patches of low altitude, ground water and strips of riverine forests. Miombo woodland is found on the lower and mid slopes of the valley. The forest within Udzungwa National Park are still in relatively good condition but degradation has taken place in all of the other reserves as

well as public forests as the result of illegal logging and farmland encroachment. Public forests may be important in terms of biodiversity and non timber resources use by local people.

According to the Forest policy 1998, no harvesting is allowed in the catchment forests, so all \the harvest was treated as deforestation. The value was estimated from charcoal, firewood and timber. Percentage of household depending on charcoal was 70% with consumption of 1.5 kg/day sold at Tshs 1000/Kg. This gave the value of charcoal at Tshs 15 330 000 000 /year. Percentage of households depending on firewood was 90% with household consumption of 3kg/day, priced at Tshs 1000/Kg, this gives the value of firewood at 4 730 400 000/year. Useof timber was estimated at 0.0019m3/household per year valued at at Tshs 68 400 000/year. Aggregate value of wood based resources on conservative estimates stands at Tshs 20 128 800 000.

The revenue from timber and related products realized by the district councils based on the district councils report was Tshs 32 766 310 in 2007 and about 27 299 356 in 2008. This amount is cumulative; however there are variances in months, though the data provided could not help in establishing the trend. However, logs in class I are few as compared to other classes, other sources of revenue was from from processed products such as doors, carvings, firewood, fines, transit pass and research permit. This amount indicates that a considerable amount of forest products which are harvested are unregulated.

2.4.6 Fishing

The Kilombero river system is of crucial importance as a breeding and nursery ground for fish in the whole of Rufiji basin (WWF 1992). Fish in Rufiji river system migrate

upstream to spawn usually at the beginning of rain in November. The peak spawning activity has been recorded in the valley in between November and December period (RUBADA, 1981).

The results show that fishing activities are mainly carried out by 22 percent of the sampled population. Fishing is mainly carried out in both permanent and temporary fishing camps along the Kilombero River and its tributaries. At the time of the study, there where 33 permanent camps some in the upstream and others downstream. Currently, a total of 26 Beach Managment Units (BMU) have been established with minimum of 30 fishing boats in the following villages signal (Mbuti), Kivukoni (Mikeregembe, mhehe, Abdalangwila, Ilua, Migude, Senga, Funga), Lumemo (Kahema), Mahutanga(soko madola), Spiti- milola, ngwesi fungusi, Ngwamba DC- Idete Gundu and Ruipa Mbingu, Butihama Iragua, shetela Kilongwe – Mofu Kihanji itembo – Itete njiwa, Mamba Mkangawalo, Fibwe - Dinari Mngeta, Dungu, Nailimbo, Keta - Merera.

On average each camp has a minimum of 80 fishermen. Fishing season is maily starts in June and ends in February, lasting for almost about 250 days. However, in this study, basing on the fact that 16 days are recommended per months for fishing, a total of 125 days as effective fishing days. The production cost for fishing involve hiring/buying a dugout canoe, fish nets, ropes, fish trap, paying registration fee, labour cost, bringing the average cost of Tshs 22 000 per trip with average 2 trips within 24 hours. The average catch per trip was about 16 fish. Pricing is according to fish size regardless of species type. Grading was done based on fish width. Grade one fetches Tshs 1 200 to 2 500, grade two fetches Tshs 800 to 1 100 and grade three fetches Tshs 500 to 700 at fishing camps with an average price at fishing camp being Tshs 2 000.

These calculations were based on prices at fishing camps which gives an average annual benefit of Tshs 2 500 000 per fisherman.. Income per fisherman is in the range of Tshs 30 000 - 300 000 Tshs per day depending on the season. Benefit estimated for the sampled population is Tshs 269 500 000 with population estimate of Tshs 4 400 000 000. About 30 fish species are recorded in KVFPRS including "*Kitoga" (Bagrus docmack), "Kambale" (Clarias gariepinus), "Perege" (Oreochromis niloticus), "Njege" (Hydrocynus vittatus), "Ndungu" (Distichodus petersii)* and *"Bura" (Schilbe moebiussi*)**.**

Plate 1: Fishing at Mikeregembe Fishing Camp in Kilombero River

A kind of labour differentiation is observed when it comes to fish cleaning and smoking. is done by women in most of time. Smoked fish are transported to other regions of the country including Dar es Salaam, Ruvuma, Morogoro and Dodoma. The industry is constrained by an increase in siltation levels caused by upstream woodland clearing, climate change factors, use of improper techniques which has implications on the

resilience of wetlands themselves and their allied biological resources like fish. For example, the use of *seine* nets in the Kilombero River have led to the over exploitation of big fish, and destruction of riparian areas thus reducing the productive capacity this wetland impairing its support to local peoples' livelihoods. Other serious issue include the use of poison (such as Furadan) in fishing which does not only affect biodiversity but it also affects water quality.

2.4.7 Brick making

Brick making is practiced by about 5 percent of the sampled households. In studied villages, there are specific areas used for soil extraction and mud brick making. Good housing was one of the indicators of wealth in the studied villages. Improved housing by using mud bricks has boosted business in mud brick making in villages. In Katindiuka, Mgwalu area an approximately area 2.73 ha is used. The Cost of production include moulders, labour cost and energy. The cost estimates for producing 10 000 mud brick was as follows:

Moulders Tshs10 000, labour for molding at is Tshs 15 per brick, labour for shifting per brick, labour for arranging in a tunnel is Tshs 10 000 for every 2 000 bricks, firewood approximately 4 m^2 (two tellas) at Tshs 20 000, labour cost for surveillance Tshs 200 000. Bringing a total cost at Tshs 600 000. Price per brick is Tshs 70 - 100 for woodbased energy and Tshs 30 - 50 for rice husks based energy. Net benefit from brick making is about T sh 400 000 and one can make a maximum of 2 brick tunnels in a year. The benefit estimatesd at sample benefit Tshs 800 000 and population benefit stood at Tshs 1 600 000 000.

Plate 2: Brick firing in Katindiuka village in Kilombero ValleyFlood plains Ramsar site

2.4.8 Livestock keeping

About 5 percent of the population is engaged livestock keeping including goats, sheep and cattle. The study focused on cattle free range grazing. However not all villages have cattle in the KVFPRS. The herd size per household was about 1 to 100 cows. The price for livestock ranged from Tshs 100 000 - Tshs 600 000 per cattle and for milk is between Tshs 200-Tshs 300 per litre. Livestock keepers also engage in agricultural activities and are allocated with grazing areas within their villages based on village land use plans. Estimated umber of cattle in study villages were between 245 and 24 500. The data show that on average two cattle are sold per herd. Cattle sale is done in organized local markets and supports the booming ‘nyama choma’ industry in the surrounding regions. Calculating the annual population benefit stands at Tshs 4 000 000 000. The data from Kilombero

District council shows the value of officially marketed livestock to be Tshs 750 000 000 in 2008.

2.4.9 Bush meat

About 5 percent of the sampled population are engaged in bushmeat business especially trophies though some do it for subsistence andhunting is from specified hunting blocks (Fig. 3). Wildlife especially those which tramp onto crops also form significant source of bushment. The activity is somehow organized and there is known areas in some villages where one can buy bush meat. Furthermore, bushmeat is readily available in Ifakara town and in some fishing camps. This study could not however establish the quantity of bushmeat transported to other areas of the country.

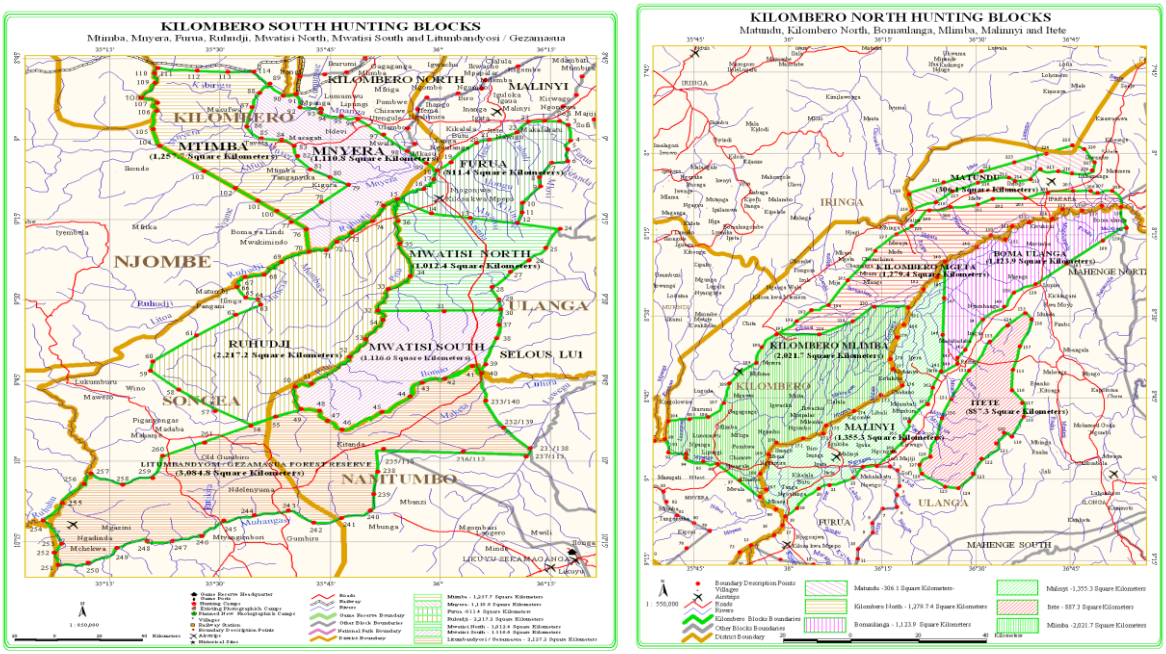

Figure 3: Kilombero North and South Hunting Blocks.

The price for bushmeat ranged from Tshs 2 000 to 5 000 per Kg depending on availability on average one can earn an average of Tshs 200 000 per year. Cost of production involved hunting tools and labour. Trend of legal hunted wildlife and eventual revenue for the past ten years is indicated in Bakengesa *et al*. (2011). Estimated earning for the sampled population per year is Tshs 4 950 000 with estimated population earning at Tshs 800 000 000.

Plate 3: Part of the Puku antelope herd in the KVFPRS

2.4.10 Domestic water

In the sampled population about 70 percent of the population gets clean water from tap, well and directly from the river. Local people are organized in water users association (WUAs) in a community well which is paid 500/month regadless of number of bucket number of buckets collected. We are using this fee as price of water. If one buys a bucket of water is sold at Tshs 10 – 20 per bucket of 20 litres this is only labour cost. Estimated

use of water is about 15 buckets per day per household. On average an household uses about 108 000 litres per year which gives a price of Tshs 0.056/lt. Sample water consumption estimated at 37 044 000 litres of water per year, extrapolated to population living in KVFPRS of 80 000, then litres of water consumed is 6 048 000 000 litres per year with the total value of Tshs 338 688 000. Wetland values realized from direct resource base is summarized in Table 5.

Table 5: Direct economic value of KVFPRS resources

Economic activity	**% hh**	**Tshs**
Rice (bags)	90	86 400 000 000
Sugarcane (tons)	11	31 680 000 000
Thatch grass (head load)	5	3 200 000 000
Forest products(m^3)	90	20 128 800 000
Grazing Livestock (livestock heads)	5	4 000 000 000
Bushmeat (Kg)	5	800 000 000
Fishing (Kg)	22	4 400 000 000
Brick making (# bricks)	5	1 600 000 000
Water (liters)	70	336 880 090
Total		**5 2545 680 090**

Analysing the dominance contributions of these activities in percentage, paddy cultivation contributes about 56.6 %, sugarcane growing 20.8 %, forest based products 13.2%, Fishing 2.9%, cattle sale 2.6%, thatch grass 2.1%, brick making 1% bushmeat hunting 0.5% and water for domestic use 0.22%.

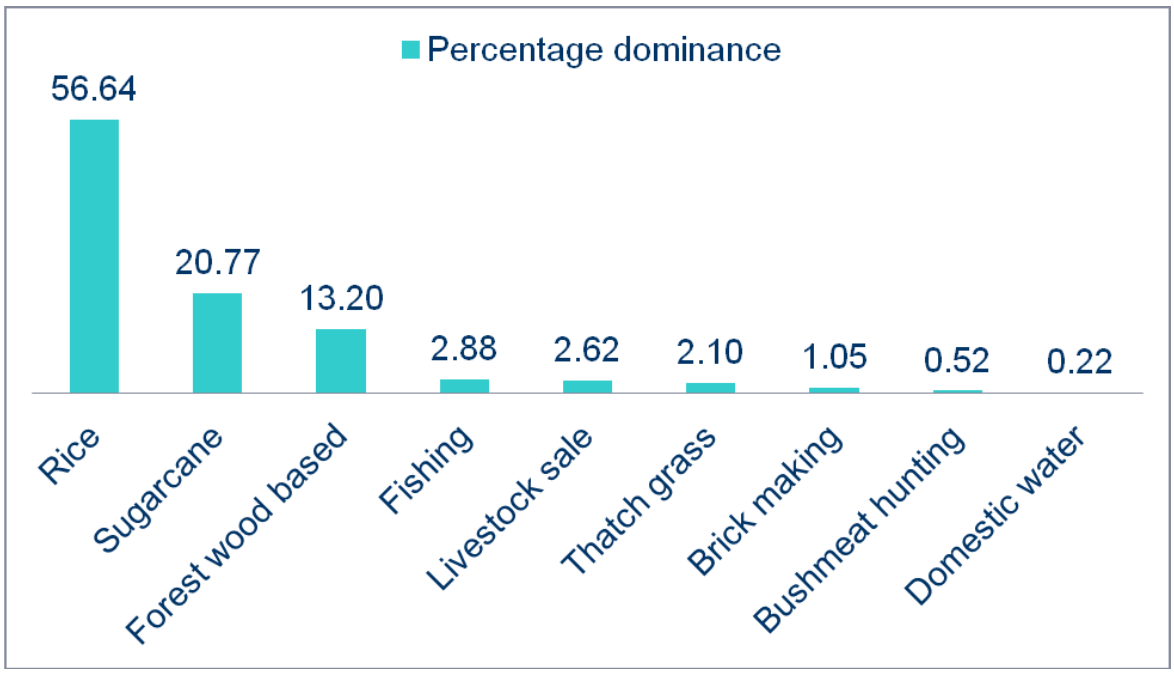

Figure 4: Contribution of direct economic activity to the total benefit realized in KVFPRS.

2.5 Conclusions and Recommendations

The study indicates that KVFPRS plays a significant role in provision of direct economic values . The aggregation of the net benefit for studied activities was estimated at Tshs 152 billion. Assessing direct economic activities in terms of contribution to local welfare, paddy cultivation was leading, followed by forest based activities, fishing, livestock, thatch grass, brick making, bushmeat hunting and domestic water. However, assessing net benefit per activity, a different story emerges, with activitieshaving highest input/production cost have low net benefit such as sugarcane production. Based on the poverty levels of local communities, there is high possibility that they will depend moreon direct economic activities which do not require higher financial investiment capital such as fishing, forest products harvesting, livestock keeping which in long run may have negative ecological impact on KVFPRS. The study recommends stimulus packages to aid household in their production activities, development of simple tools to capture values.

Informarion provided from market price method may help decision makers when deciding among alternative management options of KVFPRS.

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CHAPTER THREE

3.0 ROLE OF REGULATING AND BIODIVERSITY VALUES ON HOUSEHOLDS WELFARE IN THE KILOMBERO FLOODPLAINS RAMSAR SITE, MOROGORO, TANZANIA

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3.1 Abstract

Regulating and biodiversity value represent hidden values of ecosystem services which do not have market price, but their loss is a cost which is borne by the society at large. In order to establish their values, a market was created through a contingent valuation (CV) of Willingness – to – Contribute (WTC) for biodiversity, flood control and water (quantity and quality) as part of All services provided. The study has pioneered the use ofWTC in the country to establish values of the Kilombero Valley Flood Plain Ramsar site KVFPRS. The possibility of incorporating labour in what is termed as WTC was newly applied for valuing ecosystem services in Tanzania. A CV questionnaire was admitted to a total sample of 490 households from ten villages in KVFPRS. Results show that the total annual value for KVFPRS for all services was about Tshs 14 billion, with flood control contributing the highest value of Tshs 7 billion followed by water quality and quantity Tshs 4 billion and Biodiversity Tshs 3 billion. The study has reveals that if only payment in cash was considered, the value could only be 20 percent of realized value. The remaining value of about 80 percent was contributed through human labour hence representing about the true value of KVFPRS. It is concluded that thecontribution of value from regulating and biodiversity values are significant and there need to consider them when planning for sustainable management of KVFPRS. The study recommends the application of WTC in conservation activities in the wetlands.

Key words: Willingness to contribute, Willingness to Accept, flood control values, water quality and quantity values, Ecosystem services

3.2 Introduction

Kilombero Valley Flood Plain Ramsar Site (KVFPRS) comprise of a myriad of rivers, which make up the largest seasonally freshwater lowland floodplain in East Africa (FBD,

2007). The Kilombero River system with catchment area of 40 000 km^2 contributes about 62 percent of the annual runoff of Rufiji Basin. It regulates the flow of the Rufiji River and supplies nutrients up to Mafia- Rufiji mangrove, sea grass and coral reef complex (FBD, 2007).

Based on hydrological factors, catchment forests and surrounding environments in KVFPRS represent a convenient and the cheapest source of water for all needs. The evergreen forest areas in the North and South act as important catchments with the Miombo zone being an integral part of the wetland ecosystem, harbouring wildlife in the wet season and acting as a source of water and nutrients for the wetland. The combination of evergreen forest, Miombo and wetland is a key feature in regulating water flow throughout the Rufiji River maintaining the characteristic slow rate or rise and fall of its water levels. The minimum flow in the Rufiji basin is estimated to be 50m^3/sec in the lower catchment and maximum of 14 000m^3/sec in the wet season (FBD, 2007).

Through its regulating services, KVFPRS supports Crocodile population of the Kilombero, which also links with that of the Selous, to form one of the most significant populations of Nile crocodile in Africa (Games and Severe, 1999). The valley also contains a considerable population of hippos, elephants and lions. There are several populations of endemic Udzungwa Colobus (Dinesen, 2001). The Ramsar Site provides an important dry season habitat for large mammals particularly elephant and buffalos from an important Selous ecosystem. The KVFPRS is also an Endemic Bird Area. Three endemic birds are known: The Kilombero Weaver and two undescribed species of *cisticola.* The valley is known for its fish species and has two endemic species of *Cithannus congicus* and *Alestes stuhimanni (*Jenkins *et al*., 2000). In terms of water birds, KVFPRS supports 20 000 or more water birds.

Maintenance of the wetland habitats and the fertility of the soils for vegetation (including crops) and fisheries are supported by annual floods controlled by wetland resources. Maintenance of hydroperiods is a very important key factor in productivity and species composition of wetland community. Flooding, draining and rebuilding of KVFPRS supports livelihood activities. Flood peaks tend to occur during March - April but it can happen as early as January and as late as May. The smooth rise and fall of the Kilombero River influences the same pattern on the Rufiji River as a whole which is important in maintaining ecological balance along the whole length of the river including its delta and the marine systems adjacent to the river mouth.

Several reports (FBD, 2007) show that in recent years, there is notable change in the regulating pattern in terms of hydrological pattern, and some reports on drying of streams in both Ulanga and Kilombero districts. Drying up of Great Ruaha River can be cited as an example of what can happen due to loss of regulating services. This has been attributed to anthropogenic activities and prevailing climate change conditions in the valley and the resultant loss in welfare of surrounding communities. Among others reasons for degradation of the KVFPRS include inadequate allocation of funds to implement several management options, taking an example of Kilombero catchment which only about 10 percent of the budget was disbursed for the year 2008 against the collected royalty of about Tshs 30 m. As a result there was an increase in illegal logging, fire outbreaks and charcoal making in the catchment forests (MNRT, 2008). Unsustainable removal of forest cover is estimated to cause soil erosion of 0.37 tons per ha per year consequently affecting the quality and quantity of water flow, and which farmers, fishers, livestock keepers, wavers and traders in various levels depend on for livelihood. Despite such available data no study has been conducted so far to establish the economic value of water quality and quantity provided by KVFPRS to household welfare.

The observed increase in human activities and populations in KVFPRS is to the some extent posing a threat to its Ramsar status (Van Koppen *et al*., 2004). The prime land characteristics and high quality and availability of water and easy to invest/acquisition of land has contributed to high immigration levels resulting into clearing of high value forests and draining of floodplains and increasing area under settlements. Operational and non-operational large-scale developments are being carried out in the wetlands and catchment areas. They include investors with varying levels of investment and interests. They invest into both food and cash crops production; they also invest in tourism. In this respect, wetlands can be among the resources to use for poverty reduction in Tanzania (Mvena, *et al*., 1998; Munishi *et al*., 2003; MNRT, 2004) if management plans are followed. However, the trend is increase in levels of siltation in Kilombero rivers, flooding cycles, reduced quantity and quality and flow of water and biodiversity in the KVFPRS. The current intervention of creating village land use plans is expected to solve the problem of unsustainable utilization of KVFPRS. At the time of the current study, few villages covered by Belgium supported project "Integrated Management Plan for the Kilombero Valley Flood Plain Ramsar site" had their VLUP in place. The effectiveness of VLUP to sustainable utilization is still questionable if they are not fully implemented (Kangalawe, 2010).

From the above description, it is evident that KVFPRS provides livelihood support through immerse regulating services and non-use values to the surrounding communities and the country at large.

The ability of wetland resources to continue providing its values is highly compromised by management problems which include unsustainable agricultural practices, land/watershed degradation and soil erosion, overgrazing, water pollution, deforestation

and overexploitation of forests/woodlands, siltation of lakes, dams and other wetlands, degradation of fishery resources, inappropriate use of water resources, bushfires and vegetation burning, illegal hunting and encroachment into wetlands, lack of baseline information (data) and poor monitoring of wetlands, unsustainable investments in wetland areas, unsustainable mining and natural disasters and lack of alternative livelihoods (MNRT, 2004). These poses a challenge to the country to fulfilling her obligations of observing international treaties which Tanzania signed. Such treaties include the Ramsar convention, the Convention of Biological Diversity and the Convention on International Trade in Endangered Species of flora and fauna through raising people's awareness on the values of biodiversity; and through the benefits communities are likely to acquire through natural resource use, while realizing achievement of MDGs and realization of Vision 2025. The Vision of Government of Tanzania is to reduce abject poverty through National Strategy for Growth and Reduction of Poverty (NSGRP) and Vision 2025 recognizes the contribution of natural resources including wetlands to poverty reduction, and which hinges on sustainable management.

