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PLANNING FOR RESILIENCE IN EAST AFRICA THROUGH POLICY, ADAPTATION, RESEARCH, AND ECONOMIC DEVELOPMENT (PREPARED)

ECONOMIC VALUATION OF BIODIVERSITY AND ECOSYSTEM SERVICES IN THE MARA WETLANDS, UNITED REPUBLIC OF TANZANIA

August 2016

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ACRONYMS AND ABBREVIATIONS

BSA	Biologically Significant Area
CIP	Conservation Investment Plan
DV	Direct value
EPA	Ecosystem Profile Assessment
EV	Existence value
FGD	Focus Group Discussions
GDP	Gross Domestic Product
Ha	Hectare
HH	Household
IUCN	International Union for Conservation of Nature
IV	Indirect values
Km	Kilometer
MEA	Millennium Ecosystem Assessment
PRA	Participatory Rural Appraisal
PREPARED	Planning for Resilience in East Africa through Policy, Adaptation, Research and Economic Development
RAS	Regional Assistant Secretary
TEV	Total Economic Value
Tshs	Tanzania Shillings
TLU	Livestock Unit
US$	US Dollar (at the time of writing this report: 1 USD = 1,272 Tanzania Shillings)
USAID	United States Agency for International Development
WWF	World Wildlife Fund for Nature

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EXECUTIVE SUMMARY

This report has been produced by LTS International for the USAID-funded Planning for Resilience in East Africa through Policy, Adaptation, Research, and Economic Development (PREPARED) project. It highlights findings of a study carried out to estimate the actual or potential contribution to livelihoods by biodiversity and ecosystem services of the Mara Wetlands; an important freshwater site in Tanzania that is part of the transboundary Mara River ecosystem shared with Kenya. The rapid assessment was undertaken as part of an assignment titled: "Economic Valuation of the Mara Wetlands", commissioned by the PREPARED Project whose aim was to help address the vicious cycle involving biodiversity loss and the ability of ecosystems to provide services in the Lake Victoria basin.

The study sought to provide an overview of biodiversity values, conservation targets, the causes of biodiversity loss and current conservation investments in particular hotspots. This report therefore serves to describe these, and hence increase awareness of the ecosystem value with both direct and indirect impacts. Subsequently, it is expected that the findings of this assessment will help in securing the long-term sustainability of resources and socio-economic benefits.

The objective of the assignment was to generate information that can be used to provide an economic justification for the Mara Wetlands Conservation Investment Plan (CIP). To this end, four key questions were investigated:

1) How and for whom do the Mara wetlands generate economic benefits?
2) What is the current value of biodiversity and ecosystem services?
3) What would be the cost of wetlands degradation and loss?
4) What would be the value added from investing in enhanced Mara wetlands conservation and sustainable use?

The rapid assessment was carried out over five days in November 2015 and involved desk research, questionnaires, roundtable discussions and field visits to the Mara wetlands. Stakeholders encompassing those communities that live around the wetlands and experts were consulted during the exercise. In addition, literature review, collation of existing national and district statistics, data entry and data analysis was conducted. This rapid assessment focused on agricultural productivity, water supply, capture fishery, wood based energy, timber and non-timber products and non-fish wetland products. The market price approach was used to estimate provisioning services and benefit transfer approach was used to estimate regulating/supporting and cultural services offered by the wetlands.

The wetlands begin near the Mara gold mine in Gekaru which is under the jurisdiction of Tarime district and extends up to Lake Victoria. The wetland is located at longitudes of 34°00´E and 34°25´E, and between latitudes of 1°08´S and 1°39´S. The permanently inundated Mara wetland covers approximately 205 km^2 in area with maximum width of 13 km and width of 5 km. When the seasonally flooded areas are included, the wetland surface area increases to approximately 517 Km^2. The wetland lies under the jurisdiction of Tarime and Musoma districts of Mara region, Tanzania (Ng'umbi, 2009).

The estimated human population of the three districts that border the wetland, which was the primary focus for this study, is 16,054 in Butiama, 8,577 in Rorya and 23,983 in Tarime. The average household sizes were estimated at 6.3, 5.9 and 6.3 in Butiama, Rorya and Tarime, respectively. This translated to an estimated total of 2,548 households in Butiama, 1,454 households in Rorya and 3,807 households in Tarime.