Economic growth involves modifications of physical ecosystems that have to be utilised at sustainable levels for the benefit of present and future generations. However, in recent years due to increased population, economic activities and increased consumption, the environment is being threatened.

Several authors have attempted to estimate the value of world's ecosystem services and natural capital (Costanza *et al.*, 1987). The estimated value was between USD 16-51 trillion/year, with average of USD 33 trillion/year, contributing to Global Net Product (GNP) l of USD 18 Trillion/year. This value is the result of proper functioning of natural capital stock with associated ecological systems. Any changes to the ecological systems,

indicates the cost which can be incurred. Thus, economic valuation can aid decision making on wise use and management of global wetland resources.

Few economic valuation studies have so far been are carried out in Africa and most of them notably, studies on the flood plains of the Zambezi Basin, Hadeijia-Nguru, Nakivubo and Lake Chilwa wetlandsfocused on direct use values particularly fish, agriculture, livestock farming, natural products and medicine (Schuyt, 2005) with little attention to wetland services. Much emphasis have been put on raw materials and physical production and focusing on commercial activities and profits. The result is undervaluation of wetlands (Turpie *et al*., 2003).Literature search on Tanzania indicate that no valuation study has been done on Ramsar sites and other wetlands to establish their economic values (Kulindwa 2010). There are few studies exist on quantification of water in Pangani and in the Great Ruaha (Kadigi *et al.,* 2004, Turpie *et al.*, 2003). The study by IUCN in Mtanza – Msona Village estimated direct wetland use value at 226 million (Kasthala *et al*., 2008). Aa study sponsored by IUCN through Water and Nature Initiative (WANI) proposed the manner in which stakeholders can pay for environmental hydrological services attached to ecological health (Kulindwa, 2010).

Sustainable management of these resources depends among other factors understanding of their economic values both use and non-use values which have been ignored in most valuation studies (de Groot *et al*. 2006; Schuyt, 2005). Munishi *et al.* (2005) insists on the need to have wetland policy of which is missing in Tanzania. Economic valuation can provide information on KVFPRS management (Barbier *et al.*, 1997, de Groot *et al*., 2006). Valuation studies can also provide the rate of risks and prevention to welfare of communities as result of natural disasters especially flooding (Stale *et al.*, 2012). Thus

economic valuation is important for policy makers making informed decision on different management scenarios of KVFPRS.

The focus of the current study is on valuing regulating services of flood control, water quantity and quality and non-use value of biodiversity as ecosystem services provided by KVFPRS. These services do not have a price in a market but the cost associated with their loss is borne to communities (MA, 2005). The study ought to establish the value of regulating services: flood control, water quantity and quality and non-use biodiversity services. These regulating services do not have a price, thus making it difficult when making choices on the conservation and sustainable use. The study will help fill in the gap on how much cost is associated with the loss of these services to household welfare.

3.3 Methodology

3.3.1 Study team

The study team consisted of Natural Resources Department Staff in Kilombero and Ulanga Districts who were involved in face to face household interview and were trained on application of Contigent valuation survey. Together with Ramsar site office staff and district officials, we identified villages for CV studies

.

3.3.2 Sampling procedure

The data for the valuation exercise were collected from representative sample of households in the Ramsar site. A total of 10 purposely selected villages were used for the study. Sampling intensity was 5 percent which resulted into a total sample of 490 households. For face to face household's interview, a random sampling was employed and had a representation from each sub-village using village register as a sampling frame. After the household was selected to take part in the survey, either the husband or the wife

of the respective household (for a married couple) was responsible for answering the questionnaire. In the event both (husband and wife) were present when a visit for interview was made, then a random sampling technique was used to determine who should be the respondent. Otherwise, for those households whose heads were single or at the time of the visit there was only one of the couple present, the questionnaire was administered to either single household heads or the available spouse. This was to ensure equal chances between females and males of being selected as respondents.

Questionnaire covered socio-economic characteristics of household, economic activities carried out, experiences with KVFPRS ecological status. In our contigent valuation study we valued 4 "goods" and a detailed description of the good was vital (Mitchell and Carson, 1989). We adopted both open ended (O-E) elicitation format to closed ended format, the major argument being that the extent of information obtained from households is directly obtained, furthermore O-E lacks anchoring effects of the bid. In literature, closed choice questions are preferred (Bishop and Heberlein, 1979, Brown *et al*., 1996). This gives a respondent a take-or leave it option. The payment vehicle was in terms of contribution to the valuation scenario in cash or through labour (Labour being defined as 1 working day of 8 hours with payment of Tshs 2 500 in 2010). We adopted a lumpsum payment method based on a yearly basis.

3.3.3 Application of Contigent Valuation (CV) in KVFPRS

Application of CV in developing countries has been limited due to the fact that there is high number of zero bids, as a result of severe financial constraints (Whittington, 1998, Brouwer *et al.*, 2008, Navrud *et al.*, 2011). In this study we decided to provide options for a combination of financial and in kind (Willingness to Contribute). The respondents were given options either to contribute in cash, labour or both with the aim of reverting worst

scenarios, giving an opportunity to identify true *zeros* to CV. Four valuation scenarios were developed for valuing water quality and quantity, biodiversity and flood control as subset of all services provided. These are described below:

3.3.3.1 Scenario description for valuing all services

Valuation was aided by cards that list goods and services coupled with photographs. The respondents were given information on the KVFPRS and its surroundings in terms of its potential to support livelihood for surrounding communities. They were informed of immense goods and services that KVFPRS provide. Despite all these goods and services, the environmental integrity and status of these wetlands are increasingly threatened by indiscriminate use and sometimes abuse leading to their degradation, something that may result into these benefits disappearing forever.

Respondents were to think of the importance of the KVFPRS and its resources and the impact it would have on their livelihood in case of its disappearance. They were also asked if theyare aware of and the role they wouldplay if conservation was necessary.

The respondents were asked to consider a situation where the Government is intending to set aside money for conservation project to conserve all the services and goods offered by KVFPRS and thatif the conservation project is not implemented, the goods and services provided by wetlands would be lost. They were asked if they were for or against. They were also informed that Kilombero Conservation Project would cost money some would come from the National Government, some from Regional and Local Governments and some from foreign donor, but the households in the KVFPRS area would also contribute, either in cash or labour or both.

Respondents also estimated the worthy to households in term of the goods and services they receive from the KVFPRS and how much their household could afford and willing to contribute per year in cash or labour or both to have all the goods and services with reasons for not contributing anything.

3.3.3.2 Scenario description for valuing biodiversity

The respondents were informed that KVFPRS was designated as a Ramsar Site in 2002 as a wetland of Global biodiversity importance. The wetland supports different flora and fauna, with notably high wildlife populations.

The respondents were informed about the existing unsustainable trends in the utilization of wildlife habitats and which have resulted into drying up of swamps like Maujiji, Ngapemba and Ndefi among others. This affects both wildlife and fishing activities, leading into reduction of biodiversity properties of the area. The respondents were told that suppose the government intends to implement a biodiversity saving programme which will avoid loss of biodiversity in the years to come. The programme would avoid reduction experienced during recent years. The measures to avoid loss will be financed by the Government and foreign development partners but the local population will also have to contribute in terms of labour or cash money or both in order for the project to be implemented. Households were asked to think of biodiversity service to household welfare, during extreme biodiversity loss. They were asked if they are “for” or “against” biodiversity protection project for the Kilombero Ramsar Site and their willingness to contribute to the project in form of money, labour or both annually. to have the Kilombero Biodiversity Protection Project fully operational to avoid all future loss.

After these WTC questions, the respondents were asked to explain as to why would either be willing or not willing to contribute to the programme.

3.3.3.3 Scenario description for valuing water quantity and quality

The respondents were informed about the KVFPRS and its surroundings in terms of its hydrological services which supports water availability and quality. They were informed that disturbances in the catchment forest areas through increased anthropogenic activities have increased in recent years. Furthermore, there is also increase in use of fertilizers and herbiciding cleaned by the KVFPRS wetlands. They were told of consequence which may include reduction of water quantity and that too much nutrients flowing in the Kilombero River and its tributaries and also affectwater quality. The physical evidences of this water pollution are increased sedimentation and siltation, increase of certain plants in water including algae growth and water cabbages. Respondents were aided by photographs which portray the condition of the river. They were told that consequences of that was to incur the cost of alternative to depend on waterboreholes, purchase of drinking water, difficulty in water based transportation especially in Kilombero River and increased of waterborne diseases experienced in the KVFPRS imparting on their health. Respondents were informed that if nothing is done, the provision services of water quantity and quality by KVFPRS will be in jeopardy in terms ofquantity and quality of water.

The respondents were told that suppose the Government intends to implement a water quantity and quality control programme which will ensure a continued supply of quality water and reduce diseases that are experienced today. The programme would avoid damages to people from low quality and quantity of water in the years to come. The reduction measures would be financed by the government but local people have to contribute in terms of money or labour.

Households were asked to think of this service to household welfare, during extreme scarce of water quality and flow. They were asked if they are “for” or “against” water quality and quality for the KVFPRS and their willingness to contribute to the project in form of cash, labour or both annually to have the Kilombero water quality and quantity Project fully operational to avoid all future loss.

After these WTC questions, the respondents were asked to explain as to why would either be willing or not willing to contribute to the programme

3.3.3.4 Scenario description for valuing flood control

Respondents were given information based on the importance of wetland in flood control that supports agriculture, fishing and other economic activities. They were also informed of extreme flooding experienced in the valley as a result of human activities, which has reduced the capacity of wetlands to control beneficial flood. Here respondents were shown photos to illustrate the worst scenario in which flooding caused loss of crops, houses and human life in the valley and oral explanation on flooding which occurred in 2008. They were told if nothing is done, the use of Kilombero in future will cease due to frequent and extreme floods.

The respondents were told that suppose the Government intends to implement a flood control programme which would avoid damages to people from extreme flood in the years to come. The programme would avoid damages experienced during recent years. The measures to avoid damages would be financed by the Government and foreign development partners but households in and around KVFPRS will also have to contribute in terms of labour or cash money or both in order for the project to be implemented. Respondents were asked to think how worthy to be protected against detrimental floods is

provided by KVFPRS. They were asked if they are “for” or “against” flood protection project for the Kilombero Ramsar site. Respondents were asked their willingness to contribute to the project in form of cash, labour or both annually to have the Kilombero water quality and quantity Project fully operational to avoid all future loss.

After these WTC questions, the respondents were asked to explain as to why would either be willing or not willing to contribute to the programme

3.3.3.5 Scenario description for willingness to Accept Compensation

Respondents were presented with the scenario that suppose due to increased degradation of the KVFPRS, the Government was to stop all the activities in this wetland from the year to follow to allow restoration of functioning of KVFPRS and that eviction was to last for 5 years. In order to compensate for not using their land and the wetland for the 5 years that were to follow, they were to be paid cash per year. Then after 5 years, they would use the wetland as was the case before. The respondents were asked to state the smallest amount of money they would like to be paid annually to get the same welfare status as before the eviction.

3.4 Data Analysis

The data collected through household questionnaires were summarised, coded, cleaned and analysed using Microsoft Excel (2007) and Statistical Package for Social Sciences (SPSS Version 12.0). Both descriptive and inferential statistical analyses were performed.

For the contigent valuation exercise, calculations of mean value of household WTC to the four valuation scenarios was calculated by first calculating means of contribution to the programme in both cash and labour and converted this into monetary terms by multiplying

labour man days by the opportunity cost of Tshs 2 500 based on government rate on hired labour.

3.4.1 Cleaning of data

As it is for standard CV studies, the raw data were cleaned (Mitchell and Carson, 1989). The respondents who Voted Yes for programme but neither failed to indicate any amount or labour contribution, but who were at the same time concerned with ecological health of the KVFPRS were regarded as protesting respondents. This study grouped all respondents who were willing but not able and not willing and not able as *True zeros*. The procedure followed CV guidelines and allowed to understand protest and true zero bidders. In CV zero bidders (protests) indicates protest against the programme and not necessarily zero welfare loss from lost ecosystem services (Wittington, 1998).

3.4.2 Estimating willingness to contribute to all services

Aggregate WTCa = $\sum i\ [(\theta i) \times (\eta j) \times (\theta i\ wtp)]$……equation 1

Where:

WTCa = WTC for all KVFPRS services

θi = percentage of the willing participating households

η_j = total number of households in the area

θ_i wtp = Average contribution of individual household (Cash and Labour)

3.4.3 Estimating Willingness to contribute to flood control services

Aggregate WTC_f = $\sum i\ [(\theta i) \times (\eta j) \times (\theta i\ wtp)]$……equation 2

Where:

WTC_f = WTC for flood control services of KVFPRS

θi = percentage of the willing participating households

η_j = total number of households in the area

θ_i wtp = Average contribution of individual household (Cash and Labour)

3.4.4 Estimating Willingness to contribute to water quantity and quality services

Aggregate WTCw = $\sum i [(\theta i) \times (\eta j) \times (\theta i \text{ wtp})]$……equation 3

Where:

WTCw = WTC for water quality and quantity servives of KVFPRS

θi = percentage of the willing participating households

η_j = total number of households in the area

θ_i wtp = Average contribution of individual household (Cash and Labour)

3.4.5 Willingness to contribute to biodiversity services

Aggregate WTC_b = $\sum i [(\theta i) \times (\eta j) \times (\theta i \text{ wtp})]$……equation 4

Where:

WTC_b = WTC for biodiversity services of KVFPRS

θi = percentage of the willing participating households

η_j = total number of households in the area

θ_i wtp = Average contribution of individual household (Cash and Labour)

3.4.6 Factors influencing the household WTC to KVFPRS conservation programmes

Logistic regression models which is a binary technique for estimating the probability of an event to occur, was adopted because of the dichotomous nature of dependent variable and nominal and numerical nature of independent variables (Wuensch, 2008). The dependent variable was regressed against eight independent variables to determine their influence on

dependent variable. Four binary logistic regression models were developed to determine the influence of socio economic and demographic factors (independent variables) to WTC to All services, biodiversity, water quality and flood control as values of KVFPRS (dependent variables) to the sampled 490 households in KVFPRS. The following hypotheses were tested:

Ho: Household socio-economic and demographic factors have no effect on Willingness to contribute to All services, biodiversity services, water quality and quantity and flood control conservation

Ha: Household socio-economic and demographic factors have effect on Willingness to Contribute to All services, biodiversity services, water quality and quantity and flood control conservation.

Household size, gender, age of respondent, marital status, education, activities carried out in KVFPRS, income of household and total area owned were used as predictors.

Logistic models were expressed below:

$$L = Ln(^{Pi}/1 - Pi) = B1 + B2Xi \quad \text{......................................(5)}$$

Pi/(1-Pi)= odds ratio a ratio of probability to occur to the probability not to occur

L = Logit (log on odd ratio)

Xi = Explanatory variable

B_1 and B_2 = Coefficients

Respective model predictors were defined as:.Household with positive WTC were assigned zero (0) and those with negative WTC were assigned (1),

From the model, the independent variables included in the model were:

X_1= Household size: It was assumed that the bigger the household size, WTC tend to increase. The variable was recorded with respect to the number of people having the common catering arrangement and expected sign of the regression coefficient was positive (+β).

X_2= Gender of respondent: Female and male respondents were assumed to perceive participation in conservation programme different. Hence male were assigned 1 and female assigned 2

X3= Age of respondent: Age of a respondent in years. It was assumed that increase in age of the respondent increases the probability to contributing to conservation programme and vice versa. It was assumed that older people have much wisdom related to KVFPRS use. This variable was assumed to have a negative value of the expected signs of the estimate (-β).

X_4= Marital status: Marital status of the respondent was assumed to have influence on the willingness to contribute to conservation programme. This were coded as 1 for married, 2 single, 3 widowed and 4 for divorced respondent.

X_5= Education level: Level of education of respondent in years tends to create awareness, self-reliance, stimulate self-confidence, motivation and positive attitude. So it was assumed that people with higher education have more livelihood options compared to less educated people, therefore are less likely to WTC to wetland conservation. Level of education was recorded with respect to the number of years that a respondent had spent in schooling. The expected sign of the regression was negative (-β).

X_6=Activities carried out: Different livelihood options in particular area tend to motivate and create positive attitude towards the resource. So it was assumed that people with many livelihood options in KVFPRS are willing to contribute to conservation programme and vice versa. The expected sign of the regression was positive (+β).

X_7= Annual household income: This was the net benefit in cash household receive from KVFPRS. It was assumed that the more cash households receive, the more they will be willing to participate in conservation programme. This was assumed to have a positive regression coefficient (+β).

X_8=Land owned by household: Total land owned by respondent in ha in KVFPRS tend to increase probability to participate in conservation programme.This was assumed to have a positive regression coefficient (+β).

3.5 Results and Discussion

3.5.1 Household characteristics

In the current study, human capabilities of the household in enabling the households carry out their livelihood activities were considered. The quality of labour varies with household size, skill levels, leadership potential and health status among other things (DFID, 1999). In this study, household size, gender, age of respondent, marital status, education, activities carried out in KVFPRS, income of household and total area owned were assessed. This is summarized in Table 1.

Table 1: Characteristics of Households in the KVFPRS (N= 490)

Characteristics	Description	Result
Year of residence (Years) percent	Below 10 years	4.0
	Over 10 years	96.0
Gender (percent)	Male	84.0
	Female	16.0
Household size	Mean	5.0
Age (years)	Minimum	25.0
	Maximum	80.0
	Mean	49.5
Education (levels)	No formal education	19.4
	Primary education	70.4
	Secondary schools	9.2
	College and university	1.0
Occupation	Farmer	90.0
	Employee	5.2
	Other	4.8
Total land owned (ha)	Minimum	0.3
	Maximum	4.0
Average household income based on crop production (Tshs)	Average	666 299.6

3.5.2 Willingness to contribute to KVFPRS services

With regard to contribution to All services, majority of the population (98.4%) showed willingness to contribute to conservation programmes. On the other hand 83.9% were willing to contribute to conservation of biodiversity and 88.9% were willing to participate in improving water quality and quantity and 91% willing to contribute to flood control initiatives as indicated in Table. 2. Giving different options in terms of contribution is it in cash or in kind tries to solve the problem of low WTP in cash as observed by Brouwer *et al*. (2008). If only payment in cash was applied, only a fraction of value could be realized. It was found that though respondents were not able to contribute financially, they were able to contribute in kind. Results indicated that a combination mode of contribution had highest representation.

Table 2: Willingness to contribute in percentage to All services, biodiversity, water quality and flood control services for the KVFPRS (N=490)

Valued service	Mode of contribution	Percentage
All services		
	Nothing	1.6
	Money	8.8
	Labour	16.3
	Money and Labour	73.3
Biodiversity	Nothing	16.1
	Money	9.6
	Labour	51.2
	Money and Labour	23.1
Water quality and quantity	Nothing	11.1
	Money	14.8
	Labour	33.7
	Money and Labour	40.5
Flood control	None	9.0
	Money	12.9
	Labour	44.8
	Money and Labour	33.3

For those respondents who stated would contribute nothing to the programmes, the reasons for their choice werelack/inadequate human capital in terms of health, lack of resources , old age, lack of physical capability even to support contribution in terms of labour or any valuable items and other reason was on the lack of confidence in fund management. Mean contributions as indicated in Table 3.

Table 3: Mean Willingness to contribute in both cash and labour in the KVFPRS

Valued good	Nothing	Average cash	Mean mandays	Opportunity cost	Total (Tshs)
Value odiversity	0	57 040	47	117 286	174 326
Value		4 196	18	45 469	49 665
Water					
Value	0	9 819	18	44 785	54 605
Flood control					
Value	0	765	31	76 566	85 331

3.5.3 Economic value of KVFPRS

3.5.3.1 Economic valuation of KVFPRS in terms of All services

The study found that the average cash contribution to the programme was Tshs 57 039.80/year, and average number of labour contribution is 47 days/year translating to opportunity cost of Tshs 117 500. This brings a total contribution to Tshs 174 326/year per household.

Based on these estimates the population WTC amount to Tshs 13 946 040 816/year. This is as presented in Table 4.

Table 4: Economic value of the KVFPRS in terms of All services, biodiversity, flood control and water quality (N= 490)

Statistics	Valued goods			
	All services	Biodiversity	Flood control	Water quality
N	490	490	490	490
Mean	174 325	49 665	85 332	54 605
Maximum	1 290 000	912 500	1 032 500	1 012 500
0%	1.6	17.3	9.2	12.4
Sample WTC	85 419 500	24 336 000	41 812 500	26 756 400
Households in KVFPRS	80 000	80 000	80 000	80 000
Population WTC	13 946 040 816	3 973 224 490	6 826 530 612	4 368 391 837

3.5.3.2 Economic valuation of KVFPRS in biodiversity conservation

The value of biodiversity cash value for biodiversity conservation was Tshs 4 196 with 18 persondays which translates into opportunity cost of Tshs 45 469, totaling to Tshs 49 665. The sample value was Tshs 24 336 000, with population value of approximately 4 billion as indicated in Table 5.

3.5.3.3 Economic valuation of KVFPRS in water quantity and quality

The cash value for water quantity and quality was Tshs 9 819.20 and willingness to contribute in terms of labour of mean days of 17.9days/year with corresponding opportunity cost of Tshs 44 785.71, bringing the total to Tshs 54 604.90 per year. The sample value was Tshs 26 756 400 and for the population was Tshs 4 368 391 836 per year. Study revealed that 67 percemt of the population have access to clean and safe water. According to FBD (2007), the WTP in cash only for environmental water services in the Rufiji Basin, where the value of water among the wealth categories was put at Tshs 3 876.51 among the lower, the middleTshs 20 581.52 and the upper categories Tshs 64 807.55. Other studies which were carried out to quantify the value of water included one by Turpie *et al*. (2003) who undertook a preliminary assessment of water resources of the Pangani River Basin, and Kadigi *et al.* (2004) who did TEV of water utilization in the Great Ruaha Catchment in Tanzania, and Kulindwa (2010) who used WTP for hydrological services in the Pangani water Basin in the range of Tshs million 445-709 for lower and upper bound scenarios. Other study by Munishi (2007) who estimated the total value f the Mara River swamp at USD 22 109 600.

There is no study carried out in Tanzania to quantify the value of wetland in controlling pollution and enhancing quality water and its supply. Disturbances in Rufiji basin areas especially removal of natural vegetation causes the rate of soil erosion to be 0.37 tons per ha year higher as compared to natural state. This is confirmed by hydrometric station data on increased transportation rates; further more, in terms of water quality data; Kilombero River has received little attention as compared to Usangu and Great Ruaha (FBD, 2007). Generally, there is noted trend that the waters are lowly mineralized and dominated by sodium and bicarbonate ions in Usangu plains, the status may be the same in the Kilombero. Reduce the quality and quantity of water flow have impact on livelihood

activities in terms of affecting revenue and health of households. Records in Kilombero District show that major diseases causing mortality in the area are Malaria, ARI, Skin diseases, intestinal worms and diarrhea (DED Kilombero, 2010).

Regulating services of KVFPRS in terms of providing water flows cannot be emphasised (FBD, 2005). This is in terms of reducing and filtrating contaminations in terms of pollutants, pathogens as a result of different activities carried in and around the KVFPRS. Most of the studies have concentrated in the artificial wetlands in water treatment (Constanza *et al.*, 2010).

In terms of water quality data, the study has relied on the data from Rufiji Water Basin catchment data. Literature shows that wetlands are able to filter nitrates, ammonia, nitrites but not dissolved phosphorus or suspended solids. The flood plain has witnessed increased use of fertilizers, herbicides and clearing of riparian areas. The study by Turpie *et al*. (2010) observed a total of water treatment plant at USD 0.9-1.37 million per mega litre for large and small works respectively. Studies in South Africa, shows that unlike other wetland types floodplain wetlands play a very vital role even in phosphorus filtrations.

3.5.3.4 Economic valuation of KVFPRS in flood control

The study found the mean WTC for flood control services to be a Tshs 8 765 and Contribution in terms of number of days to be 31 days/year with opportunity cost of 76 566. This bring a total of Tshs 85 332. The value of sampled household stands at Tshs 41 812 500 and population value of Tshs 6 826 530 612 as indicated in Table 4. Literature search on Tanzania indicate that most of valuation studies conducted have asked households on their WTP and sometimes not considering regulatory values (Staarjar,

2005, Turpie 2007). In this study, we have pioneered applying WTC as measure of welfare.

The valley suffers from severe flooding which is detrimental to the welfare of the surrounding communities. Records indicate a prevalence of severe flooding in the valley for every 4th year. The last reported was in 2008 where considerable number of villages were flooded for about 2 months with recorded rainfall of above 2000mm. This is evidenced by the marks of inundation on houses and some lost lives were recorded, on top of destruction of crops and several infrastructures like roads and bridges in the valley. This may lead to many communities being cut off to basic commodities reduced quantity and quality of water. Communities suffered from loss of natural capital, water borne diseases and disruption of livelihood activities.

In KVFPRS, the noted detrimental flood occurred in 1977-78, 1987/1988, 1997/98 and the latest on 4th - 20th April, 2008. This was evident in Mlimba and Kidatu Divisions; more specifically targeting: Mofu, Mtuju, Chita and Kidatu. Records from the Kilombero District (DED, Ibid) show that 818 households with a population of 4,098 were severely affected. To assist and manage this disaster a total of Tshs 131 665 000 was requested from the Prime Ministers Office – Disaster Management Department to cover for foods, medical, energy and distribution costs. Despite these efforts no effective, long term mechanism is put to avoid, reduce and mitigate flood to community welfare in developing countries where households in most cases have no insurance (Navrud *et al.*, 2010). In the wake of climate change, there is noted trend in building up of increased water flow in the KVFRS (Bakengesa, *et al.*, 2010), measures to install mechanism to reduce detrimental flood need be worked out as a matter of urgency.

3.5.4 Willingness to Accept Compensation

The WTA was on average of Tshs 2 709 500 with maximum of 100 000 000 (SE 3.9401E). About 92% of respondents voted for the programme and 8 percent did not state any amount as a way to protest compensation. Also, others stated higher amount as the way of protest, but the threshold could not be established.

3.5.5 Socio- Economic and Demographic Factors Affecting Conservation of KVFPRS

3.5.5.1 Socio economic and demographic factors affecting contribution to All services

The logistic Regression Model revealed a fairly good performance. The PAC (Percentage Accuracy Classification) on the model with all variables included is 96.6 percent. It was found also that activities carried out in the wetland had statistically significant effect on contribution to *All services* at ($P< 0.001$), while age of respondent was revelead as statistically significant factor influencing Willingness to Contribute to *All services* at ($P< 0.05$). Other factors such as household size, gender, marital status, income of household though not statistically significant were found to be positively correlated with contribution to *All services*. The results of the model are as indicated in Table 5.

Table 5: Logistic model results for Contribution to *All services* in the KVFPRS

Variable	B	S.E.	Wald	Sig.	Exp(B)
Household size	.004	.064	.004	.948	1.004
Gender	.551	.721	.584	.445	1.734
Age	-.064	.027	5.700	.017**	.938
Marital status	.201	.702	.082	.774	1.223
Education	-.161	.102	2.468	.116	.851
Activities in wetland	5.788	1.304	19.697	.000***	326.339
Income of household	.000	.000	1.733	.188	1.000
Total area owned	-.027	.053	.252	.615	.974
Constant	-5.216	2.847	3.358	.067	.005
Model summary					
Number of observations	490				
Overall percentage	78.8	PAC96.6			
Model Chi-square	385.162				
-2log likelihood	121.416				
Cox &Snell R-square	0.544				
Negelkerke R-square	0.845				

3.5.5.2 Socio-economic and demographic factors affecting contribution to Water quality and quantity programme

The logistic Regression Model revealed a fairly good performance. The PAC (Percentage Accuracy Classification) on the model with all variables included is 92.9 percent. It was found also that activities carried out in the wetland had statistically significant effect on contribution to water quality and quantity at ($P< 0.001$). While ages of respondent, marital status, income of household though not statistically significant were found to bepositively correlated to contribution to water quality and quantity. On the other hand, household size, gender, education, total area owned by household were found to statistically negatively correlated. The results of the model are as presented in Table 6.

Table 6: Logistic model results for Willingness to Contribute to water quantity and quality

		Variables in the Equation					
		B	**S.E.**	**Wald**	**df**	**Sig.**	**Exp(B)**
	Household size	-.052	.043	1.441	1	.230	.049
	Gender	-.747	.518	2,083	1	.149	.474
	Age	.015	.025	.354	1	.552	1.015
	Status	.102	.459	.050	1	.823	1.108
	Education	-.020	.083	.056	1	.813	.981
	Activities in wetland	4.126	.984	17.567	1	.000	61.916
	Income	.000	.000	2.453	1	.117	1.000
	Total area	-.073	.041	3.067	1	.080	.930
	Constant	-6.491	2.786	5.427	1	.020	.002
Model summary							
Number of observation	490						
Overall percentage	86.1 PAC 92.9						
Model Chi-square	209.162						
-2 log likelihood	185.518						
Cox & Snell R-square	0.347						
Negelkerke R-square	0.628						

3.5.5.3 Socio-economic and demographic factors affecting contribution to biodiversity services programme

The logistic Regression Model revealed a fairly good performance. The Percentage Accuracy Classification (PAC) on the model with all variables included is 90.4 percent. It was found also that activities carried out in the wetland had statistically significant effect on contribution to All services ($P< 0.001$). Other factors such as age, education, income though not statistically significant had positive correlation with Willingness to contribute to flood control programme. Results of the model are as indicated in Table 7.

Table 7: Logistic model results for Willingness to Contribute to biodiversity conservation programme in the KVFPRS

		Variables in the Equation					
		B	**S.E.**	**Wald**	**df**	**Sig.**	**Exp(B)**
Step 1	Household size	-.014	.033	.169	1	.681	.987
	Gender	-.002	.391	.000	1	.995	.998
	Age	-.035	.016	5.090	1	.024	.965
	Status	.338	.350	.933	1	.334	1.403
	Education	.000	.060	.000	1	.993	.999
	Activities in wetland	2.159	.621	12.078	1	.001	8.660
	Income	.000	.000	1.933	1	.164	1.000
	Total area	-.027	.028	.898	1	.343	.974
	Constant	-2.490	1.722	2.090	1	.148	.083
Model summary							
Number of observation	490						
Overall percentage	81	PAC 87.8					
Model Chi-square	148.131						
-2 log likelihood	328.077						
Cox & Snell R-square	0.261						
Negelkerke R-square	0.42						

3.5.5.4 Socio- economic and demographic factors affecting contribution to flood control programme

The logistic Regression Model revealed a fairly good performance. The PAC (Percentage Accuracy Classification) on the model with all variables included is 90.4 percent. It was found also that gender and awarenss had statistically significant effect on contribution to flood control ($P< 0.001$). Other factors such as age, education, income though not statistically significant had positive correlation with Willingness to contribute to flood control programme. Results of the model are as indicated in Table 8.

Table 8: Logistic model results for Willingness to Contribute to flood control programme in the KVFPRS

Variables in the Equation							
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Householdsize	-.041	.040	1.038	1	.308	.960
	Gender	-.861	.490	3.086	1	.079	.423
	Age	.008	.021	.145	1	.703	1.008
	Status	.201	.416	.233	1	.629	1.223
	Education	.006	.075	.006	1	.937	1.006
	awarenesswetland	3.809	.853	19.968	1	.000	45.124
	Totalarea	-.035	.036	.953	1	.329	.966
	Incomeof household	.000	.000	.821	1	.365	1.000
	Constant	-6.123	2.379	6.623	1	.010	.002
Model summary							
Number of observations		490					
Overall percentage		85.7	PAC 90.4				
Model chi-square		172.778					
2log likelihood		229.136					
Cox & Snell R-Square		0.297					
Negelkerke R-Square		0.0531					

3.6 Conclusion

The results revealed the importance of non-marketed environmental goods to household welfare in Kilombero Valley Flood Plain Ramsar Site. These are flood control values, biodiversity values, water quality and quantity values and All services. The mode of contribution was through cash, labour and in combination of cash and labour. The results show in the following in terms of Willingness to Contribute to All services were, at household level Tshs 57 000 with mean 47 person days, Willingness to contribute to Biodiversity was Tshs 4 000 with mean 18 person days, Willingess to contribute to water quality and quantity was Tshs 10 000 and mean 18 persondays and Willingness to contribute to flood control programme was Tshs 9 000 with mean 30 persondays.

In total, the contribution in terms of cash and labour which were equated to an opportunity cost, resulted into social benefit to avoid loss of *all* provided by KVFPRS at Tshs 14 billion, Biodiversity value was at Tshs 4 billion, Flood control values of about was Tshs 7 billion and Water quality and quantity values of was about Tshs 4 billion. These values may increase as their loss becomes more vivid and communities feel more the need for their availability in their welfare.

Looking at theoretical background of CV, this study has fairly demonstrated that the composite of contribution to all services values is the same as the individual programmes valued separately if contribution in both kind and cash are encouraged, while the relationship becomes odd if each mode is considered separately, and this makes contigent valuation application in developing countries where cash is limiting factor. Even for labour alone, the relationship is odd because societies are normally distributed. There might be some who may not be able to contribute even in labour based on different limitations which are mainly endogenous.

Logistic results show that the ativities carried out in the wetland were the most statistically significant variable in all models. Other predictors had varied contributions across ecosystem services

3.7 Recommendation

Based on the fact that livelihood activities are many, which mostly depends on non-marketed goods, thus in policy formulation there is need to take on board these non-marketed ecosystem services. Thus, the study recommendeds application of WTC in capturing wetland values when planning for sustainable management of wetlands.

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CHAPTER FOUR

4.0 INSIGHTS INTO WETLAND RELATED INCOME, INVESTMENT, BIODIVERSITY AND OTHER USES IN RELATION TO SETTLEMENT PATTERN IN SELECTED VILLAGES OF KILOMBERO VALLEY FLOOD PLAINS RAMSAR SITE, TANZANIA

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4.1 Abstract

Tanzania signed the 1971 Ramsar Convention in 2000. The Convention advocates the wise use concept of wetland resources. Currently, Ramsar sites in the country cover about 5 million hectares, of which the Kilombero Valley Flood plains Ramsar Site covers about 20 percent. Being, one of the most fertile floodplains with 330 000 ha irrigation potential, it is a subject of a unique interaction with surrounding communities in which patterns of settlement in relation to proximity to the wetlands continually influence the socio-economic status of the community. The current study assessed how settlement patterns around the wetland influence local incomes, investments, biodiversity and other wetlands values in the Kilombero Ramsar Site. We surveyed four villages (Msolwa – Station, Lumemo, Namwawala and Mofu) with differential proximity to the wetland. Data were collected through discussions with district officials, literature searches, focus group discussions and Participatory Rural Appraisal (PRA) methods. All households surveyed were geo-referenced in order to record their location respect relative to the wetland. It was found that within each village there is a distinctly skewed distribution of wellbeing, locally with over 60 percent of the households having medium to low levels of material wealth. Based on the villages and settlement patterns, the wealth increased with increasing distance from the core wetland. Also, it was also observed that, middle to high income groups and large scale investors displace the smallholders into areas closer to the wetlands. This of course increases pressure on the wetland ecosystem. Fishing activities are concentrated in Namwawala, and Lumemo Villages which are closer to the wetlands. The livestock grazing pressure, from displaced pastoralists moving into the area and more concentrated in Mofu Village increasing the pressure and degradation of the wetland ecosystem and wetland use conflicts. Such settlement pattern and the resultant utilization trend are likely to degrade biodiversity of the ecosystem. On the other hand, communities

closer to the core wetland are likely to benefit more from wetland related activities which include both consumptive and non-consumptive natural resource use.

4.2 Introduction

Global wetland conservation efforts were initiated through Ramsar Convention of 1971, which called for wise use of all wetlands through local, regional and national actions and international cooperation (Ramsar Convention, 1971). The government of Tanzania ratified to Ramsar Convention in 2000. Accordingly, Wildlife Division in the Ministry of Natural Resources and Tourism (MNRT) has a facilitating role in implementing the Ramsar Convention. To date, the country has four Ramsar Sites with 4 868 424 ha. These sites are Malagarasi-Moyovosi (3 250 000ha), Lake Natron (224 781 ha), Kilombero Valley Flood Plains (796 735 ha) and Rufiji-Mafia-Kilwa Marine Ramsar Site (596 908 ha), Lake Nyasa is a proposed Ramsar Site and efforts are made for its designation (MNRT, 2004).

Kilombero Valley Floodplain Ramsar Site was designated and added to the Ramsar Convention's list of wetlands of International Importance in April, 2002. Being one of the most fertile lands with 330 000 ha of irrigation potential, it is subjected to a unique interaction with surrounding communities thus calling for significant management attention to warrant its sustainability (McCartney and van Koppen, 2004). Sustainable ecological viability of these wetlands depends on what decisions made on their utilization and trend on human populations's trends and their anthropogenic activities (Groot *et al.,* 2006, Birol *et al*., 2006, Barbier *et al.,* 1996).

Wetland functioning is influenced by both natural and human induced activities. Human activities cause wetland degradation and loss by changing water quality, quantity and flow

rates, increased pollutant inputs and change of species composition as a result of disturbance and the introduction of non-native species. Proper functioning of wetlands attracts communities into settling in them so to benefit from wetland rich resources. People who live within or around wetlands have been involved in various economic activities and their settlement patterns have been influenced by the wetlands (Doody and Mesaki, 2003). Studies show that half of global wetland has been lost as a result of growing economic pressures and increased transformational investment opportunities (Zedler and Kercher, 2005). It has also been noted that in recent years expansion of human settlements, livestock grazing, agriculture and commercial forestry have increased pressure on Tanzania's natural habitats (Newmark and John, 2000). This study assessed how settlement patterns around the wetland influence local incomes, investments, biodiversity and other wetlands values.

4.3 Methodology

4.3.1 Study Area

The study was carried out in Kilombero Valley inland floodplain Ramsar Site in Morogoro Region, Tanzania. The valley covers 7 967 km^2, approximately 260 km long and 52 km wide, with a catchment's area of about 40 000 km^2. The Central point coordinates are 8 °40' S and 36 °10' E. The Floodplain lies between 210 and 400 m.asl. The Valley is divided by the Kilombero River and falls within two administrative Districts of Kilombero and Ulanga. The valley is fed by many rivers both permanent and seasonal. Sub -humid tropical climate characterize it climate with humidity of 70-80 percent and annual rainfall of about 2 000-3 100mm. (MNRT, 2004). The distribution of land in Kilombero and Ulanga districts is as presented in Table 1.

Table 1: Area of land and water (km^2) in Kilombero and Ulanga districts with their estimated human population within and outside of the Kilombero Valley Ramsar Site

District	Area Description	Kilombero	Ulanga	Total
Land Area (km^2)		13 577	23 681	37 258
Water Area (km^2)		1 341	879	2 220
Total District Land Area (km^2)		14 918	24 560	39 478
Total land in Ramsar Site (km^2)				
Number of Wards	Inside Ramsar Site	16	12	28
	Outside Ramsar Site	3*	12*	15
Number of Villages	Inside Ramsar Site	72	36	108
	Outside Ramsar Site	9	29	38
Population	Inside Ramsar Site	279 655	115 187	394 482
	Outside Ramsar Site	43 124	79 022	122 146

* *Includes Kidatu Ward and its 3 villages which although are within the valley, are excluded because this portion of the Valley is under the sugar cane plantations of the Kilombero Sugar Company.*

(Source: Kilombero Flood Plains Ramsar Project Document, 2005)

The valley embodies a wide variety of wetland habitat types and has high concentrations of mammals (Puku, Buffalo, Hippo and Elephant), birds (including three endemic species), fish (including two endemic species *Citharinus congicus* and *Alestes stuhlmanni*). Human population was estimated at 400 000 in 2005 with population increase of about 3 percent per year. Four villages within the Ramsar, Msolwa-Station, Lumemo, Namawala and Mofu were studied based on representation of land use, agricultural landscape, habitat types, economic activities of fishing and livestock grazing. Study villages are as represented in Fig. 1.

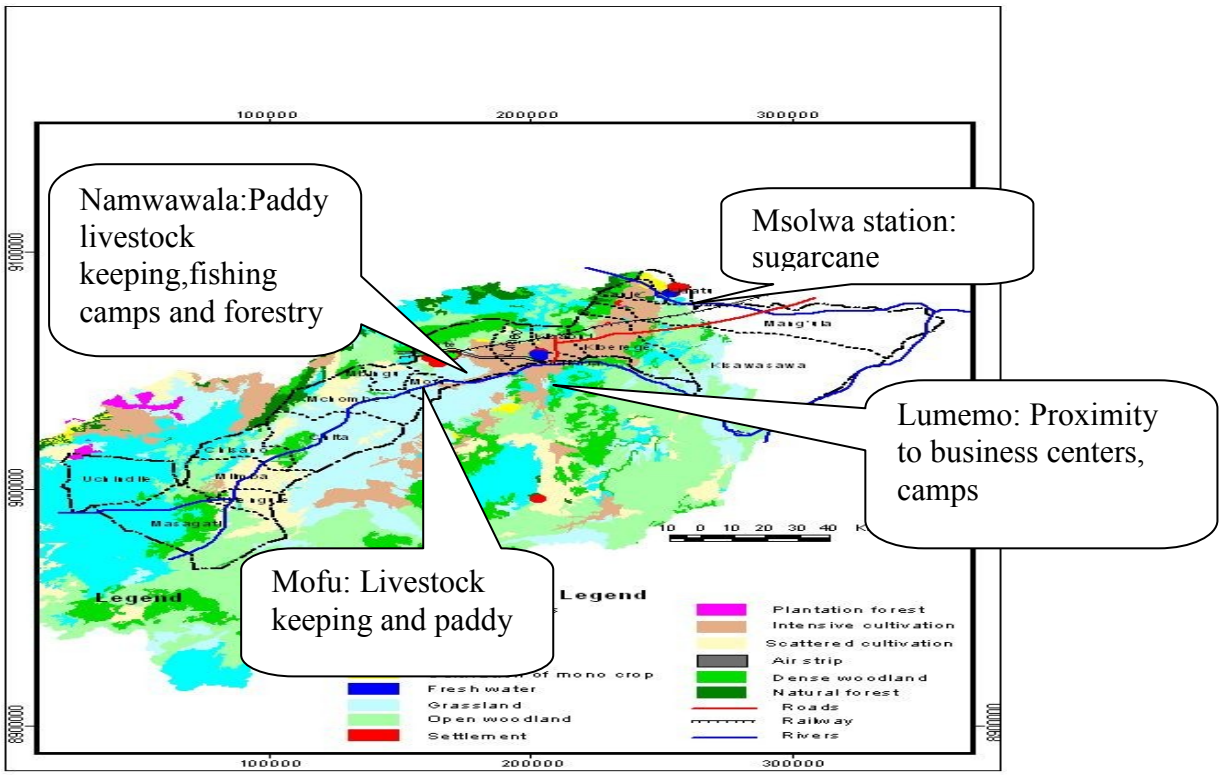

Figure 1: Study villages in Kilombero Ramsar Site, Tanzania.

4.3.2 Methods

The study involved a range of data collection methods including discussions with district officials, Kilombero Ramsar Office, literature searches, focus group discussions with fishermen, livestock keepers and farmers, different Participatory Rural Appraisal (PRA) methods, and household questionnaire survey. Information on village characteristics, biophysical data, economic activities being carried out and communities' access and utilization of wetland resources were discussed. Household survey involved 132 households (at least 30 households from each village) based on representation of wealth categories in each sub-village. Wealth ranking based on local indicators were determined during PRA by villagers, in which three classifications were reached i.e. high, middle and low classes. For every surveyed household, its compound was geo-referenced to give its location within the wetland. These Global positioning system (GPS) points were then mapped by using the Arc View Programme on ward basis (Lumemo, Idete, Kidatu and

Mofu). Data obtained through Focus group discussions and PRA were analysed using qualitative methods while household interview data were analyzed using R-Statistical package.