A review of literature was carried out prior to commencement of field work, while field surveys to collect socio-economic data were undertaken using two major survey tools *i.e.* questionnaires and Participatory

Rural Appraisal (PRA) techniques. The questionnaires were administered to 30 randomly selected households from the three riparian districts. In every district, Focus Group Discussions (FGD) were also conducted with professionals from different sectors in the districts, among them: village government officials and village environmental committees for each village involved and Ward Executive Officers. During the study, information on wetland aquatic and terrestrial biodiversity resources of significance to the local people was sought.

A simple coding system was developed (for example, coding firewood as 1 and charcoal as 2). Ranking was also employed to identify the magnitude of differences between variables. The data was entered into a spreadsheet, which captured all the coded variables. Data analysis involved tabulation and generation of graphs and pie charts with emphasis on pertinent community relevant evaluation parameters.

The findings showed that the value for crop agricultural production in 2015 during the rapid assessment was US$ 1.39 million per year equivalent to US$ 29 per capita per year, while the total value of water for livestock in the Mara wetlands was estimated at US$ 671,259. However, gross return from water in the industries was not calculated since industrial activity is miniscule in the three districts of Rorya, Butiama and Tarime. Total capture fishery in the Mara wetlands was estimated at US$ 135,212 in Butiama US$ 77,158 in Rorya and US$ 202,022 in Tarime and thus a gross total of US$ 414,393 per year. The wood based and non-timber products in the Mara region were estimated at US$ 556,518. The fodder requirement for the wetland area was estimated based on Tropical Livestock Units (TLUs) in each district. The total value of fodder was estimated at Tshs. 503 million per year or US$ 359,397 per year. Butiama leads in honey production with a value of US$ 6,300 per year. The total annual return from honey was estimated at US$ 11,140 per year. The total value of medicinal plants, bush meat, papyrus and wild fruits and vegetables was estimated at US$ 133,479 or Tshs. 169.8 million per year. Medicinal plants had the highest value in Butiama at US$ 5,985 per year, followed by Tarime at US$ 4,005 per year then Rorya at US$ 2,285 per year. The total value of cultural tourism was estimated at US$ 19,688 or Tshs. 25 million per year. Tarime's value for cultural sites was estimated at US$ 18,936 per year while that of Butiama and Rorya were US$ 249 per year and US$ 504 per year, respectively. The total value of carbon sequestration was estimated to be US$ 835,989 per year or Tsh. 1,063 million per year for the Mara Wetlands. The grand total economic value of the Mara wetlands was Tshs. 6,341 million per year or US$ 5.0 million per year, which is equivalent to a per capita value of Tshs. 130,438 or US$ 103 per year.

The assessment was limited by the amount of available documented materials on biodiversity inventories and values, including resource use, for the Mara wetlands. There were also data limitations due to time constraints that meant that where some results from the data collection were inconclusive, there was insufficient time for onsite verification.

CHAPTER 1: INTRODUCTION

1.1 BACKGROUND

This rapid assessment report is part of an assignment titled the "Economic Valuation of the Mara Wetlands" under the PREPARED Project. The aim of the PREPARED project is to help address the vicious cycle of biodiversity loss, which reduces the ability of the ecosystems to provide services in the Lake Victoria basin.

An Ecosystem Profile Assessment (EPA) was undertaken by the project to provide an overview of biodiversity values, conservation targets, the causes of biodiversity loss and current conservation investments in particular hotspots. The EPA, which identified the Mara Wetlands in Tanzania as a Biologically Significant Area (BSA), provides a baseline analysis to guide further investment planning in the priority sites. This valuation provides information on the economic benefits associated with biodiversity conservation and/or the economic costs associated with biodiversity degradation and loss in the Mara wetlands.

A lot of general literature on the Mara Wetlands exists, which provided valuable background information. Other sources of information included government publications sourced from the internet e.g. on population sizes. There also exists published articles, chapters, technical reports and policy briefs on the economic valuation of biodiversity and ecosystem services in the region but it was not possible to find any detailed specific studies on the biodiversity and ecosystem services of the Mara Wetlands. This rapid economic valuation study therefore serves to describe these values, and assist in increasing awareness of the ecosystem's value both in terms of its direct and indirect impacts. Subsequently, it is expected that this assessment will assist in efforts to secure the long-term sustainability of resource use and socio-economic benefits in the Mara River wetlands.