4.4 Results

4.4.1 Settlement pattern of selected villages in Kilombero Ramsar Site

Settlement pattern in the studied wetlands villages was a product of many factors: out of which the most important of which were historical background of the village, socio-economic factors and different ecosystems in the village. The establishment of Namwawala and Msolwa Station villages was associated with economic an interventions which in this case was establishment of TAZARA Railway Line (attracting workers/labourers from different parts of the country, and whose settlement formed a village. Also, abundance of fertile arable land and grazing potential attracted associated groups. An Increased pastoral population in western zone in Mofu and Namwawala Villages for example is a product of their grazing potential. Equally instructive is the presence of different ecosystems on settlement patterns by dictating the size and location of areas to be used for settlement. A sizeable proportion of the district lies along the Kilombero Valley, while other parts are in the Rufiji Basin, Selous Game Reserve, The Udzungwa Mountains National Park, consist of Miombo woodlands that rise to about 1 700 m.asl.

Thus, residential land use which is designated for various intensity of housing and home-gardening in the study was mainly characterized by scattered settlement pattern with concentration at village centres/hamlets.

Residence years within the study villages had a ranged from two to 72 years. Field data shows that there are more newly settled villagers in Mofu than there is in Msolwa station. This is treated as a continuum in other villages given that settlement is dynamic in agrarian economies.

The housing landscape is characterised by mud and grass thatched, mud bricks and grass/reed thatched, mud bricks and iron sheets thatched and cement bricks with iron sheet thatched. There is a gradient of away from the core wetland areas, coupled with differentiation across the wealth categories. Good housing was one of the indicators of wealth in the studied villages.

4.4.2 Influence of wetland to local income and household wealth categories in selected villages in Kilombero Ramsar Site

Findings from the study show that people derive income from primary net production to tertiary wetland values. Sources of income includes agriculture (cash and food crops), livestock keeping, fishing, brick making, local brew making, forest produce and service provision to associated industries. About 90 percent of the population is engaged in agricultural production, which is predominantly small-scale (peasant) farmers, which make the largest proportion of inhabitants of wetland areas. Subsistence farmers practice rain-fed which is somewhat unsustainable agriculture. When the farms become degraded due to continuous and improper cultivation practices, new ones are opened up in forest area and wetlands through what is called *"kupaka*". However, we expect current approaches such as *Kilimo Kwanza*, a national strategy to improve on agricultural productivity will transform such practices in a sustainable way. Crops grown are Paddy, maize, peas, simsim, sunflowers and cocoa.

The study found that wealthy categories differed across the studied villages and within villages. In the studied villages, Lumemo and Mofuhad an on higher percentage of wealth people as compared to Msolwa station. Local wealth indicators were almost the same in the studied villages, the facets include income, the number of livestock owned, the type of house, ability to cultivate owned farm land holdings, ability to hire labour and machinery, education level(s) for head of household and dependants, meet basic needs (meals, clothing) and ability to investment. Based on thee categories wealth classes in the studied villages are as indicated in Table 2.

Table 2: Distribution of wealth categories in sub-villages in studied villages of KVFPRS

			Wealth Category (percent)			
Ward	**Village**	**sub village**	**High**	**Middle**	**Low**	**Total number of households**
		Lusapa		67	33	70
		Lihala		50	50	105
		Lumemo A	20	70	10	230
Lumemo	Lumemo	Lumemo B	10	70	20	229
		Igombati		75	25	179
		Magoha		75	25	162
		Mnola	25	50	25	175
				Total		**1 150**
		Bomamzinga		25	75	158
		Idandu	15	25	60	813
Idete	Namwawala	Namwawala A	53	35	12	386
		Namwawala B	16	24	60	225
		Videnge		88	22	103
				Total		**1 685**
	Msolwa	Msolwa Kati		84	16	1 800
Kidatu	Station	Nyange		88	12	947
		Mtukula		10	90	347
				Total		**2 747**
		Misheni	25	60	15	150
		Nganyangila	25	45	30	87
Mofu	Mofu	Mbaruka	65	25	10	826
		Kidimu		35	65	144
		Mwaya	55	30	15	480
				Total		**1 687**

The total number of households in the village show Msolwa Station as being a highly populated area, which is partly due to employment opportunity provided by the Illovo

Sugar Processing Company while in Mofu and Namawala Villages fertile agricultural lands and abundant grazing lands attract farmers, fishermen and pastoralists from other parts of the country.

4.4.3 Pattern of land holdings in Kilombero Ramsar Site Villages

The study found households had land holdings with range of 0.3-4.0 ha this was an aggregate of different plots owned by the household comprising of homegarden and farms meant for food and cash crops production. The findings from the study show that plots owned by households ranged from 1 to more than 5 plots, with most of them having 3 plots (Fig 2). It was found that home gardens were within the village and temporary ones found in the farm fields; which determines ones settlement inclination.

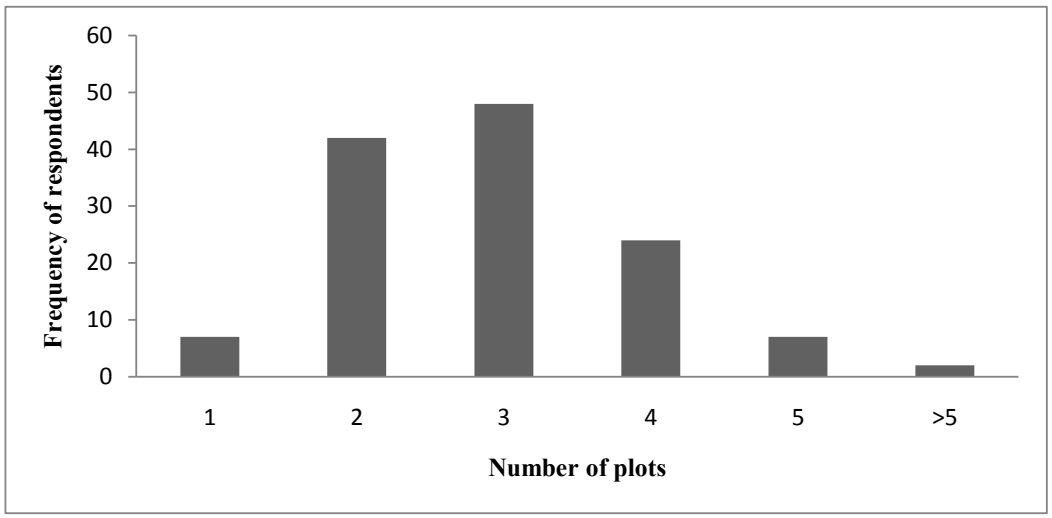

Figure 2: Distribution of land plots owned by households in Kilombero Ramsar site, Tanzania.

However, for agricultural purposes (both cash and food crops), farms were located within the village and in other villages depending on the type of crop. For example, households in Msolwa Station cultivate paddy as far as in Mofu. Correspondingly during the cropping

season, households do migrate to other villages. The igration trend is towards the western zone in search for paddy farms.

4.4.4 Household home garden sizes in studied villages in Kilombero Ramsar Site

All the studied households owned a piece of land used for home garden activities. Sizes ranged from 0.1ha to greater than 0.8ha. With most of the respondents owning in the range of 0.1-0.2 ha (Fig. 3). With respect to home garden size, no significant differences were found between wealthy categories; however the difference is apparent on the type of house and building materials used across differently wealth categories.

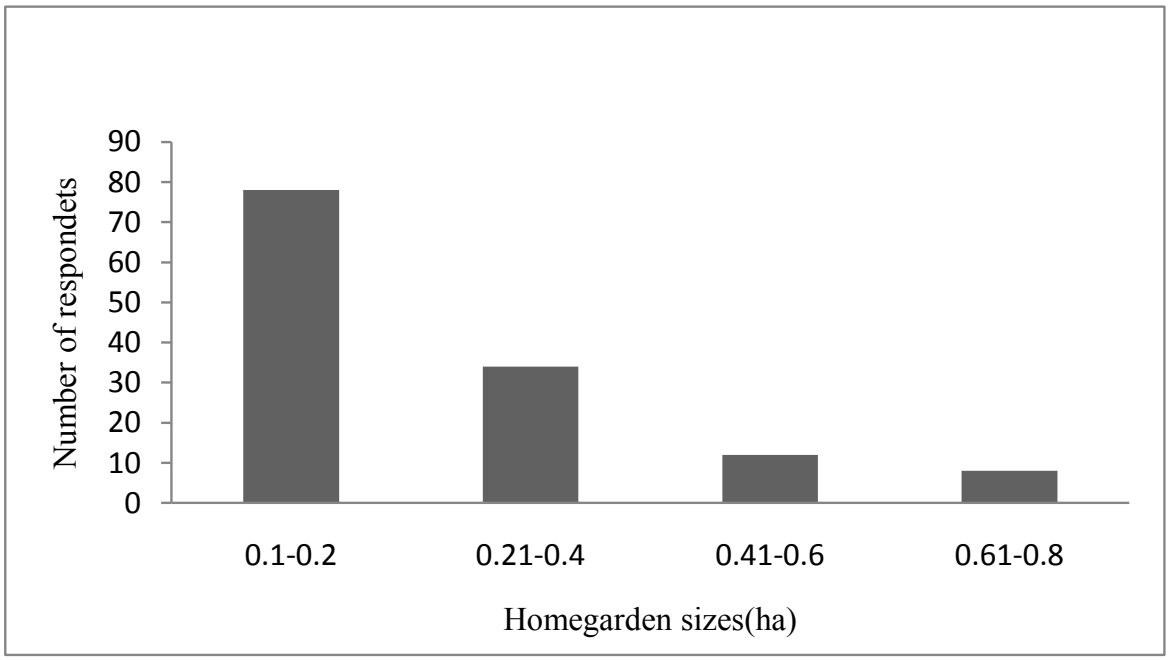

Figure 3: Homegarden sizes in studied villages in Kilombero Ramsar Site, Tanzania.

4.4.5 Paddy and sugarcane production in Kilombero Ramsar Site

Paddy production is carried out by 90 percent of respondents where households owned farms within and outside their village. Land sizes put under paddy production ranged from 0.2 to over 8ha, with most of respondents falling in 0.2-1.6 ha.(Fig. 4) with average

production of 12 paddy bags per acre with one growing season per year, if sold at farm gate price it fetches an average of Tshs 60 000 per rice bag.

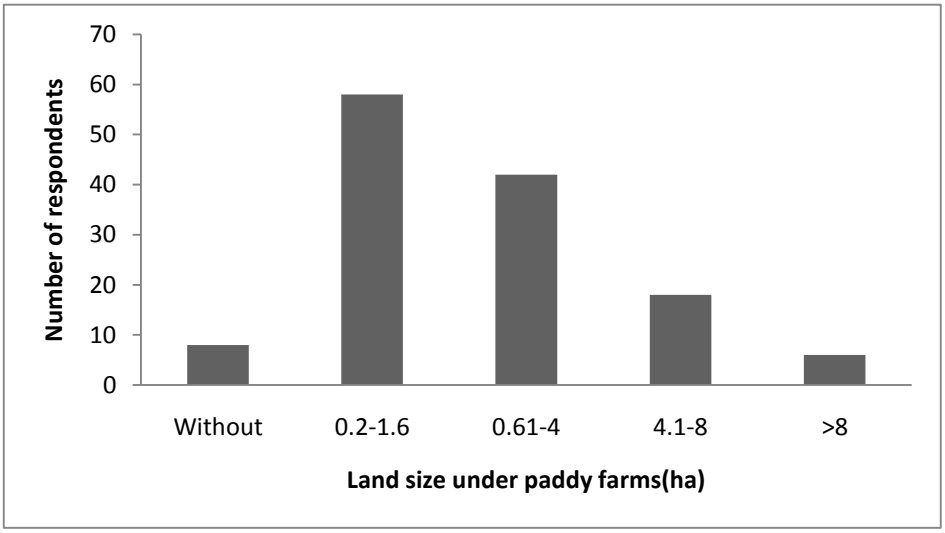

Figure 4: Number of respondents against land size under paddy farms in Kilombero Ramsar Site

According to the current study, sugarcane is only cultivated in Msolwa Station. In this village the once known areas for paddy now under sugarcane production and there is considerable change of the cropping landscape. Sugar cane growing accelerated in year 2001/02 following privatization of Kilombero Sugar Company which required much supply of sugarcane from out-growers. Thus, due to attractive price of sugarcane nearby villages in both Kidatu and Mang'ula Division put considerable land under sugarcane production with most of respondents producing sugarcane under 2 ha as presented in Fig. 5. The study found that for proper managed sugarcane farm produces between 50 - 60 tons/acre while most of farmers manage to produce between 21- 30tons/acre sold at 32 000 per ton depending on sucrose levels (10 being the best and hence good price and 9-8 low levels and hence low price).

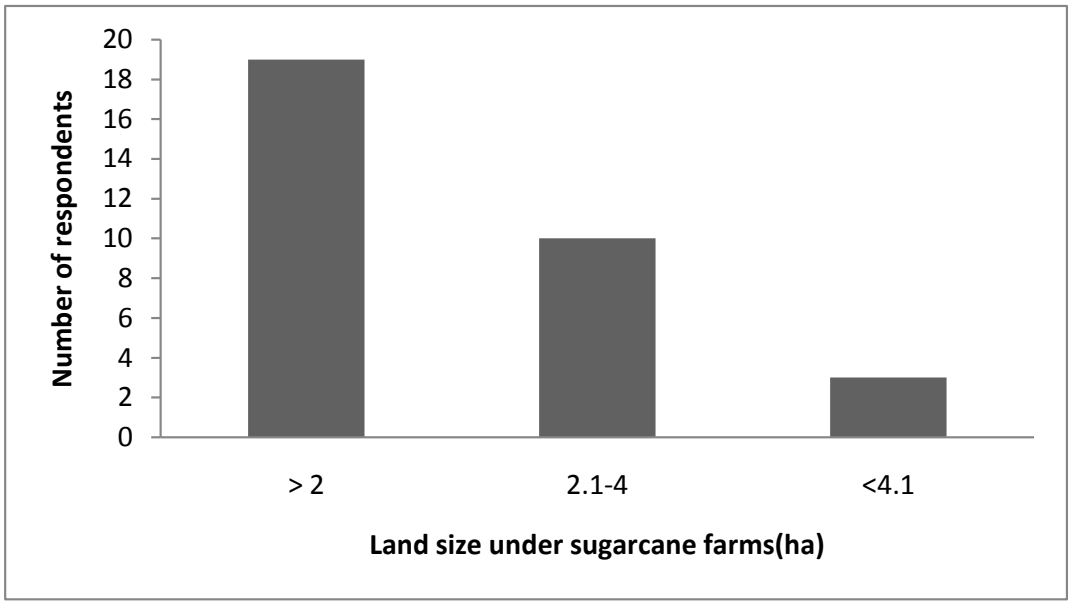

Figure 5: Land partitioning among sugarcane farmers in Kilombero Ramsar site, Tanzania.

Currently, investments in sugarcane are attracted into other villages and divisions within the floodplain. A land bank of about 13 923 ha has been set aside by Kilombero District for investment in Ruipa River Basin, Mofu, Mbingu, Namwawala and Ngalimila.

4.4.6 Livestock keeping in Kilombero Ramsar Site

Pastoral groups mainly Sukuma, Gogo, Barbaig and the Maasai are concentrating in Namwawala and Mofu Villages in western part of the wetland. Current data for Mofu Village shows a total of 7 547 Livestock Units (LU). Since 1 LU needs approximately 2 ha per year, with 7 547 LU, then 14 676.4 ha are required against 4,186 ha which are currently used for grazing. Likewise in Namwawala in Mikochini livestock keepers have organized themselves and formed a ranch with the aim of intergrating the livestock enterprise in the wetlands. The study found that the price for livestock ranged from Tshs 100 000 - Tshs 600 000 per cattle and for milk is from Tshs 200 to Tshs 300 per litre of milk. If proper livestock management interventions were observed, they would have y

reduced negative effects on the wetlands especially on soil degradation/erosion and compaction which may result into reduced water consequent drying. Data from Kilombero District council (Table 3) shows that the value of officially marketed livestock is about Tshs750 000 000 in 2008.

Table 3: Marketed livestock with respective value in Kilombero District, Tanzania

Head	Number	Total value Tshs '000'
Cattle	2 378	594 500
Goats	329	82 250
Pigs	502	7 530
Sheep	1 040	62 400
Total	**4 249**	**746 680**

Source: District Natural Resources Office (2008)

4.4.7 Forestry related activities in Kilombero Ramsar Site

About 90 percent of the households in Kilombero District rely wholly or partly depend on wood fuel (firewood, charcoal and rice husks) for their energy needs. Apart from land clearing for agriculture, there is great exploitation of the forest cover. National and Village natural reserved forests covers an area of 232 915 hectares. About 4 percent of respondents in the study area use forests as source of income, through timber and non timber products. Revenue is also earned at district level by issuing long term harvesting licence, charging fee for firewood and charcoal, sale of confiscated timber and fines. These sources raised an income worthy about Tshs 4 million which was collected in year 2008.

Local people at small scale and institutions do invest in tree planting especially with Teak *(Tectona grandis)* About 11 000 ha have been planted by major institutions of Green Resource Ltd, Kilombero Valley Teak Company, Kilombero Sugar company Ltd and Ifakara Roman catholic. Investment in biofuel production in the wetland, internationally contributes to Kyoto Protocol of Clean Development Mechanism in reducing effect of green house gases. Other interventions such as Reduced Emission from Deforestation and Forest Degradation (REDD) or Payment for Environmental Services (PES), contribute towards this end.

4.4.8 Fishing in Kilombero Flood plain Ramsar site

Fishing activities are mainly carried out in fishing camps along the Kilombero River. Income per fisherman is in a range of Tshs 30 000- 300 000 Tshs per day depending on the season. Some fish species found in the River are "*Kitoga" (Bagrus docmack), "Kambale" (Clarias gariepinus), "Perege" (Oreochromis niloticus), "Njege" (Hydrocynus vittatus), "Ndungu" (Distichodus petersii), "Perege" (Oreochromis ssp)* and *"Bura" (Schilbe moebiussi*)**.** Secondary field data on production for 2008, show a production of about 300 tons worthy about Tshs 334 million. In most of time fishing methods are hooks, traps and nets mainly gills nets. The use of improper techniques has implications on the resilience of wetlands themselves and their allied biological resources like fish. For example, use of *seine* nets in the Kilombero River have led to the over exploitation of big fish, and destruction of riparian areas thus reducing the productive capacity this wetland and impairing its support to local peoples' livelihoods. Other serious issue is the use of poison (e.g Furadan) in fishing which does not only affect biodiversity but also water quality.

4.4.9 Wildlife presence in wetland areas and potential for tourism industry

The Kilombero Valley flood plain supports high biodiversity. Large animals such as Elephant, Buffalo and Hippo, as well as accounting for 75 percent of the world population of Puku antelope. There are possibilities of communicable diseases from cattle to wildlife and change of habitat may impair life of wildlife in the Valley. It is important also to note that the river also supports life in the Selous Game Reserve which also provide habitat for wildlife, crocodiles, hippos, elephants, giraffes and variety of vegetation.Tourism stimulates economic growth by creating employment opportunities, investments and brings in foreign currencies. Habitat destruction poses threat to tourism industry. Noted is loss of habitat through agricultural encroachment and over-grazing by ever increasing number of livestock. This is noted in the period of 2004 - 2007 which marked with indiscrimate tree cutting activities, clearing for settlement and agricultural expansion. Other issue facing welfare of wildlife is Poaching as we were preparing the paper, there was operation clearing of poachers “Kipepeo” going on in Mbuti camp one of fishing camp in the Ramsar site.

There are possibilities of tourism investment in Mofu, Lumemo through sport hunting, sport fishing and bird watching. These are all welcome developments. This calls for planned intervention for resilience and maintenance of the Kilombero wetland ecosystem.

4.4.10 Indirect Wetland Values

Values that are provided by wetland to maintain and protect natural and human systems through services such as water quality and flow, flood control and protection are referred to as indirect values. In recent years, we have seen agricultural production for sugarcane and rice being characterized by machinery, pesticides, herbicides, modified rice and sugarcane varieties, construction of irrigation schemes which divert water from the

wetlands. Frequent floods of Kilombero river and other rivers has become paramount. It is said that recur for every 4th in 10 years. According to respondents, the latest was 2nd- 4th April, 2008 with considerable harvest and residence losses. The loss decreased away from core wetland areas. Though it was difficult for respondents to appreciate the indirect use value such as wetland flood control, pollution control by wetlands, there is need to consider and manage these indirect and non use values for Kilombero wetlands.

4.5 Discussion

As more people move into this Ramsar Site for business, agriculture, fishing and livestock ventures, wetland resources will be increasingly extracted and required. It is worth noting that residential settlement areas in these villages do not exceed 2 percent of the total village land e.g, out of 28 242 ha of Mofu village, 582 ha are used for settlements against 654 ha planned for settlement due to increase in households number (VLUP, 2008). This figure shows that currently, the areas used for settlement is not enough to accommodate existing households. Meaning expansion not only for settlements but to other income related activities such as farming, livestock keeping, tree planting related planting activities, fishing activities which will have effect on existing natural vegetation and associated biodiversity. The wise use of wetland is to maintain ecological character, by implanting of ecosystem approached within the context of sustainable development. If not followed, this signals the source of resource use conflict in future given the population increase estimate for Kilombero district which of 3 percent per annum and the increased land investment both from foreign companies and local people (Kilombero District Profile, 2008). The trend is not only for Mofu but also to the other 108 Villages in the Ramsar Site (Table 1). Privatizations of Kilombero Sugar Processing company to foreign affiliated monopoly company Illovo, marked the increase in production of sugar form 29 000 tons to 140 000 tons per year, increased local work force in full paid salaries to 6 000,

this is positive development led to job creation, further-more increased out-growers production from 103 000tons/year up to 535 000 tons/year for the 2004/5 growing season. There has been also tremendous increase in tax paid to government up to 30 billion Tshs/year. This is a positive economic growth indicator for the country. Furthermore, presence of investors in Kilombero has provided social services to surrounding communities in terms of health care clinics, schools a manifestation of improved access to quality education, medical services and mobility. However intensified sugar production activities, contribute to other ecological blemishes on wetlands in terms of reduced water quality and quantity.

4.6 Conclusion and Recommendation

The paper has described settlement pattern around wetlands and their influence on local income, investment, biodiversity and other related values. This forms a part of a long term study of the interaction of these factors among others. Unplanned settlement pattern can hinder services provided by wetlands both use and non-use values. Although the unit of analysis is Kilombero Ramsar Site, it is reasonable to infer that this is also likely to occur in similar wetlands. Despite the potential of the Kilombero wetlands areas to alleviate poverty, most of residents are still poor even by local standards. Current investments in the areas seem to be poised for accelerating further alienation of the inhabitants notably the low income groups.