Under the PREPARED project, Conservation Investment Plans (CIPs) are being prepared for selected BSAs in the Lake Victoria Basin, including the Mara Wetlands. The project envisages that each CIP should contain a section on the economic benefits associated with conserving biodiversity and/or the economic costs associated with biodiversity degradation and loss in that BSA. This assumes that information about the value of biodiversity and ecosystem services will help to justify and make the case for the conservation interventions and investment packages that are being proposed in the CIPs, and assist in better mainstreaming biodiversity priorities into government policies and budgets.

1.2 OBJECTIVES, SCOPE AND PURPOSE

Under the above consideration, the rapid assessment aimed to generate information that can be used to provide an economic justification for the Mara Wetlands CIP. To this end, it addressed four key questions, as outlined in the box below.

Questions for the Rapid Assessment

1. How and for whom do the Mara wetlands generate economic benefits?
2. What is the current value of biodiversity and ecosystem services?
3. What would be the cost of wetlands degradation and loss?
4. What would be the value added from investing in enhanced Mara wetlands conservation and wise Use?

Consequently, it is expected that the rapid valuation exercise will help improve the mainstreaming of biodiversity priorities into government policies and budgets. The rapid assessment was carried out over five days and involved field visits to the wetlands. In undertaking the valuation exercise, stakeholders and expert consultations were undertaken. In addition, literature review, collation of existing national and district statistics, data entry and analysis were completed. The stakeholders by definition were taken as those communities that live around the wetlands. It is important to appreciate that this assessment was carried out over a very short time and on the basis of very limited information. In particular, there were limited up-to-date maps of the wetlands that show land cover or estimates in terms of land use. This therefore necessitated several assumptions on which the values are based.

1.3 THE VALUATION METHODOLOGY

Most economic valuation exercises of ecosystems are now based on the Total Economic Value (TEV) framework, which attempts to go beyond the marketed outputs and direct physical products that economists have traditionally limited themselves to when considering the goods and services associated with the natural environment. The TEV framework categorizes the economic value of wetlands and other natural ecosystems into four categories: direct values (DV), indirect values (IV), option values (OV) and existence values (EV) (IUCN, 2006). The direct value refers to physical use of resources, while the indirect value refers to ecosystem services such as watershed protection, carbon sequestration, landscape, water quality and supplies. Option value refers to future economic options such as industrial, pharmaceutical or recreational applications or uses, while existence value is the intrinsic worth of the ecosystem, regardless of its use such as landscape, aesthetic, heritage, bequest and cultural values (see Figure 1.1).

Total Economic Value (TEV) = DV + IV+ OV + EV

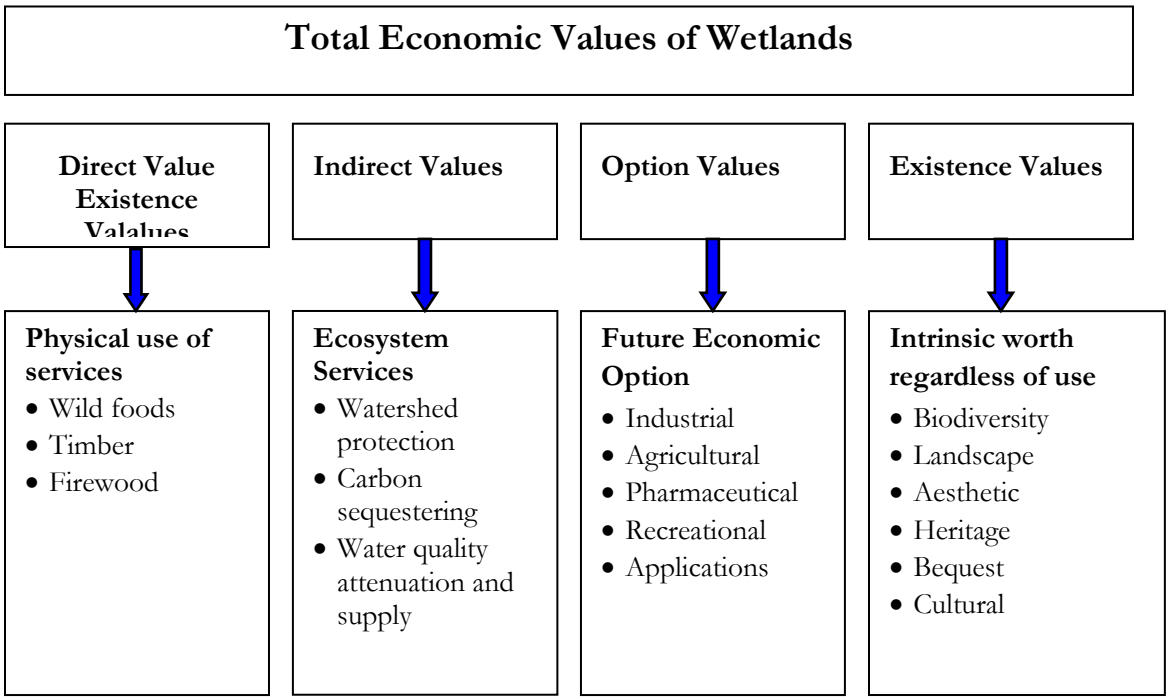

Figure 1.1. The Total Economic Value of a wetland

Source: IUCN 2006

It is rarely possible, under any circumstance, to calculate the economic value of each and every component of total economic value. For this particular study, there are also major gaps in both biophysical and socio-economic data pertaining to the Mara wetlands. For this reason, the current study focused on those ecosystem values which are of particular conservation significance or economic importance to surrounding populations, and for which sufficient data was available to enable valuation. This rapid assessment sought to articulate the economic value of the Mara Wetlands by focusing on agricultural productivity, water supply, capture fishery, wood based energy, timber and non-timber products and non-fish wetland products. Unlike other valuation methodologies, the economic valuation of natural resources is a relatively new science. It is complicated but offers a solution to the appreciation of the value of natural resources that otherwise have tended to be ignored in decision making processes.

Total economic value encompasses all components of (dis)utility derived from ecosystem services using a common unit of account; money or any market-based unit of measurement that allows comparisons of the benefits of various goods. Since in many societies people are always familiar with money as a unit of account, expressing relative preferences in terms of money values may give useful information to stakeholders and policy-makers. However, valuation techniques are affected by uncertainty, stemming from gaps in knowledge about ecosystem dynamics, human preferences and technical issues in the valuation process. It is therefore important to include uncertainty issues in valuation studies and acknowledge the limitations of the valuation techniques.

1.4 MILLENNIUM ECOSYSTEM ASSESSMENT CLASSIFICATION OF ECOSYSTEM SERVICES

This classification of ecosystem services under this rapid assessment is consistent with that of the Millennium Ecosystem Assessment Classification of Ecosystem Services which defines ecosystem services as the benefits obtained from ecosystems (MEA, 2003). The services are important in terms of meeting people's livelihood and welfare needs, including socio-economic development, food and nutrition requirements. The assessment classifies ecosystem services as Provisioning, Regulating and Cultural services. The classification has been globally accepted and applied by: The Economics of Ecosystems and Biodiversity (TEEB) and the Common International Classification of Ecosystem Services (CICES) (Maes *et al*., 2013).

1.4.1 Provisioning Services

These are defined as the products obtained from ecosystems, including food and fiber, fuel (firewood, charcoal, dung, and other biological materials that serve as sources of energy); genetic resources; and fresh water. In the Mara Wetlands, these were classified as agricultural products (crops and livestock); water supply (for crops and irrigation, domestic water use and water for livestock use); capture fisheries, timber (for poles and other building materials) and other plant based products (e.g. medicines, grazing, fodder and papyrus).

1.4.2 Regulating Services

These are the benefits obtained from the regulation of ecosystem processes, including air quality maintenance; climate regulation; water regulation; erosion control; water purification and waste treatment; regulation of human diseases; biological control; pollination and storm protection. The application of agricultural chemicals and pesticides is minimal within the wetlands' area but it is expected that the upper catchment areas, especially in Kenya where large scale farms are common, could be generating a lot of chemical wastes. From physical observations, use of latrines is common and hence the danger of pollutants leaching into the soils and ending up in the wetlands.

The Mara Wetlands regulates water flow and quality (e.g. water storage and ground recharge, waste processing, sediment trapping and flood attenuation). It also provides support to agricultural production (pollination, seed dispersal and pest control). In addition, it supports breeding/nursery habitats and refugia (e.g. aquaculture and wildlife habitat). It also helps in mitigation of climate variability and change (through carbon storage, sequestration and avoided emissions).

1.4.3 Cultural Services

These are the non-material benefits that people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, aesthetic values and experiences, spiritual and religious values, knowledge systems (traditional and formal), educational values, inspiration, social relations, cultural heritage values and recreation and ecotourism. In particular, the Mara Wetlands are important for nature tourism, research and education and as a habitat for species with special conservation value.