Use of integrated land use plans is recommended in order to accommodate different interests and reduce land use conflicts while sustaining ecological integrity of the Kilombero Wetlands Ramsar site. The development of land use plans to cater for different land use like mixed farming, scattered farming, grazing land, game reserve, forest reserve,

large scale farming, open spaces and national park is important for sustainable use of wetlands.

To this end, efforts are underway in which 10 out of 108 villages in Ramsar site have been facilitated to develop land use plans. An increase in that direction is a must commitment expected from local and international development leadership. To this end development leadership need among other commitment promote of integrated wetland watershed management programmes through active participation of local people as a key to prevent manifestations of ecological imbalance such as floods and pollution. However this needs to be decided based on economic valuation of wetland values in order to allow policy makers to have a basis for deciding on wetland sustainable management interventions.

Opportunities for sustainable wetland management do exist in Tanzania. Foremost, is the ratification to the Ramsar Convention. By ratifying the convention the country demonstrates it commitment towards sustainable wetland management through wise use, which calls for active participation of local communities in management issues through awareness creation and developing land use plans. This can contribute to maintenance of natural properties of ecosystem for present and future generations. Again, at policy level, the country has initiated inclusion of wetland issues in resource management policies which is a positive move.

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CHAPTER FIVE

5.0 POTENTIAL CLIMATE CHANGE IMPACTS ON DIRECT ECONOMIC VALUES FROM WILDLIFE IN THE IN THE KILOMBERO FLOODPLAINS RAMSAR SITE, TANZANIA

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5.1 Abstract

Tanzania is one of the globally recognized leading nations in wildlife conservation, with rich and diverse wildlife resources. Game controlled areas in Tanzania are used for wildlife conservation and most of them were set aside when human populations were low and global climate was stable. Under Climate change scenario realized for Tanzania by the next decades a 10% increase in annual inflow is predicted in Kilombero Ramsar site. This may have varied impacts on the wildlife populations with consequences on the potential direct economic values from wildlife hunting. The current study assessed how rainfall may influence wildlife populations and their contribution to national economy. Data were collected from discussions with Game officials, literature searches, field observation and use recorded data for weather and hunting licences. We established rainfall pattern based on 40 years (1968 - 2008), and its correlation with wildlife outtake by both tourist and local hunters. The mean annual rainfall was 1600 mm with a probability of 0.90 of receiving ($100 \leq 300$) of the mean annual rainfall especially for March and April point rainfall. Increased inflow of water is likely to be exacerbated by inflow from surrounding catchments. There were a total of 258 and 78 local and tourist hunters respectively in the period 2001 - 2008. There was a positive correlation between the number of animals hunted per species and point annual rainfall for Buffalos, Reedbuck, Hippos, Puku, Warthog, Crocodiles and Hartebeest. Conversely, the availability of game birds declined with increased point rainfall. This would mean that revenues from Buffalo Reedbuck, Hippos, Puku, Warthog, Crocodiles and Hartebeest is likely increase or remain the same with increasing point annual rainfall. On the other hand, hunting revenues from game birds is likely decrease with point annual rainfall. The predicted hydrological change in Kilombero River is likely to affect wildlife populations and the contribution of hunting industry to national earnings. Thus climate adaptation measures need to be instituted in order to accommodate climate induced economic loses.

Keywords: Climate change, direct wildlife economic value, Ramsar site, ecological change

5.2 Introduction

The history of wildlife conservation in the country dates back to late 1890s when laws controlling hunting were enacted during German rule which focused on off-take, hunting methods and the trade. Management also continued under the British rule in 1920s through establishment of Game Controlled Areas in 1946 which opened way to tourist hunting industry (URT, 1998). The present Wildlife framework in Protected Areas (PA) covers 28% of 945,000 km^2 of the land surface. Currently, the Framework of PAs comprises of 12 National Parks (4%), 31 Game Reserves (15%), Ngorogoro Conservation Area (1%) and 38 Game Controlled Areas (8%). The revised Wildlife Policy (2007) has led to establishment of new category of PAs known as Wetlands and Wetland Reserves (Tarimo, 2009). Wildlife utilization industry is currently practiced through this network of PAs devoted to wildlife conservation. Game viewing, tourist hunting, resident hunting and ranching and farming are practiced.

Consumptive utilization of wildlife is the policy adopted by the country, with exception of five years in the period (1973-1978) when hunting was banned. When the ban was lifted, the Tanzania Wildlife Company (TAWICO) was the authority allocating quotas and hunting blocks until 1984 when economic liberalization was introduced and the power to allocate hunting blocks and determine quotas vested todate to the Director of Wildlife who is the Secretary to the Hunting Block Allocation Advisory Board to the Minister for Natural Resources and Tourism (Wildlife Act No. 5, 2009). Hunting is practiced by both traditional and tourist hunters in Game Reserves, Special open areas and in Game

Controlled Areas which are subdivided into hunting blocks where professional hunters and their clients may hunt trophy animals.

Country earnings from game hunting were USD 48 million for the period of 2004 - 2007 (Mande, 2009). Some 1 654 game hunting tourists in 2004, made the Government earn USD 9 million, and by 2007, annual earnings increased to USD 15 million and the number of game hunting tourists increased to 3 233. Also, the number of hunting firms operating in the country increased from 21 in 1988 to 54 in 2008, while hunting blocks increased from 128 in 1988 to 158 in 2008. A total of 158 hunting blocks in 42 districts allocated to 54 licensed hunting companies. Fees and other charges are as stipulated in the Tanzania Tourist Hunting Regulations 2003 and the New 2008 schedule of trophy fees. Since 1994, there is a consensus agreement between the Director of Wildlife and the Tanzania Hunting Operators Association (TAHOA) on procedures for allocating hunting blocks. This is further consolidated in the 2009 Wildlife Act No. 5, implying increased hunting activities countrywide.

Tanzania's great reservoir of wildlife and biological diversity is facing management challenges as a result of ecosystem fragmentation, over utilization of resources and conflicts between agriculture and wildlife. Persistent drought due to increase in temperature and unreliable rainfall pattern in the country is expected to affect the behavior of most of the migratory wild species, in particular the wildebeest and some bird species (NAPA, 2007). Wildlife life is supported by different niches and conditions which depend on a combination of climatic factors (Holmes, 1995). These include duration of intensity of sunlight, temperature range, rainfall humidity and winds. As for Tanzania flora, rainfall is the most important factor considering both total annual rainfall and respective monthly distributions. Habitat fragmentation has been linked to human population and their

anthropogenic activities, resource overexploitation, climate change and invasive species. Habitat destruction can also be linked to pollution, fragmentation and degradation making it difficult for plants, animals and other organisms to survive (Scholes and Biggs, 2004). The study by WRI (2000) indicated that more than 50% of wildlife habitats in old tropical countries suffer from habitat alterations. In Tanzania, PAs covers about 28% of land surface and these suffer from encroachment and other activities experience from elsewhere in the US, reveal that the effect of global climate change is seen through alpine plants to be growing at higher altitudes on mountains and migrating birds spending longer time in their summer breeding grounds (Walther *et al*., 2002).

Wetland ecosystems among other attributes are rich in wildlife biodiversity. At global level, efforts to conserve them is through the Ramsar Convention of 1971 which calls for wise use of all wetlands through local, regional and national actions and international cooperation. The government of Tanzania ratified to Ramsar Convention in 2000 and Wildlife Division in the Ministry of Natural Resources and Tourism (MNRT) has a facilitating role in implementing the Ramsar convention on wise use of wetlands (Tarimo, 2009). The country is endowed with exceptional wetland resources ranging from lake systems, river floodplains and deltaic mangrove formations that cover about 10% of 945,000 km^2 of the land surface. Currently, four sites have been designated and cover about five million ha, of which Kilombero Ramsar Site covers about one million ha. The wetland is the largest inland fresh water wetland in low altitude (200 – 400 m a.s.l.) and has a wide variety of wetland habitat types and high concentrations of mammals which include Puku (75% of the world wetland dependent populations), Buffalo, Hippo, Elephant, three endemic birds species, fish (including two endemic species *Citharinus congicus* and *Alestes stuhlmanni*) (Ramsar, 2008) (http://ramsar.org/sitelist.pdf). Sustainable management of these resources depends among other factors understanding

their economic values consisting of both use and non-use values which are being ignored in most valuation studies (de Groot *et al*., 2006; Schuyt, 2005).

The report by IPCC 2001, indicates that there will be increase in global temperature by additional of 1.4^0C to 5.8^0 C by 2100 and rainfall will continue to increase but vary with region, with some regions showing decreasing rainfall. IPCC 2001 further reports increase in extreme weather events such as hurricanes, flooding and drought associated with warming. Climate change poses major risks to ecosystems including wetlands and their services, which may result into their decline with multiplier effects on wildlife populations. Climate predictions in Tanzania (TMA, 2005), show that the mean daily temperature will rise by 3^0C – 5^0C throughout the country and the mean annual temperature by 2^0C – 4^0C. There will also be an increase in rainfall in some parts while other parts will experience decreased rainfall. Predictions further show that areas with bimodal rainfall pattern will experience increased rainfall of 5% – 45% and those with unimodal rainfall pattern will experience decreased rainfall of 5% – 15%. The initial National Communication (INC) shows that rainfall pattern and soil moisture will vary due to changes in mean temperature hence affecting the runoff of major rivers. The report indicates that changes in precipitation, both increases and decreases, are likely. This will have implication on the frequency and intensity of weather events, such as storms and floods. For instance the increase in temperature between 1.8^0C – to 3.6^0C in the catchments areas of River Pangani in the North and North East of the country, hence decrease in rainfall, will lead to a decrease of 6-9% of the annual flow of the river. The Rufiji River, which houses Mtera and Kidatu Hydropower Stations, is expected to experience an increase in river flow by 5 - 11% due to low temperature fluctuation of between 3.3^0C to 4.6^0C and hence increase in rainfall and floods.

This study was carried out to establish patterns of rainfall in the Kilombero Ramsar site, and provides knowledge on its influences on wildlife populations and possible impacts on the revenues derived from wildlife hunting. This eventually provides a picture on climate related economic trend variations with changing climate patterns especially rainfall to overall national economy.

5.3 Materials and Methods

5.3.1 Study area

The Kilombero Valley inland floodplain Ramsar Site in Morogoro Region, Tanzania covers 796 735 ha, approximately 260 km long, and 52 km wide, with a catchment area of about 40 000 km^2. The Central point coordinates are 8 °40' S and 36 °10' E. The Floodplain lies between 210 and 400 m a.s.l. The Valley is divided by the Kilombero River and falls within two administrative districts of Kilombero and Ulanga. North Kilombero Game Controlled Area is found in Kilombero District. The District is situated in vast floodplains between Kilombero River in the South–East and the Udzungwa Mountains in the North-West. Considerable proportion of the districts falls within the declared Ramsar Site. Generally, the District has high temperatures (hot weather conditions) and has bimodal rainfall patterns. Short rains begin towards the end of November and ends in January or February. Long rains usually start in March and ends in May or June. The average temperature in the District ranges from 26ºC to 32ºC. The average rainfall ranges from 1 200 to 1 600 mm. Kilombero experiences seasonal flooding which causes some parts of the district to be inaccessible during the long rain season.

Kilombero Game Controlled Areas is divided into two blocks. The north block is in Kilombero district while the south block is in Ulanga District. The study was done on the Northern block which is sub-divided into two hunting blocks of Kilombero North Mlimba

and Kilombero north Mngeta. Plans are underway to further subdivide existing hunting blocks and establish new one at the confluence of Mnyera and Ruhudji Rivers (Kilombero District Profile, 2009). Human population (2005) is estimated at 400 000 with an annual population increase of about 3%.

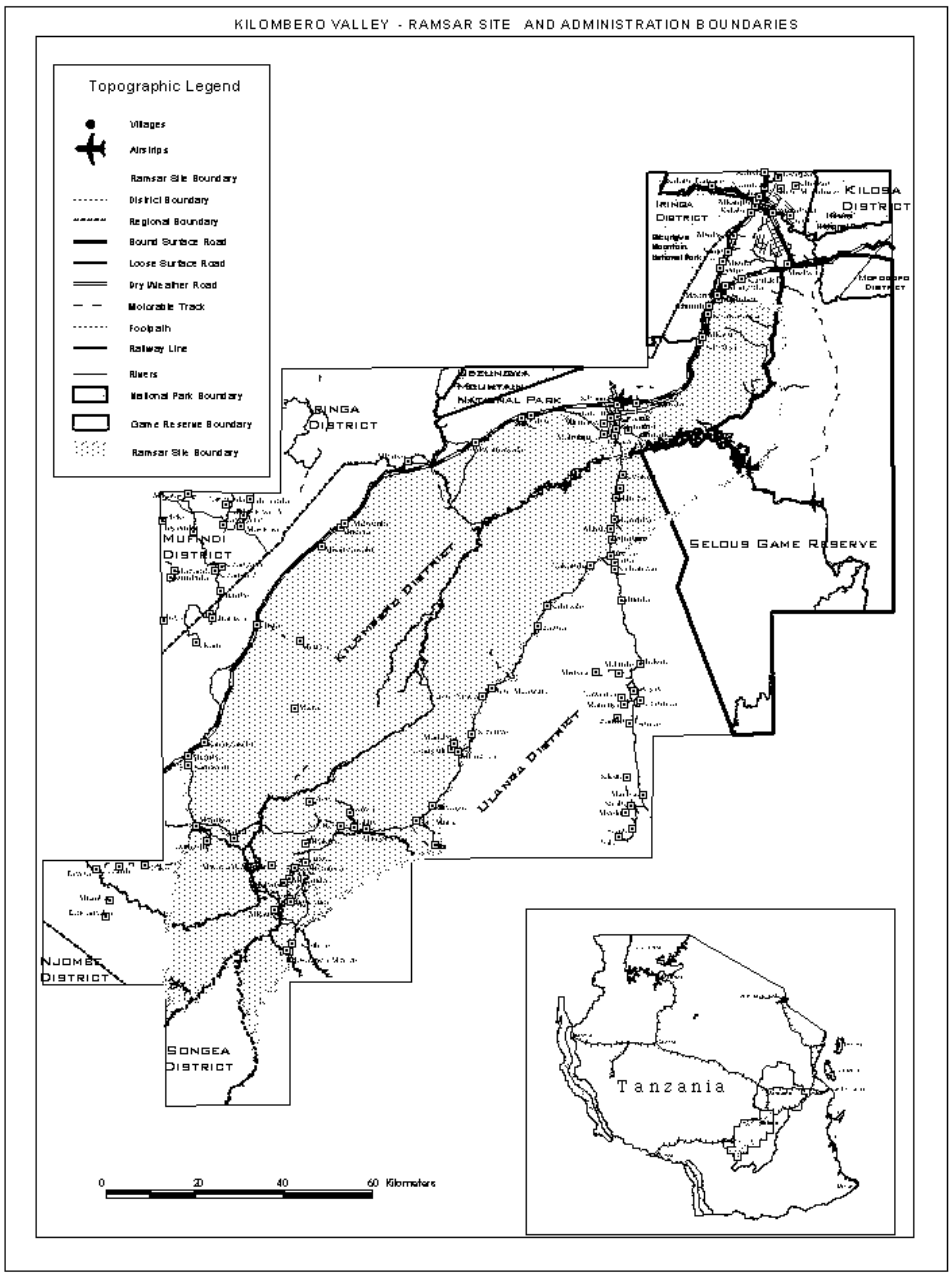

Figure 1: Map showing Kilombero Valley Ramsar Site, Morogoro Region, Tanzania.

Figure 2: Map showing North Kilombero Hunting blocks, Morogoro Region, Tanzania.

5.3.2 Data Collection and analysis

The study involved a range of data collection methods. Data were collected from discussions with Game officials, which were analyzed using qualitative methods, literature searches, field observations and use of recorded data for weather and hunting licenses. Climatic weather data was obtained from TMA for local weather station. Data on wildlife outtake was obtained from Kilombero Game Office archives.

We established rainfall pattern based on 40 years mean monthly and mean annual time series data (1968-2008), and their corresponding deviations. The probability of having the computed mean annual rainfall was calculated based on the following equations (Alder and Roessler 1972).

$$z = (x - m)/ s \quad \text{(1)}$$

Where:

Z = area under a normal frequency curve which corresponding to a certain probability

x = mean annual rainfall

m = selected amount of rainfall deviations which the probability calculation assesses (in our case the deviation of 100 and 300)

s = the standard deviation

The probability of proportional of years receiving a certain amount was computed using binomial frequency $(p+q)^n$ ..... (2)

Where:

P = the general probability of the selected amount of rainfall as assessed from the normal distribution

Q = the probability of not receiving the mean annual rainfall (1-p)

N = number of years

Relationship between the series of annual wildlife outtake and annual rainfall (mm) was analyzed using regression analysis to detect parameters trends. Computations of direct wildlife economic values were based on hunting related revenues which include hunting licences fees, game fees, block fees, permit fee, Professional Hunter (PH) examinations fee, PH license fee and trophy handling fees as provided by the Tanzania Hunting Schedule, 2003.

5.4 Results

We present rainfall pattern, its prediction, wildlife outtake by both local and tourist hunters, the trend between total annual rainfall and wildlife outtakes and direct economic value derived from wildlife hunting as well as possible impacts on wildlife populations and earnings as a result of climate change.

5.4.1 Rainfall Pattern and probability

A Bimodal rainfall pattern was observed with average annual rainfall of 1617 mm. The highest total annual rainfall recorded over the period was 2388 mm in 1989 while the lowest was 942 mm recorded in 2003. On average April was the wettest month with average monthly rainfall of 413 mm. On the other hand the driest month was September with average monthly rainfall of 4mm (Table 1).

Table 1: Average monthly and mean annual rainfall for North Kilombero in Kilombero Ramsar site, Morogoro, Tanzania (1968-2008)

Years	Average monthly rainfall (mm)	Standard Deviation
January	210	106
Feb	211	117
March	363	145
April	413	160
May	121	82
June	17	16
July	7	14
August	14	18
Sept	4	6
Oct	7	7
Nov	61	50
Dec	189	129
	Mean 1617	**393**

The probability of receiving a calculated mean rainfall was 0.90. This suggests a stable rainfall distribution for Ifakara and correspondingly weather predictions. An extension of such prediction using bimodal distribution is correspondingly academic as p is almost one unit thus making the q value close to zero.

5.4.2 Wildlife hunting licenses and outtakes in North Kilombero hunting block

Respective hunting licenses and outtakes both for resident and tourist hunters are presented in order to indicate economic contribution of these two groups of hunters. A total of 258 hunting licenses were issued to local hunters and a total of 873 off takes. Respective off takes and species are presented in Table 2. Big game like Buffalo (*Syncerus caffer*), Hartebeest (*Alcelaphus buselaphus*), Eland (*Taurotragus oryx*), Reedbuck (*Redunca* spp) and Game birds like Guinea fowls (*Numida*), Egyptians and Spurwing Geese (*Alopochen and Plectropterus*), Francolins and Pigeons were hunted.

Table 2: Wildlife outtakes by local hunters in North Kilombero hunting block.

Year	Hunting licenses	Buffalo	Hartebeest	Eland	Reedbuck	Warthog	Bushbuck	Guinea fowl	Geese	Francolins	Pigeons	Dikdiki	Duiker	Impala	Total
2001	45	39	15	1	18	7	4	16	12	1	0				113
2002	21	20	2	0	2	0	2	2						1	29
2003	33	30	14	0	5	0	0	6	24						79
2004	28	17	7	1	10	1	3	24	20	14	3				100
2005	47	47	10	2	11	3	1	36	32	12					154
2006	38	22	14	2	11	0	1	40	50	5					145
2007	22	16	7	6	7	4	2	45	30	35	40		9	2	203
2008	24	17	7	0	7	2	0	10	5	0	0	4	0	1	53
Total	**258**	**208**	**76**	**12**	**71**	**17**	**13**	**179**	**173**	**67**	**43**	**4**	**9**	**4**	**873**

A total of 78 hunting licences were issued to tourist hunters with a total outtake of 289 (Table 3). Leading game animals were Buffalos, Puku, Warthog, Hartebeest and Crocodiles.

Table 3: Wildlife outtakes by tourist hunters in North Kilombero Hunting block

Year	P.H	Buffalos	Lions	Sable Antelope	Eland	Hartebeest	Hippopotamus	Leopard	Puku	Reedbuck	Waterbuck	Baboon	Bushbuck	Bush pig	Crocodile	Duiker	Hyena spotted	Warthog	Total
2006	23	43	2	5	2	7	5	0	19	5	4	2	0	0	6	1	1	8	110
2007	26	31	2	4	1	7	2	3	8	3	4	0	1	0	4	0	1	6	77
2008	29	49	3	3	1	4	5	0	10	1	5	0	3	2	7	1	2	6	102
Total	78	123	7	12	4	18	12	3	37	9	13	2	4	2	17	2	4	20	289

Relationship between total annual rainfall and wildlife outtakes was done by combining leading wildlife outtakes for both local and tourist hunters (Table 4).

Table 4: Influence of total annual rainfall on wildlife outtake

Year	Total annual Rainfall (mm)	Buffalo	Guinea fowls	Geese	Hartebeest	Reedbuck	Puku	Crocodile	Warthog	Hippo
2001	1427	39	16	12	15	18				
2002	1728	20	2	0	2	2				
2003	942	30	6	24	14	5				
2004	1449	17	24	20	7	10				
2005	1077	47	36	32	10	11				
2006							10	7	6	5
	1621	71	40	50	18	12				
2007	1655	47	45	30	14	10	8	4	6	2
2008	1643	60	10	5	14	12	19	6	8	5

The number of animals hunted per species was positively correlated with annual rainfall for Buffalos (Fig. 3), Reedbuck (Fig.4), Hartebeest (Fig.5), Hippos (Fig.6), Crocodile (Fig. 7), Puku (Fig. 8), Warthog (Fig. 9). Respective outtakes were magnified to facilitate interpretations. Magnification factors are presented in respective figures (Appendix 1) conversely, the availability of Geese (Fig.10) and Guinea fowls (Fig. 11) declined with annual rainfall above average rainfall (Appendix 1).