1.4.4 Supporting Services

Supporting services are those that are necessary for the production of all other ecosystem services. They differ from provisioning, regulating, and cultural services in that their impacts on people are either indirect or occur over a very long time, whereas changes in the other categories have relatively direct and short-term impacts on people.

CHAPTER 2: THE MARA WETLANDS

2.1 LOCATION AND SIZE

The Mara Wetlands are found in the Tanzanian part of the wider Mara Basin. The wetland is currently estimated to cover approximately 205 square-kilometers with an average width of 13 kilometers and length of 37 kilometers, covering a total 51,700 hectares. The wetland covers three administrative districts of the Mara Region, namely: Butiama, Rorya and Tarime (see Figure 2.1).

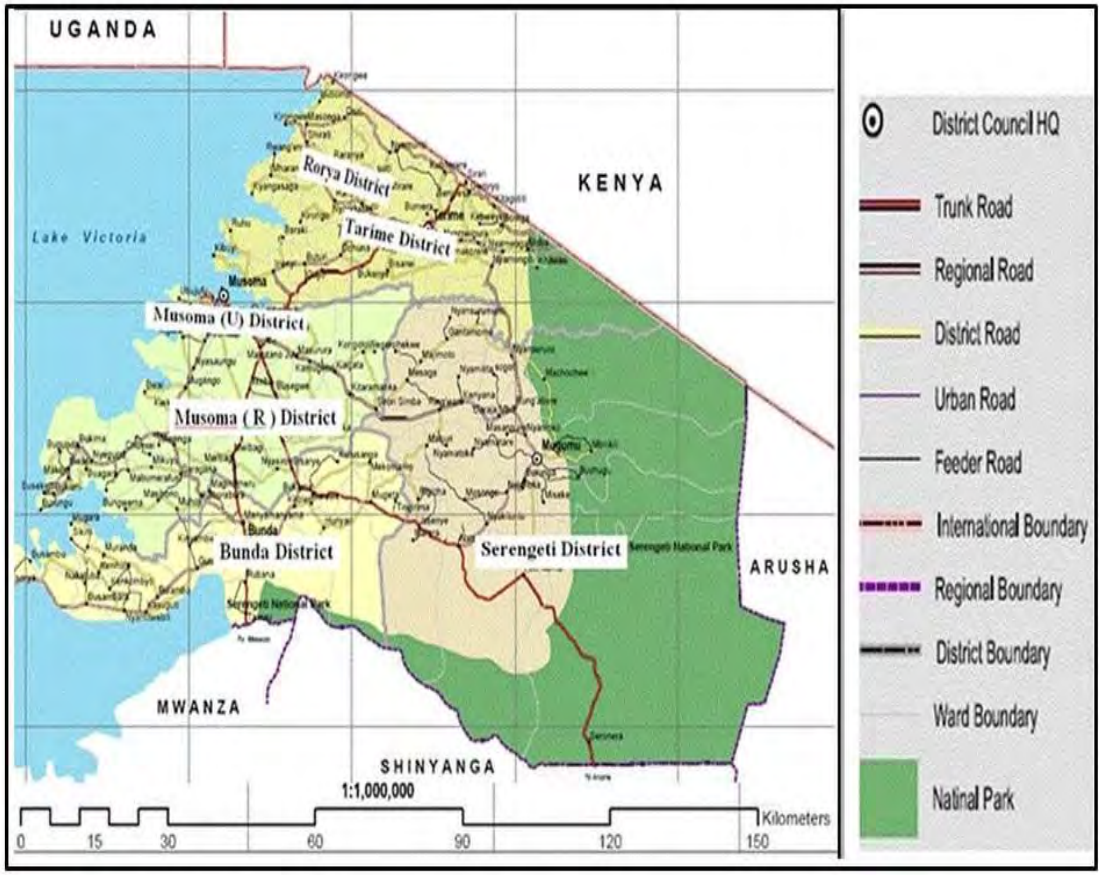

Figure 2.1. Map of the Mara Region and its administrative districts

Source: Regional Administration and Local Government Authority (2008)

The Mara Basin in its entirety is of global biological significance being home to the Maasai Mara Game Reserve in Kenya and the Serengeti National Park in Tanzania, where it has gained international recognition as a World Heritage Site and Biosphere Reserve. The area's importance may be attributed - to a large extent, on the existence of the Mara River; which originates from the Mau Forest in Kenya and empties into Lake Victoria through the Mara Wetlands. The wetlands are therefore of both global conservation significance and of great economic importance at local, regional, national and international levels. However, the wetland is increasingly under threat from conversion for agricultural cultivation and other activities and over utilization of the wetland resources (Munishi, 2007; Bogers, 2007). This chapter

attempts to quantify the benefits associated with these economic activities, with the aim of providing information which can be compared with the profits and returns to the major alternative uses of the Mara Wetlands, such as reclamation and conversion for settlement, agricultural uses and industrial developments.