5.4.3 Direct Economic Value of Wildlife

Calculations on the direct economic values are as presented in Table 5. Fees are as stipulated in the Government hunting schedule of 2003. Different tables for local and tourist hunters are presented. This is because local and tourist hunters pay different fees. In terms of revenues, a total of USD 13 000 was earned from local hunters. Buffalo hunting earned a total of about USD 9 000 in big game and in terms of game birds, Goose hunting earned a total of about USD 363. Respective income from other wildlife is as indicated in Table 5.

Table 5: Direct economic Value of wildlife as earned from Residentl hunters in the North Kilombero Hunting Block, Morogoro, Tanzania.

Year	Hunting licenses	Buffalo	Hartebeest	Eland	Reedbuck	Warthog	Bushbuck	Guinea fowl	Geese	Francolins	Pigeons	Dikdiki	Duiker	Impala	Total outtake annual
2001	45	39	15	1	18	7	4	16	12	1	-				113
2002	21	20	2	-	2	-	2	2	-	-				1	29
2003	33	30	14	-	5	-	-	6	24	-					79
2004	28	17	7	1	10	1	3	24	20	14	3				100
2005	47	47	10	2	11	3	1	36	32	12					154
2006	38	22	14	2	11	-	1	40	50	5					145
2007	22	16	7	6	7	4	2	45	30	35	40		9	2	203
2008	24	17	7	0	7	2	-	10	5	-	-	4	-	1	53
Total outtake	258	208	76	12	71	17	13	179	173	67	43	4	9	4	873
Fee USD/animal		42	21	70		10.5	8.4	6.3	2.1	1	1	3.1	4.2	14.1	
Total Income (USD)		8 736	1596	840		178.5	109.2	1128	363.3	67	43	12.4	37.8	56.4	13 167.6

Wildlife economic value in the study period fetched to USD 245 600. With highest income earned from Buffalo USD (92 250), Lion, crocodile, Hippopotami and Puku hunting respective income per hunted category is as indicated in Table 6.

5.5 Discussion

Rainfall probability indicates a more stable pattern in the Kilombero Ramsar Site. This stable rainfall finding is in close agreement with findings of Nshubemuki *et al*. 1978 (1931-1973), except for increased amount of rainfall in the month of April. A variety of atmospheric pressure and winds in Tanzania are mostly represented by months of January, April, July and October (Jackson, 1971, 1972) as cited by Nshubemuki *et al.*, 1978. It is evident that a much wetter scenario is building up in the Kilombero Ramsar Site, especially if one considers the surrounding catchments causing 10% increased inflows as predicted (TMA, 2005). According to Mitsch and Gasselink (1993), hydrology change of water stored within the wetland constitutes of rainfall falling direct in the wetland (P) and ground water (Qin) minus evaporation (E) from wetland surface area water minus evaporation from wetland surface area and outflow from wetlands (Qout). The equation on the change in water stored within the wetland is summarized as $\Delta S = P + Q_{in} - E - Q_{out}$.The stored water constitutes the ecology and consequential wetland biodiversity. In another study by Kashaingili, *et al*. (2005) in Usangu, it was indicated that a flow of $0.5 m^3/s$ is required to maintain habitat and ecology of Ruaha National Park taking into account other anthropogenic activities taking place in the wetland. Thus inflows tend to counter productive.

Table 6: Direct economic Value of wildlife as earned from Tourist hunters in the North Kilombero Hunting Block.

P.H		Buffalos	Lions	Sable Antelope	Eland	Hartebeest	Hippopotamus	Leopard	Puku	Reedbuck	Waterbuck	Baboon	Bushbuck	Bush pig	Crocodile	Duiker	Hyena spotted	Warthog	Total
23	43	2	5	2	7	5	0	19	5	4	2	0	0	6	1	1	8	110	
26	31	2	4	1	7	2	3	8	3	4	0	1	0	4	0	1	6	77	
29	49	3	3	1	4	5	0	10	1	5	0	3	2	7	1	2	6	102	
78	123	7	12	4	18	12	3	37	9	13	2	4	2	17	2	4	20	289	
Fees in USD 450	750	2 500	1 500	1 050	465	1 050	2 500	275	350	550	110	425	240	1 050	220	230	400		
Total 35100	9 2250	1 7500	1 8000	4 200	8 370	12 600	7 500	1 0175	3 150	7 150	220	1 700	480	17 850	440	920	8 000	245 605	

Noted in this regard is a bad climatic condition in 1997, in which a hunting company Wengert Windrose of Arusha could not meet required 40% utilization rate as required in 3 out of 5 hunting blocks (Rugemeleza, 1999). Predicted increased inflow in the wetland may result into destructive flooding. Others, Jones *et al*. (1997) observed climate change as among factors altering distribution of wildlife and habitat coupled with expanding settlements and agriculture in Kilombero District. With respect to Wildlife outtake and potential contribution to the Government Economy, holding all other factors constant (which is not the case in the actual situation), there may be variations that may reduce wildlife populations and overall wildlife hunting industry. A total of earning of about USD 260 000 was recorded with average annual earnings of USD 1 600 from local hunters and average annual earnings of USD 82 000 from tourist hunters. The predicted trend for number of animals hunted per species is positively correlated with point annual rainfall for Buffalos, Reedbuck, Hartebeest, Hippos, Puku, Warthog and Crocodiles. While the availability of Geese and Guinea fowls are predicted to decline with point annual rainfall above average rainfall. This would mean that revenues from Buffalo Reedbuck, Hippos, Puku, Warthog, Crocodile and Hartebeest is likely increase or remain the same with increasing point rainfall. On the other hand hunting revenues from Geese and Guinea fowl is likely to decrease with increased point rainfall. The other scenario, with the predicted increase in river inflow of 10% within the Kilombero River under the scenarios of climate change in Tanzania, earnings from wildlife in Tanzania is likely to be affected through change in habitat ranges and niches of wildlife. Ranging from open grasslands (wildbeest), to tall grass and open woodland (Hartebeest), and wet niches (Waterbucks and Buffaloes). It is instructive that flooding will selectively favor certain species at the expense of others (Primark, 2006; Holmes, 1995).

5.6 Conclusions

Different wildlife populations adapt differently to environmental changes. In the light of hydrological change in Kilombero River (10%) increase of inflow from surrounding catchments may affect wildlife populations. Kilombero Ramsar Site covers about 20 percent of 5 million hectars of wetlands declared as Ramsar sites in Tanzania. It is the largest inland fresh water wetland in low altitude (200 – 400 m.a.s.l) and has a wide variety of wetland habitat types and high concentrations of mammals. The wetland is the largest inland fresh water wetland in low altitude (200 – 400 ma.s.l) Conservation and active utilization are the basic tenents based on presence of high concentrations of mammals which include Puku (75 percent of the world wetland dependent populations), Buffalo, Hippo, Elephant, three endemic birds species, fish (including two endemic species *Citharinus congicus* and *Alestes stuhlmanni*) (Ramsar, 2008). Active utilization is shown by parcelling the area into hunting blocks and they represent Protected Areas in the country whereby tourist hunters annually make available some USD 82,000 and resident hunters some USD 1,600 as the Government revenues. Thus, its contribution to national economy is significant.

Rainfall has a stable pattern. However, given the predicted 10 percent hydrological change, couples by increase of inflow from surrounding catchments and results of this study, it is evident that increased rainfall and inflow will affect habitat s and dependent wildlife as we have observed giving example of Buffaloes and Geese availability with changing rainfall pattern.(Fig. 3 and Fig. 10). Lessons learnt from Kilombero Ramsar site can be applied to other Protected Areas in Tanzania and elsewhere. Thus, climate adaptation measures supported from internal and international community to maintain ecosystem balances and address sectors vulnerability need to be instituted in Kilombero as well as other Protected Areas so that Wildlife sector through wildlife hunting continues to contribute to national economy.

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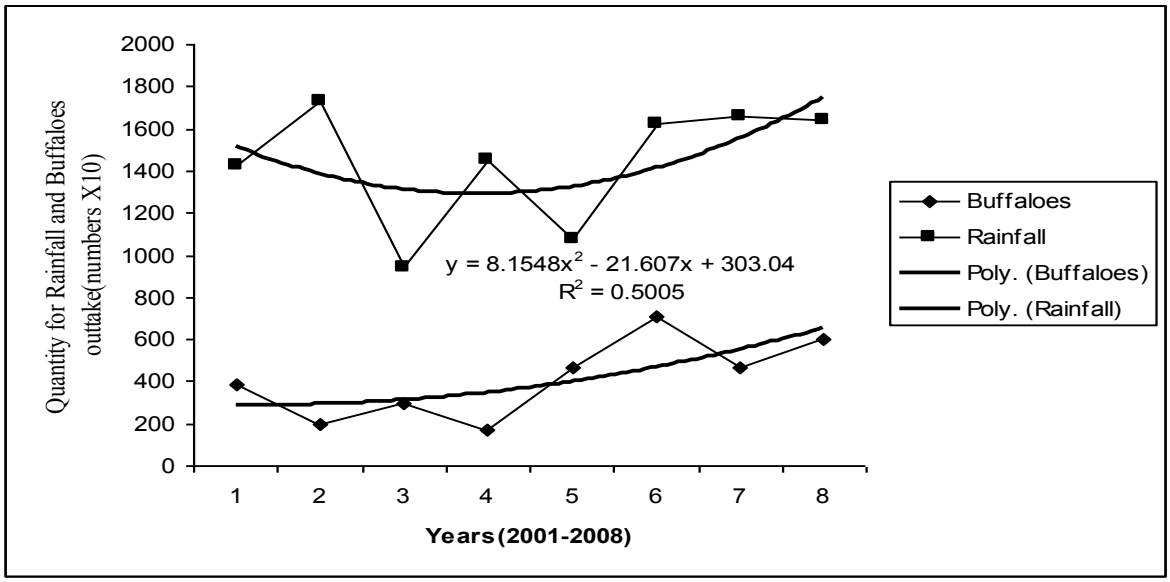

Figure 1: Graphical Presentations of Relationship between annual rainfall and wildlife outtake in North Kilombero Game Controlled Area, Morogoro, Tanzania.

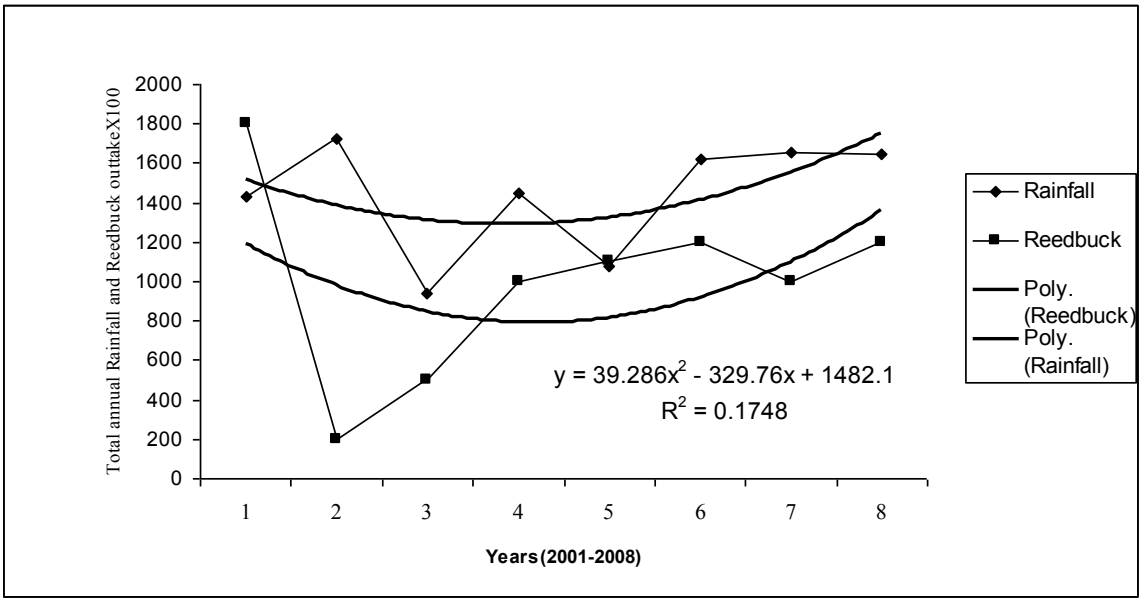

Figure 2: Relationship between total annual Rainfall and Buffaloes outtake in North Kilombero Game Controlled Area, Morogoro, Tanzania.

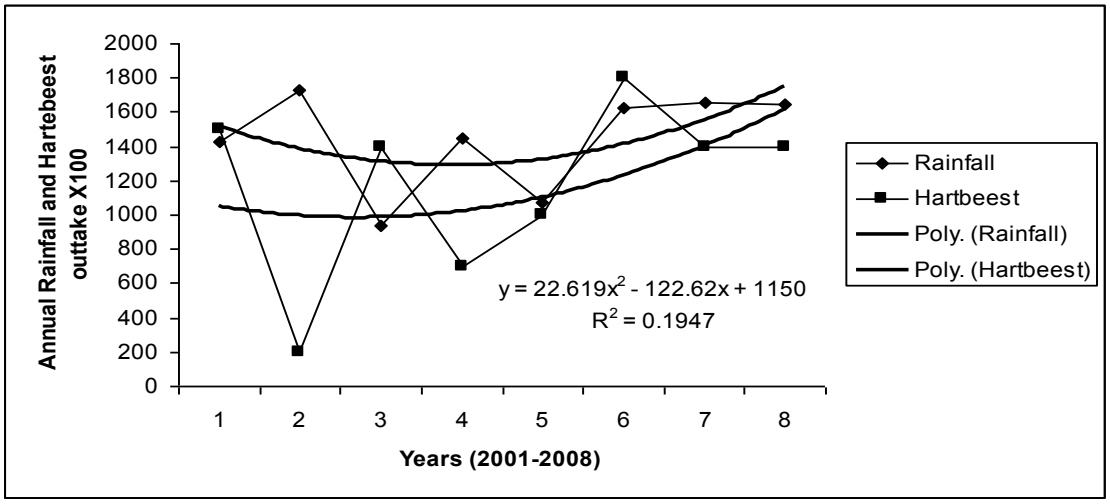

Figure 3: Relationship between total annual Rainfall and Reedbuck outtake in North Kilombero Game Controlled Area, Morogoro, Tanzania.

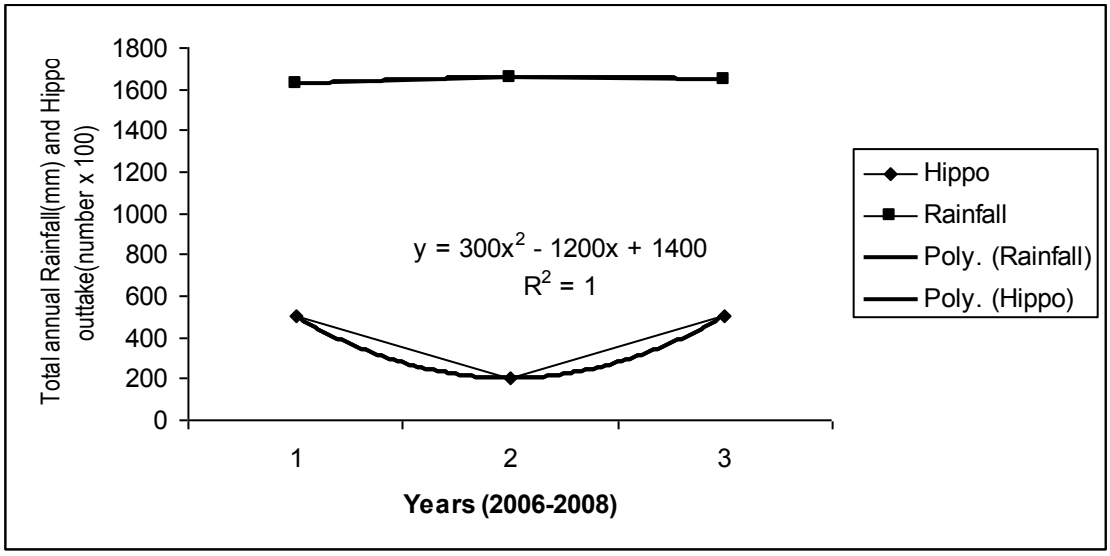

Figure 4: Relationship between total annual Rainfall and Hartebeest outtake in North Kilombero Game Controlled Area, Morogoro, Tanzania.

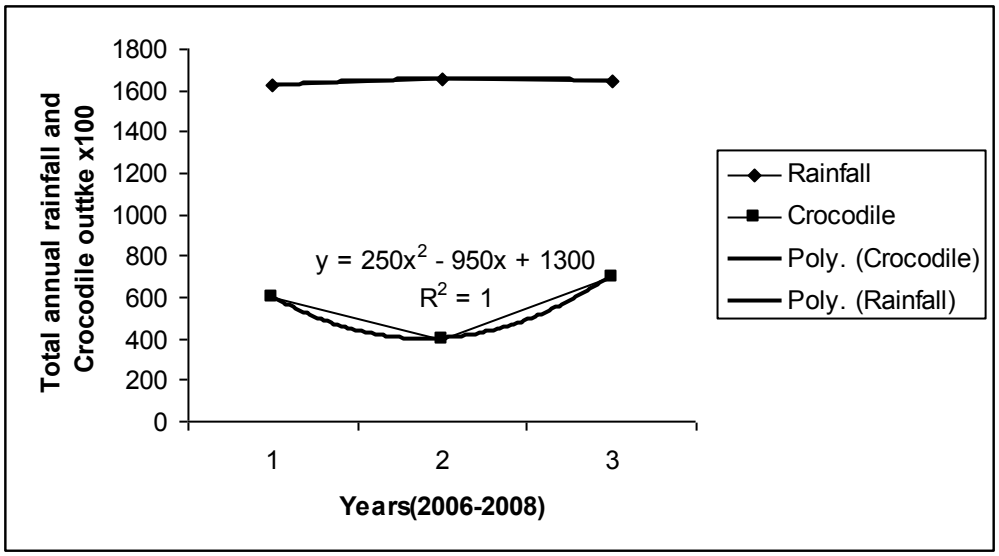

Figure 5: Relationship between total annual Rainfall and Hippo outtake in North Kilombero Game Controlled Area, Morogoro, Tanzania.

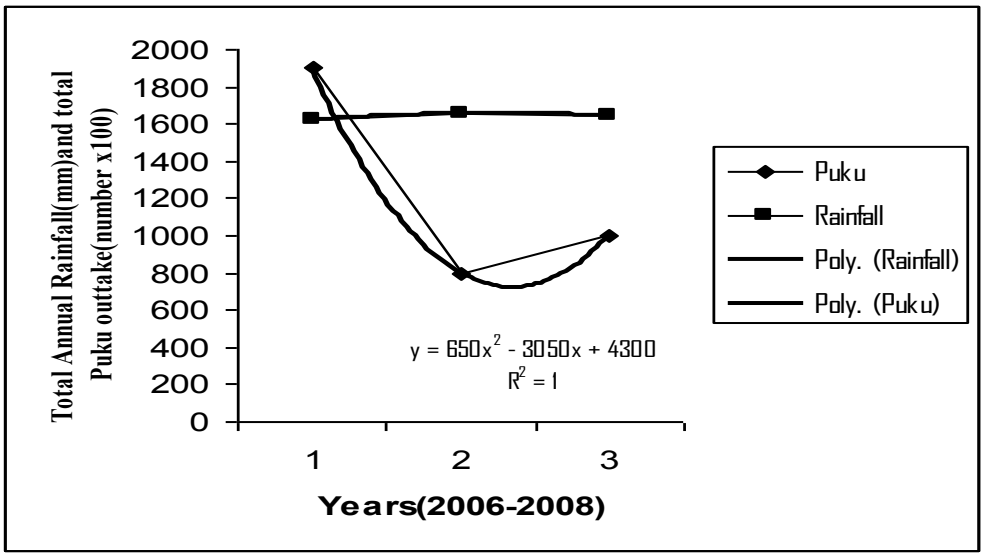

Figure 6: Relationship between total annual Rainfall and Crocodile outtake in North Kilombero Game Controlled Area, Morogoro, Tanzania.

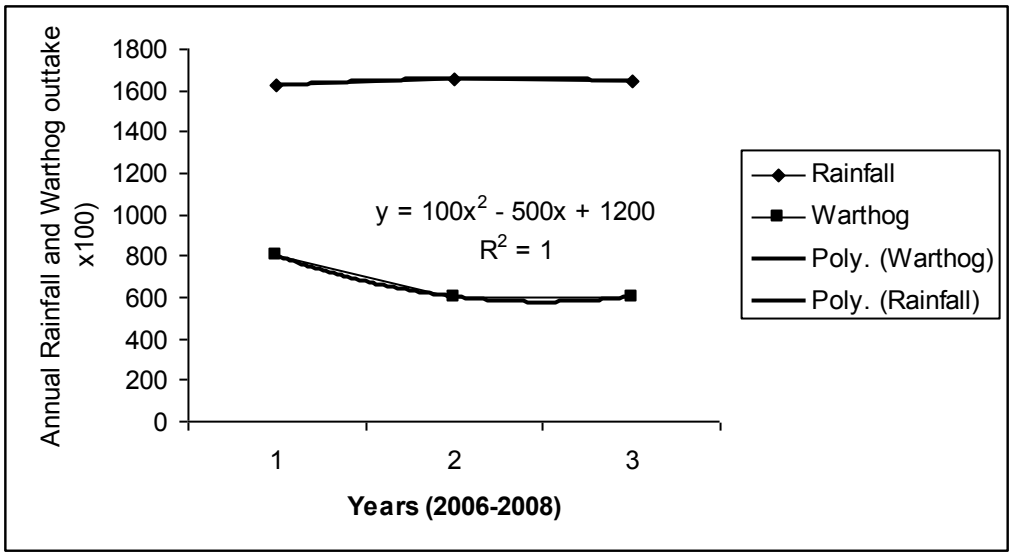

Figure 7: Relationship between total annual Rainfall and Puku outtake in North Kilombero Game Controlled Area, Morogoro, Tanzania.

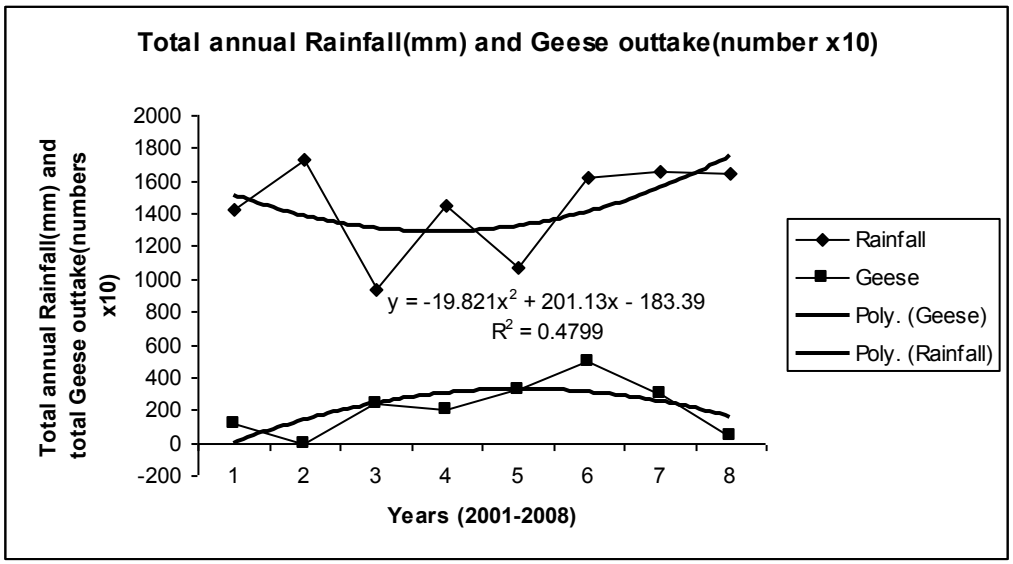

Figure 8: Relationship between total annual Rainfall and Warthog outtake in North Kilombero Game Controlled Area, Morogoro, Tanzania.

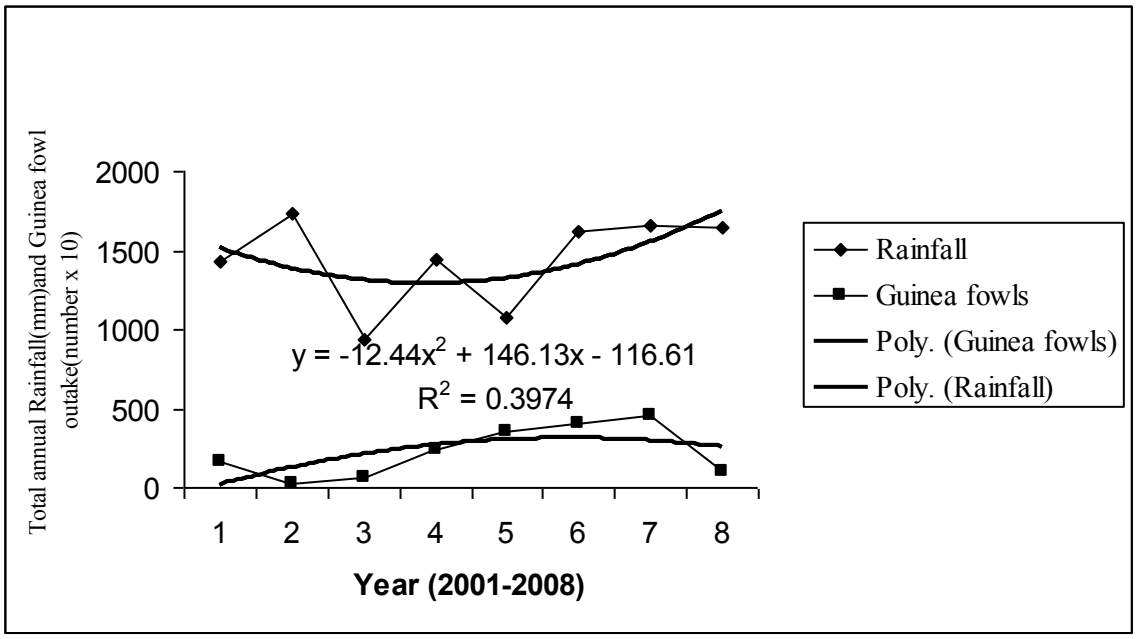

Figure 9: Relationship between total annual Rainfall and Geese outtake in North Kilombero Game Controlled Area, Morogoro, Tanzania.

CHAPTER SIX

6.0 GREEN ACCOUNTING FOR WETLAND RESOURCES IN THE NATIONAL ECONOMY: A CASE STUDY OF KILOMBERO VALLEY RAMSAR SITE, MOROGORO, TANZANIA

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6.1 Abstract

Green natural resources in the national accounting system is becoming popular at global level though has limited application in developing countries todate. The idea is to capture change in the condition of the natural resource base corresponding to its contribution to human welfare and the national economy for sustainability, and make some adjustments in the actual contribution of the resource. This study analysed the contribution ofKilombero Floodplains Ramsar site resources both marketed and non-marketed goods and services and these values together with wetland services and degradation were used in efforts to introduce green natural resources accounting Current data show that direct economic activities accounts for Tshs152 billion and non marketed goods accounts for Tshs 14 billion, Wetland services Tshs 75 million bringing the total value of Kilombero Ramsar site to the national account to Tshs 167 billion. Degradation was captured in terms of deforestation, overfishing and overgrazing. The study observed overfishing of about 98 000 kg valued at Tshs 196 million , for livestock grazing extra of 200 livestock units required valued at 10 billion and deforestation rate of 52.2 ha/year valued at Tshs 30 million. These degradation values associated with overuse of wetland resources are substantial, they should be considered when computing final accounts to facilitate green economy.

6.2 Introduction

Kilombero Valley Floodplain Ramsar Site (KVFPRS) was designated and added to the Ramsar Convention's list of wetlands of International Importance in April, 2002. The valley has got natural features which are of significant importance in terms of environmental and economic values to surrounding communities, national and international interests. Being one of the most fertile lands with 330 000ha of irrigation potential, presence of rivers, forests and wildlife is of considerable benefit thus calling for significant management attention to warrant its sustainability (McCartney and van Koppen, 2004). Contribution of

wetland resources to national accounts is significant and hence needs to be understood. Futhermore, sustainable levels of utilizations need to be understood in order to capture degradation which may have impact on wetland resources sustainability.Such transactions are currently not done.

The aim of national income is to provide information suitable for analyzing the performance of economic system. Current national income accounting conventions produce a variety of measures relating to national income. The most widely used are Gross National Product (GNP) and Gross Domestic Product (GDP). In these measures, as observed by Perman *et al.,* (2003), there is observed setbacks in the use of existing System of National Accounts (SNA) in measuring or monitoring impact of environmental changes on income or welfare. Critics to current accounting conventions centres on three issues: the absence of any allowance for the depletion of natural resources, absence of adjustment for degradation of environmental amenity and the fact that the activity to offset environmental damage is counted as part of income. Inclusion of environmental degradation in national accounting system is part of addressing the issue of sustainability of resource. Unfortunately, natural resources play a little role in standard national accounts Repetto *et al*. (1989) cited by Perman *et al.* (2003) observed that low-income countries, which are typically most dependent on natural resources for employment, revenues and foreign exchange earnings are instructed to use a system for national accounting and macroeconomic analysis that almost completely ignores their principal assets.

The GDP is used to measure the amount of monetary exchanged for final goods and services. In Tanzania, 2001 prices are used as base year (NBS, 2012). For sustainability purposes requires inclusion of socio economic sustainability use of resources (Haener and Adamowicz, 2000, Solow, 1993). In capturing sustainability, it requires sustained GDP. In

Tanzania, the GDP over years, has been fluctuating as indicated in Fig.1. Though there is a general decreasing trend from 5% in 2002 to below 4% in 2011.

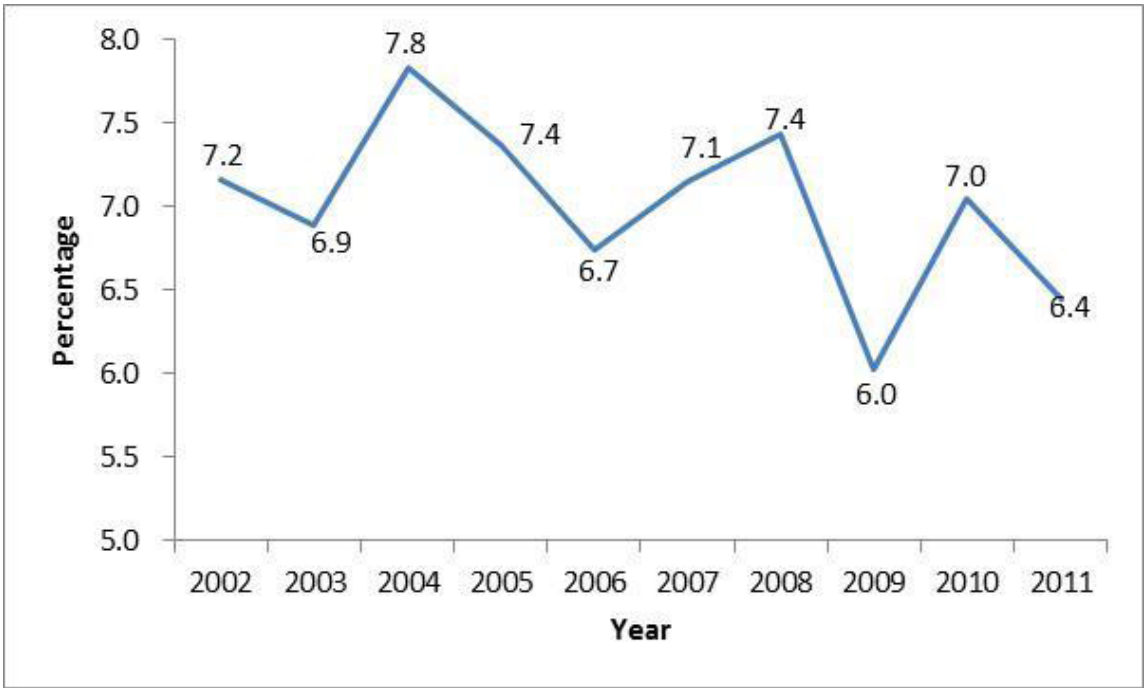

Figure 1: Average annual growth rates of total GDP at 2001 prices.

Source: NBS, (2012)

Natural resources Accounts (NRA) allows for expression of economic values associated with stock and flow within particular resources. In this way, it allows for tracking of stocks and flows over time and therefore it needs be instituted to enable adjustments to be made on the GDP. Ignoring the cost of environmental degradation in policy decisions, economic activities can be incouraged to the extent of degradation of natural resource base and the long time economic growth. In policy analysis, NRA assists macro economic and sector department to come together to coordinate, when examining trade off in allocating resources such as Water or land for competing needs of crops, livestock and wildlife based tourism (Mkata, 2002). Eximining Agriculture and fishing sector as they affect overall GDP is as indicated in Fig. 2.

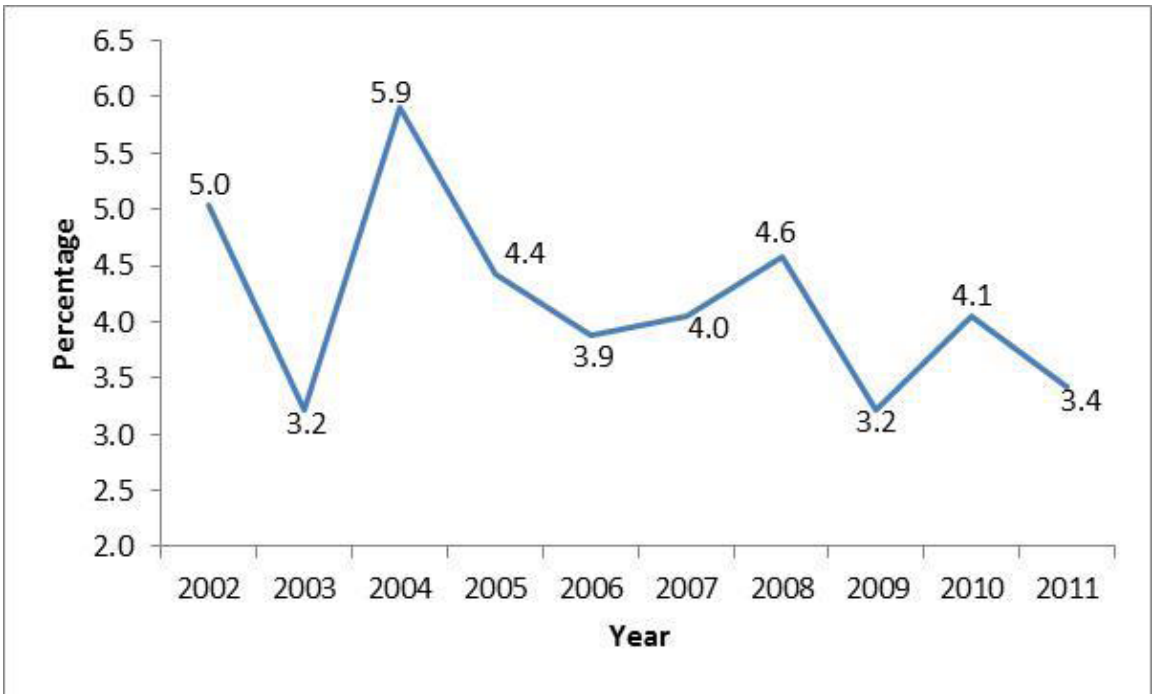

Figure 2: Average annual growth rates of agriculture and fishing GDP at 2001 prices.

Source: NBS (2012)

Despite acknowledging the importance of accounting for natural resources, the country is faced with absence of continous and reliable data and methodological problems of capturing non-marketed goods. The study, contributes to the bridging of this gap.

6.3 METHODOLOGY

6.3.1 Study area

KVFPRS covers an area of approximately 796 735 ha. The central point coordinates are 8 °40' S and 36 °10' E. KVFPRS lies between 210 and 400 m.asl with the main part of it lying at 210 - 250 m.asl. KVFPRS is the largest inland fresh water wetland in low altitude and is divided by the Kilombero River and falls into two districts: Kilombero and Ulanga.

KVFPRS boundary is watershed based boundary rather than administrative boundaries, as such KVFPRS is treated as one entity. The boundary borders the rapids on Mnyera River in the West and it touches rapids of the Ruhudji River in the South and includes land in both districts. On the Southern side the boundary runs along the road to Lupiro village and then along the borders of Selous Game Reserve to Msolwa River and encompasses the Southern part of Msolwa Station. The Ramsar site has a total of 108 villages with 72 villages in Kilombero and 36 villages in Ulanga. This means not all the villages in Ulanga and Kilombero Districts are covered in Ramsar boundaries. The KVFPRS supports human population of about 400 000 people who depend on direct and indirect ecosystem services from the wetland.

6.3.2 Study methods and Sources of Data

Primary data was collected from household surveys and discussions with relevant personels in relevant institutions; also informal discussions with stakeholders in KVFPRS. Secondary data was from literature search. Information collected was in 4 categories i)direct marketed goods from agriculture (paddy and sugarcane) production, forest products, thatch grass, water for domestic use, bush meat, brick making and fishing.(ii) Indirect use values from flood control and water quality and quantity (iii) Existance biodiversity values and degradation data from over fishing, deforestation and livestock grazing.

Calculation of the Green Gross Domestic Product contribution of wetlands was guided by the following modified GDP as follows:-

$GDP_G = \sum_{i=1}^{n} (X_i P_i)$ + IUV + EV – RD……..equation 1

Whereby:

GDP_G = Green Gross Domestic Product

X_i = Direct wetland resource *i*

P_i = Prices of product *i*

IUV	=	Indirect use values
EV	=	Biodiversity (existence value)
RD	=	Degradation resulting from resource over-exploitation/use

6.3.3 Data analysis

Data analysed was on actual use of marketed goods at domestic levels whereby the actual products and prices and sale domestic consumption, for wetland indirect use values and biodiversity values were analysed based on contigent valuation analysis as presented in chapter 2. Degradation was analysed by calculation forest degradation, required livestock units and harvested fish. Deforestation was analysed based on harvesting levels by converting harvested wood into round wood based on Kaale, (2005), $1m^3$ of wood is equivalent to 725 kg of firewood and Amous, (1999) estimates that $1m^3$ of wood is equivalent to 165 kg of charcoal, on required livestock units, the number of available catle was converted into livestock units against recommended levels and overfishing was calculated based on fished kgs minus recommended kgs of harvestable fish.

6.4 RESULTS AND DISCUSSION

6.4.1 Direct use values

Direct use values and services used in this study were agriculture (paddy and sugarcane) production, forest products, thatch grass, water for domestic use, bush meat, brick making and fishing.

6.4.1.1 Paddy production

Paddy growing is practiced by about 90 percent of the population. The costs of paddy production include fixed and variable costs. There are labour costs of various activities involved in production including seed sowing, weeding, bird/wildlife scaring, harvesting

and packaging. This cost stood at Tshs 300 000/acre (Tshs 750 000/ha) in 2010. The average price was Tshs 50 000 per bag of paddy of 70 kg. Estimated household benefit is Tshs 300 000 per acre lower bound based on land size of 0.2 ha to Tshs 1 200 000 for higher bound of 1.6ha.

6.4.1.2 Sugarcane production

According to the current study, sugarcane is only cultivated in lowlands of Msolwa Station and Ikwambi villages and is practiced by 11 percent of the sampled households as outgrowers. The price was Tshs 32 000 per ton depending on sucrose levels.(10 being the best and hence good price and between 9and 8 having low levels and hence low price)

6.4.1.3 Thatch grass collection

In the study area, 5 percent of respondents were engaged in thatch grass business. The main grasses used are *Panicum maximum* and *Pennisetum* spp. In a day one can harvest up to 30 headloads. The production costs involve harvesting tools such as sickle and ropes, transportation and labour. The annual average benefit for the household is estimated at 800 000 with a sample value of Tshs 19 600 000 and population value of Tshs 3 200 000 000.

6.4.1.4 Forest products

According to the Forest policy, 1998 no harvesting is allowed in the catchment forests, so all the harvest was treated as deforestation. The value was estimated from charcoal, firewood and timber. Percentage of household depending on charcoal was 70% with consumption of 1.5kg/day sold at Tshs 1000/Kg. This gas the value of charcoal at Tshs 15,330 000 000 /year. Percentage of households depending on firewood was 90% with household consumption of 3kg/day, priced at Tshs 1000/Kg, this gives the value of firewood at 4 730 400 000 /year. Useof timber was estimated at 0.0019m3/household per year valued

at at Tshs 68 400 000/year. Aggregate value of wood based resources on conservative estimates stands at Tshs 20 128 800 000. Although the trend in illegal harvesting is on rise from catchment forests resulting on dependence on resources, inadequate capacity of catchment office to patrol all the forests to the extent that new settlements are found within forest reserves and several challenges in implementing Participatory Forest Management (PFM) initiatives.

The revenue from timber and related products realized by the district councils based on the district councils report was Tshs 32 766 310 in 2007 and about 27 299 356 in 2008. This amount is cumulative; however there are variances in months, though the data provided could not help in establishing the trend. However, logs in class I are few as compared to other classes, other sources of revenue was from from processed products such as doors, carvings, firewood, fines, transit pass and research permit. This amount indicates that a considerable amount of forest products which are harvested are unregulated.

In terms of revenue realized by the district councils based on district councils report revenue for timber and related products was Tshs 32 766 310 in 2007 and about 27 299 356 in 2008. This amount is cumulative; there are variances in months, though data provided could not help in establishing the trend. However, logs in class I are few as compared to other classes, fee from processed products eg doors, carvings, firewood, fines, transit pass and research permit.

There are efforts in village to plant trees around homestead and in woodlots to curb the growing demand of wood related products. Most planted tree in woodlot is *Tectona grandis*. In terms of hydrodynamics, the forest and Miombo habitat of the catchments play an

important role in the maintenance of the water runoff pattern that support the Wetland and so are an integral part of the Wetland system.

6.4.1.5 Fishing

Results show that fishing activities are mainly carried out by 22 percent of the sampled population. Fishing is mainly carried out in both permanent and temporary fishing camps along the Kilombero River and its tributaries. On average each camp has a minimum of 80 fishermen. Fishing season, is maily starting in June- February almost about 250 days, though for this study based on the fact that 16 days are recommended per months for fishing, we used a total of 125 days as effective fishing days. Average catch per trip was about 16 fish. Pricing is according to fish size regardless of species type. Grade based on fish width. With grade one Tshs 1 200 - 2 500, grade two Tshs 1 100 - 800 and grade three Tshs 700- 500 at fishing camps. Average price at was Tshs 2 000.

Our calculations are based on prices at fishing camps. This gives average annual benefit per fisherman of Tshs 2 500 000. Benefit estimated for the sampled population was Tshs 269 500 000 with population estimate of Tshs 4.4 billion.

6. 4.1.6 Brick making

Brick making is practiced by about 5 percent of the sampled households. Cost of production include moulders, labour cost and energy. Cost estimates for producing 10 000 mud brick was as follows:

Moulders Tshs 10 000, labour for molding at Tshs 15 per brick, labour for shifting Tshs per brick, labour for arranging in a tunnel Tshs 10 000 for every 2 000 bricks, firewood approximately $4m^2$ (two tellas) at Tshs 20 000, labour cost for surveillance 200 000. Bringing a total cost at Tshs 600 000. Price per brick is T shs 70 - 100 for woodbased

energy and Tshs 30- 50 for rice husks based energy. Net benefit from brick making is about Tshs 400 000 and one can make a maximum of 2 brick tunnels in a year. Estimates brings sample benefit at 9 800 000 and population benefit of 1 600 000 000.

6.4.1.7 Livestock free grazing

About 5 percent of the population engages keeping livestock to include goats, sheep and cattle. The study concentrated on cattle. Free range grazing is practiced in grasslands, bushlands and swamps. Households had herd size of about 1- 100 cows per household in study villages. Estimated cattle in study villages are between 245 - 24 500. Data show that on average two cattle are sold. Calculating annual population benefit stands at Tshs 17 600 000 000. Records show that, the valley as total free range cattle of 300 000. (DED, Kilombero). Expert recommendation is I LU requires 2 ha in a year. Thus, with such population, an estimate of 600 000 ha is required. The study found that the price for livestock ranged from Tshs100 000 - Tshs 600 000 per cattle, data from Kilombero District council shows the value of officially marketed livestock as Tshs 750 000 000 in 2008.

6.4.1.8 Bushmeat

In the study area about 5 percent of the sampled population engage in bushmeat business especially trophies though some do it for subsistence. Wild animals are hunted from hunting blocks, catch of astray animals especially those trampling into crops, swamps, river, wooded grassland, national parks and from Selous Game reserve.

Price for bushmeat is in a range of Tshs 2 000 – 5 000 per Kg depending on availability on average one can earn an average of Tshs 200 000 per year. Cost of production involved hunting tools and labour. Trend of legal hunted wildlife and eventual revenue for the past

ten years is indicated in Bakengesa *et al*. (2011). Estimated earning for the sampled population per year is Tshs 4 950 000 with estimated population earning of 800 000 000.

6.4.1.9 Domestic water

In the sampled population about 70 percent of population clean water from tap, well and directly from the river. Local people are organized in water users association (WUAs) in a community well which is paid 500/month regadless of number of bucket collected. This fee was used as price of water. If one buys a bucket of water is sold at Tshs 10 – 20 per bucket of 20 litres this is only labour cost. Estimated use of water is about 15 buckets per day per household. On average an household uses about 108 000 litres per year which gives a price of Tshs 0.056/lt. Sample water consumption estimated at 37 044 000 litres of water per year, extrapolated to population living in KVFPRS of 80 000, then litres of water consumed was 6 048 000 000 litres per year with the value of Tshs 336 880 000. Direct use values from KVFPRS is summarized in Table 1.

Table 1: Economic value of KVFPRS in terms of Direct use values

Economic activity	Units	% hh	Population value Tshs
Rice	bags	90	86 400 000 000
Sugarcane	tons	11	31 680 000 000
Thatch grass	headload	5	3 200 000 000
Forest products	m^3	90	20 128 800 000
Grazing livestock	livestock heads	5	4 000 000 000
Bushmeat	kg	5	800 000 000
Fishing	kg	22	4 400 000 000
Brick making	#bricks	5	1 600 000 000
Water	litres	70	336 880 090
Total			152 545 680 090

6.4.2 Indirect and existence biodiversity values

Indirect use values were flood control, water quality and quantity and existence biodiversity values. These are important ecological and hydrological processes that supports various values generated by the wetlands, in most of time their information is lacking. Results are as indicated in Table 2.

Table 2: Economic value of KVFPRS in terms of all servcies, biodiversity, flood control and water quality and quantity

Statistics	Valued goods			
	All services	Biodiversity	Flood control	Water quality
N	490	490	490	490
Mean	174 325.5102	49 665.30612	85 331.63265	54 604.89796
Maximum	1 290 000	912 500	1 032 500	1 012 500
0	1.6 percent	17.3 percent	9.2 percent	12.4 percent
Sample WTC	85 419 500	24 336 000	41 812 500	26 756 400
Households in KVFPRS	80 000	80 000	80 000	80 000
Population WTC	13 946 040 816.33	3 973 224 489.80	6 826 530 612.24	4 368 391 836.73

6.4.3 Wetlands in the National Accounts

Economic activities of wetlands are covered in different categories. In other words wetlands do not appear as a separate entity. Tanzania mainland adapts the International Standard Industrial Classification (ISIC) revision three which has 15 categories of economic activities. According to this classification, categories under which wetland falls include (a) Agriculture, hunting and forestry (b) fishing (c) Mining and quarrying (d) Electricity, Gas and water supply. This means, contribution of wetland resources in these economic activities is not clearly understood. For the purpose of this study, wetland values were assumed to contribute to agriculture, hunting and forestry, livestock and fishing. The contribution calculated based on the base year 2001. This is indicated in Table 3.

Table 2: The contribution of KVFPRS values in the national accounts

	Value (Mill)	
Economic Activity	2001	2010
Agriculture	2 636 193	3 824 428
Crops	1 945 945	2 913 474
Livestock	459 448	597 572
Forestry and hunting	230 800	313 382
Fishing	153 660	236 126
Total Agriculture and Fishing	2 789 853	4 060 554
Value of Wetlands at current price		167 000
GDP at Constant Market Prices 2001		
Wetland Contribution		
Direct use value		152 000
Indirect use value and non use biodiversity value		14 000
Wetland services (Royalties, licenses, levy(Crops, hunting, forestry)		75

6.4.4 Accounting for Wetland Degradation in the National Accounts

Being a Ramsar site, a wise use concept is advocated. Under the status quo scenario, we have estimated total benefit both marketed and non-marketed. In order to measure the quality of wetland, there is need to develop indicators as that of Canada environmental indicators refer to Table 4. The idea of indicators is to signal the pressures that human activities are generating and how is the environment affected by the pressure with corresponding provisions to human welfare. Some extract of indicators that can be applicable to KVFPRS which requires periodic assessment of KVFPRS resources. Learning from experiences in Costa Rica, the economic difficulties experienced was based on the fact that it failed to account for degradation of natural resources (Patriaquin, *et al.*, 2004) The income generated from natural resources exceeded the sustainable levels thus, reducing the production for future income. If indicators could be developed, could help to send signals on the status of natural resources. The Government of Tanzania recognises and acknowledges that environmental degradation should be incorporated into national accounts. However, discussions with the stakeholders responsible for national accounts revealed that this is not

done in Tanzania for various reasons. The major limiting factors relate to methodological aspects and the unavailability of continuous and reliable data, especially on deforestation and its impact on soil erosion and other non-market products.

Table 3: Canada preliminary environmental indicators, 1991

Resource	Issue	Indicator
Water	Quality of water	- Population served by clean water - Concentration of nitrogen and phosphorus in water - Observed concentration of pesticides in water - Discharges
Land	Protected areas	- Land under protected status
	Wildllife state	- Level of migratory gamebird population
	Forests	-Regeneration rates against harvested volume
	Agriculture	- Change in agriculture land use - Amount of chemical fertilizer used - Agricultural pesticide applied
	Fisheries	- Total commercial fish - Type of species
	Water	- Rate of water withdraw with key sectors
	Energy	- Emmission of carbon per unit energy - Total per capita energy use
	Biodiversity	- Extent of species - Farmland species index - Land use under active conservation management

Source: Adapted and modified from Perman *et al*, 2003

The study observed overfishing of about 98 000 kg valued at Tshs 196 million, for livestock grazing extra of 200 livestock units required and for forest a deforestation rate of 52.2 ha/year valued at Tshs 30 million. Totalling to 10.1 billion, thus green contribution of wetland to Tshs 157 billion. These values are significant and their inclusion in the final accounts in vital for sustainability of KVFPRS.

6.5 Conclusions and Recommendations

The total value of KVFPRS in terms of marketed goods stood at Tshs152 billion and non marketed goods which accounts for Tshs 14 billion, wetland services was Tshs 75 million bringing the total value of Kilombero Ramsar site at Tshs 167 billion. In terms of Greening these values in the national economy, the value of degradation in terms of overfishing, grazing and deforestation was calculated. The study observed overfishing of about 98 000 kg valued at Tshs 196 million, for livestock grazing extra of 200 livestock units required valued at 10 billion and for forest a deforestation rate of 52.2 ha/year valued at Tshs 30 million. Resulting into the degradation value of Tshs 10.1 billion. Thus, green contribution of wetland into the national accounts tuned to Tshs 157 billion. These values are significant and their inclusion in the final accounts is vital for sustainability of KVFPRS. Data on wetland resources is scanty and some resources are not values, hence the study recommends countrywide studies to capture wetland values in terms of direct, indirect and existence biodiversity values and degradation to capture values which may improve the contribution of wetland values in the national accounts. Furthermore, the study recommends development of quality indicators to feed into sustainability framework. In doing so, a more reliable capturing of environmental values can be achieved and made as intergral part of national accounts.

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CHAPTER SEVEN

7.0 GENERAL CONCLUSION

The study concludes that KVFPRS has significant contribution in terms of direct use in terms of supporting agriculture, forestry, fishing, bush meat, thatch grass harvesting, provision of clay for brick making and water for various uses. These activities are vital in addressing Millenium development Goals. The total direct value was estimated at Tshs 152 billion. Non- marketed services at Tshs 7 billion for flood control at Tshs 4 billion water quality and quality, non-use existence biodiversity values at Tshs 4 billion. These values are significant and should be considered in developing management plans for the KVFPRS. The study demonstrated that wetlands contribute significantly in the national accounts and the value has improved by incoperating indirect, existence biodiversity values and service from wetlands tuning to 75 million. This brings a total of Tshs 167 billion s contributed to the national accounts from KVFPRS. Apart from realized values in the national accounts, the need to consider degradation in the national accounts was initiated. The study observed overfishing of about 98 000 kg valued at Tshs 196 million, livestock grazing above the 200 livestock units required valued at 10 billion and deforestation rate of 52.2 ha/year valued at Tshs 30 million. This Results into degradation value of Tshs 10.1 billion and thus green contribution of wetland resources was Tshs 157 billion. These values are significant and their inclusion in the final accounts is vital for sustainability of KVFPRS. The general conclusion is that sustainable management of wetland ecosystems can not be attained if consideration of direct use, indirect use and existence biodiversity values is ignored when planning for sustainable wetland management. Furthermore, accounting for the wetland resources and capturing degradation in the national accounting is vital for capturing change in the condition of the natural resource base corresponding to human welfare and the national economy.

APPENDICES

Appendix 1: Checklist of questions for village leaders

1) Administrative Issues:

Village ……..……. Ward ……..…..

Village registration number …… Date ……...……

Village area (Ha) …….……..….

Village population (Total) …….…….……...

Number of Households …….…….

What is the ethnic composition …….……..…..……

What are the migration trends? …….……..……..

Settlement pattern……..……..

2) Wetland utilization and Management

- What are the main economic activities in this village? What are their economic contributions to the village?
- This villages is within wetland Ramsar site, what trend do you experience in terms of provision of goods and ecological services from wetlands?
- Who are the main players in wetland management?
- In your opinion what should be done to improve service provision of wetland?

Appendix 2: Valuation household questionnaire

Introductory Section

In order to sustainably manage wetlands, there is need to understand how local people value wetlands services and products. In view of this Sokoine University of Agriculture in collaboration with University of Life Sciences in Norway, are carrying out study to establish economic values of wetlands to local people in Tanzania. This questionnaire is administered to head of household to represent the household.

Socio-economic survey

Identification Variables

Date _____

Item	Name/Number
1. Name of interviewer	
2. Date of interview	
3. Name of respondent	
4. Ethnic group	
5. Year of residence	
6. Village name	
7. Sub-village name	
8. Ward	
9. Division	
10.Geo-reference of household and Distance from core wetland	
11 Wealth category*	

**pre determined through discussion with village leaders based on local assessments*

Household Characteristics

12 Total size of the household…….

13. Number of children below 5 years .....

14 Provide the following information for the respondent

Respondent characteristics	Age	Marital status	Education level	Main occupation
Husband				
Wife				
Other support				

Code: Gender 1=Male, 2 =Female

Marital status 1= Married, 2 = Single, 3 = Widowed, 4= Divorced

Main occupation 1 =No occupation, 2= Farmer, 3 = Others (specify)

Education level (specify)……..

16. Are you born in this village?

01 Yes

02 No

If not born in this village which factors influenced your movement to this village?

01 search for work 02 Search for farm land

03 Search for grazing land 04 Followed family

05 Other specify----------

Land Ownership

17. Total acreage owned …….
18. Number of plots …….
19. Indicate size, user and ownership, location, price per unit, of each plot

Plots	Size	User	Ownership	Location	Price per unit	Year of acquiring
Homestead						

1=husband2=wife3=husband+wife 4=children, 5=relative6=other

1=Acquired through application2= inherited 3=borrowed 4=rented 5=taken without permission 6=bought 7=exchanged

20. Is land a constraint in terms of acreages? 1= yes, 2= no
21. How much grazing area do you have?.....

Household Production and Income

22. Total production (husband and wives and children) last year (production should be aggregated in 1 season focus placed on products from wetlands)

Type of crop	Total production (in units)	Total production cost	Amount consumed in Units	Amount sold in Unit (Bags, tin)	Unit Price
Paddy					
Thatch grass					
Brick making					
Sugar cane					

23. Household income from Livestock and their products Last year

Type of livestock	Number of livestock owned	Number sold	Unit Price
Cattle			
Goat			
Chicken			
others			

24. Household income from fishing activities last year

Type of fish	Number of fish per catch(number of fish)	Production cost per catch(Tshs)	Amount consumed (number of fish)	Amount sold(Number of fish)	Price(Tshs/ fish)

25. Household forestry related products use. We would like to know how much forestry related products do your household use indicating source and price.

Item	Sources	Quantity harvested	Quantity consumed	Quantity sold	Price
Firewood					
Timber					
Medicines					
Charcoal					
Other					

26. Household water use. We would like to know how much water do your household use for different purposes indicating source and price

Use	How much per day(units)	Price per unit(units)
Water for domestic use		
Water for irrigation		
Others		

27. Other sources of income. Apart from what you have told us above, we would like other sources of income you have to support your household.

Source of income	Amount in a day(Tshs)	Total production cost(Tshs)	Net income(Tshs)

27. How can you rate the demand for household to continue depending on wetlands?

1. Increasing
2. Decreasing
3. Same

Give reasons

i. ……..
ii. ……...
iii. ……

Contingent valuation survey section

Wetlands are known to provide a lot of goods and services to communities living around. In the Kilombero wetlands and their surrounding areas there are numerous benefits that people draw from wetlands for their livelihoods and which account significantly to their daily needs.

28. Are you aware of these benefits _____ (01)Yes _____ (02)No

29. Which benefits do you enjoy from wetlands? _____

Despite all these benefits, the environmental integrity and status of these wetlands are increasingly threatened by indiscriminate use and sometimes abuse leading to their degradation, something that may result into these benefits disappearing forever.

30. Do you agree with these observations?
_____(01) Yes _____(02) No

31. Have you experienced a reduction of services/products in recent years
_____(01) Yes _____(02) No

Bearing in mind that the wetlands are important to you in your everyday needs, its disappearance together with the goods and services it provides will have a negative impact on your household's livelihoods.

32. As a beneficiary of goods and services supplied by wetlands do you think wetlands are worth conserving?
(1) Yes_____ (2) No_____

33. Are you aware of any conservation activities in your area?
_____(01) Yes _____(02) No

34a If the answer in 33 is yes, what conservation activities do you know?..... and who is responsible to conserve the areas?_____

34b If the answer in 32 is no, would you like to conserve the wetland?
_____(01) Yes _____(02) No

35. If the answer in yes, What role do you prefer in conservation?
01 planting trees
02 Paying some amount of money.
03 Others specify_____

Valuing All services

36. In order to facilitate conservation of all wetlands goods and services the Government intends to institute a conservation fund, would you be willing to contribute towards this goal? (1) Yes_____ (2) No_____

Would your household be willing to support in this programme?

Yes_____ No_____

I don't Know_____

If yes:

i. What would you prefer as a contribution mode (a)cash……...(b)labour……...(c)both……

ii. What is the highest number of persons- days your household would be willing to contribute per year to conservation programme?_____Number of Persons-day per year

iii. What is the maximum amount your household would be willing to contribute per year to this conservation programme?_____Tshs per year

If No to Q 36.

What is the main reason your household is not willing to support anything?

To the interviwer: Do not read the reasons to the respondents, but circle the reasons that fits best respondents answer. If the answer does not correspond with any option listed below, circle "6 other" and write down the respondent's answer

1. I can't afford to contribute anything
2. Other things are important than conservation programme
3. The government should solely pay for all the cost both material and labour needed
4. I don't trust the government will implement this conservation plan
5. I don't think a conservation plan will avoid similar type of conservation in future
6. Other…….. (please specify)…….

Valuing willingness to accept

Imagine that due to increased degradation of the wetland, the government stops all the activities in wetland in order to restore its functioning. This could be instituted from next 5.years and that you have to find somewhere else to support your livelihood. Suppose in order to compensate you for not using the wetland any more, you were given additional cash per year over and above what you said you earn at the table above.
How much money would you have to receive each year……. to give you same quality of life as you have now?

37. Compensation amount……
38. Reasons for stated

……
……..

Follow up questions

40. How would you spend the money?.....
41. Taking into account what you have just said about how would you spend your money do you think your quality of life will be the same , better or worse?
    Yes/ No
    Why?.....

Valuing Flood Control

In recent years, the valley has experienced extreme flooding as a result of human induced activities along the riparian areas, thus reducing the capacity of river banks to hold water. Extreme flooding has caused loss of crops, houses and some deaths have been recorded. Suppose the government intends to implement a flood control programme which will guide water levels from causing damages to people and their resources and biodiversity of

valuable plants and animals which would be reduced in in abundance in years to come, and hence reduced dependency and peoples livelihoods. This programme which will completely avoid damages you have experienced during recent years. The measure to avoid damages will be financed by the government, but local population will have to contribute in terms of labour, cash or both in order for the project to be implemented.

42. Would your household be willing to support in this programme?

(i) Yes_____ No_____

I don't Know_____

(ii) If yes:

iii. What would you prefer as a contribution mode

(a) cash…….....(b)labour……...(c)both……

iv. What is the highest number of persons- days your household would be willing to contribute per year to this flood prevention programme?_____Number of Persons-day per year

(v) What is the maximum amount your household would be willing to contribute per year to this flood prevention program?_____Tshs per year

If No to Q 42.

What is the main reason your household is not willing to support anything?

To the interviwer: Do not read the reasons to the respondents, but circle the reasons that fits best respondents answer. If the answer does not correspond with any option listed below, circle "6 other" and write down the respondent's answer

7. I can't afford to contribute anything
8. Other things are important than avoiding floods
9. The government should solely pay for all the cost both material and labour needed
10. I don't trust the government will implement this flood protection plan
11. I don't think a flood prevention plan will avoid similar type of floods in future
12. Other…….. (please specify)…….

Valuing biodiversity

KVFPRS was designated as a Ramsar Site in 2002 as a wetland of Global biodiversity importance. The wetland supports different flora and fauna, with notably high wildlife populations. Existing unsustainable trends in the utilization of forests and wildlife habitats have drying up of swamps like Maujiji, Ngapemba and Ndefi among others. This affects both wildlife, availability of forest resources and fishing activities, leading into reduction of biodiversity properties of the area. Suppose the government intends to implement a biodiversity saving programme which will avoid loss of biodiversity in the years to come. The programme would avoid reduction experienced during recent years. The measures to avoid loss will be financed by the Government and foreign development partners but the local population will also have to contribute in terms of labour or cash or both in order for the project to be implemented. Think of biodiversity service to household welfare, during extreme biodiversity loss.

43. Would your household be willing to support in this programme?

i. Yes_____ No_____

I don't Know_____

If yes:

ii. What would you prefer as a contribution mode

(a)cash……...(b)labour……...(c)both……

iii. What is the highest number of persons- days your household would be willing to contribute per year to this flood prevention programme?_____Number of Persons-day per year

iii. What is the maximum amount your household would be willing to contribute per year to this biodiversity conservation program?_____Tshs per year

If No to Q 43

What is the main reason your household is not willing to support anything?

To the interviwer: Do not read the reasons to the respondents, but circle the reasons that fits best respondents answer. If the answer does not correspond with any option listed below, circle "6 other" and write down the respondent's answer

1. I can't afford to contribute anything
2. Other things are important than biodiversity conservation
3. The government should solely pay for all the cost both material and labour needed
4. I don't trust the government will implement this biodiversity conservation programme
5. I don't think a biodiversity conservation plan will avoid biodiversity loss in future
6. Other…….. (please specify)…….

Valuing water quantity and quality

KVFPRS and its surroundings is rich in terms of its hydrological services which supports water availability and quality. Disturbances in the catchment forest areas through increased anthropogenic activities have increased in recent years. ThEconsequence which may include reduction of water quantity and that too much nutrients flowing in the Kilombero River and its tributaries can also affect water quality. The physical evidences of this water pollution is increased sedimentation and siltation, increase of certain plants in water including algae growth and water cabbages.If this conditions persists communities may be forced to incurcosts of alternatives such aswaterboreholes,, difficulty in water based transportation especially in Kilombero River and increased of waterborne diseases experienced in the KVFPRS imparting on health. If nothing is done, the provision services of water quantity and quality by KVFPRS will be in jeopardy in terms ofquantity and quality of water. Suppose the Government intends to implement a water quantity and quality control programme which will ensure a continued supply of quality water and reduce diseases that are experienced today. The programme would avoid damages to people from low quality and quantity of water in the years to come. The reduction measures would be financed by the government but local people have to contribute in terms of money or labour.

44. Would your household be willing to support in this programme?

Yes_____ No_____

I don't Know_____

If yes:

i. What would you prefer as a contribution mode (a)cash……....(b)labour……...(c)both……

ii. What is the highest number of persons- days your household would be willing to contribute per year to water quality and quantity programme?_____Number of Persons-day per year

iii. What is the maximum amount your household would be willing to contribute per year to this water quality and quantity program?_____Tshs per year

If No to Q 44.

What is the main reason your household is not willing to support anything?

To the interviwer: Do not read the reasons to the respondents, but circle the reasons that fits best respondents answer. If the answer does not correspond with any option listed below, circle "6 other" and write down the respondent's answer

1. I can't afford to contribute anything
2. Other things are important than water quality and quantity
3. The government should solely pay for all the cost both material and labour needed
4. I don't trust the government will implement this water quality and quantity programme
5. I don't think a water quality and quantity plan will avoid similar type of loss in water quality and quantity in in future
6. Other…….. (please specify)…….

THANK YOU FOR PARTICIPATING IN THIS STUDY

Appendix 3: Checklist for stakeholders on National accounts

IDENTIFICATION VARIABLES

ITEM	NAME/NUMBER
1. Sheet No.	
2. Name of Interviewer	
3. Date of Interview	
4. Name of Office, respondent(s) and position	
8. District	
9. Region	

B. OTHER VARIABLES

B.1 CHECKLIST FOR GOVERNMENT OFFICIALS

1. How are benefits of wetlands accounted for in national accounting in Tanzania?

- Formal (regulated) sector (sales, export etc,) and
- Informal (unregulated) sector (outside official sales, illegal, non-market products)

2. Which wetland products/services from both formal and informal sectors are accounted for in national accounting?

Products/services for formal sector	Products/services for informal sector

3. **Which benefits of wetlands are accounted for in current national accounting?**

4. How is environmental degradation incorporated into national accounting, especially adjustments due to pollution and flooding?

Wetland degradation and Changes in Asset Values

In natural resource accounting, national income accounts are adjusted for the contribution made to income by the increase or decrease of different natural resources, most often changes in wetlands.

5. Is wetlands degradation included in national accounts in Tanzania? How?
6. Which benefits of wetland degradation are accounted for?

7. What are the indicators for wetland degradation?

8. How can wetland degradation be incoperated in national accounts?

THANK YOU