This rapid valuation study of the Mara Wetlands aimed to ensure that the wetlands are conserved and utilized sustainably. The main objective was to facilitate more equitable, sustainable, inclusive and informed decision making for the Mara Wetlands conservation and use. The valuation provided a way of articulating in monetary terms the economic importance of biodiversity and ecosystem services for posterity. Although no exhaustive studies on valuing the ecosystem services of the Mara Wetlands have been carried out, "The Biodiversity Values of the Mara River (Masurura) Swamp, Mara Region Northern Tanzania" (Munishi 2007) provided very important baseline information for this rapid valuation.

2.2 THE STUDY AREA

The current population of the entire Mara Region is estimated at 1.9 million people based on 2012 national census data, with an estimated population growth rate of 2.5% per annum. The estimated population of the three study districts that border the wetlands; which were the primary focus for this study, are estimated at 16,054 in Butiama, 8,577 in Rorya and 23,983 in Tarime (see Table 2.1). The average household sizes are estimated at 6.3 in Butiama, 5.9 in Rorya and 6.3 in Tarime and therefore a total of 2,538 households in Butiama, 1,454 households in Rorya and 3,807 households in Tarime District.

There are a total of 17 villages around the Mara Wetlands namely: Kirumi, Kwisaro, Bushahili, Wegoro, Ryamisanga, Bukabwa in Butiama; Marasibora, Kwibuse, Kembwi, Bisarwi, Nyamerambaro, Surubu, Weigita and Nkerege in Tarime and Mesaga, Majimoto and Iseresere in Rorya District (Munishi 2007). However, the rapid assessment focused on a total of 10 villages selected from the three districts as listed below.

1. Butiama district

- Kirumi
- Ketesakwa
- Ryamsaga
- Wegoro
- Kongoto

2. Rorya District

- Marazibora
- Kinesi
- Kwibuse

3. Tarime District

- Nyangoto
- Mrito

Table 2.1. Population projections in the entire Mara Wetland-adjacent districts (2012-2014)

District	Population			Average Household Size	Number Of Household
	2012	2013	2014		
Butiama	241,732	247,775	253,970	6.3	38,370
Rorya	265,241	271,872	278,669	5.9	44,956
Tarime	339,693	348,185	356,890	6.3	53,919

Source: Own calculations

Generally, the Mara Region is known to have a high rural population that is largely dependent on the local economy and a high dependency ratio, where the number of dependents, aged zero to 14 and over the age of 65, depend highly on those aged between 15 and 64. It is also reported that the population has more than doubled in the last four decades with increasing negative environmental impacts depicted by land scarcity, deforestation, erosion, decline in soil fertility and lake eutrophication. For the purpose of this rapid assessment, the rural households were estimated to comprise 100% of the beneficiaries for all the three districts.

Table 2.2. Estimated population density by district (2014)

District	Population	Populated Area	Area Under Water	Population Density
Butiama	253,970	2,782	980	91
Rorya	278,669	9,252	93	30
Tarime	356,890	1,792	0	199

2.3 ECONOMIC SITUATION OF THE WETLANDS

The total arable land of the Mara Wetlands is 51,700 hectares where only 10,340 hectares are under crop production (i.e. 20% of total arable land). The main food crops grown are cassava, sorghum, maize and finger millet (see Table 2.3). It is reported that Butiama and Rorya Districts are prone to food deficiency (URT, 2013). The study established that crop production yields low returns but takes a lot of household labor. Crop production is also mainly for subsistence though household surplus (e.g. of tomatoes grown in the wetlands) is sold in the nearby markets, especially in Musoma, Isebania and Bunda.

Table 2.3. Estimated area (in ha) under major food crops in the three wetland adjacent districts of Butiama, Rorya and Tarime (2011/2012)

Food crops	Area under food crops (Ha)
Cassava	110,739
Sorghum	81,432
Maize	98,208

Sweet Potatoes	32,634
Finger Millet	115,113
Paddy	14,886
Beans	15,735
TOTAL	**365,137**

Source: URT, 2013

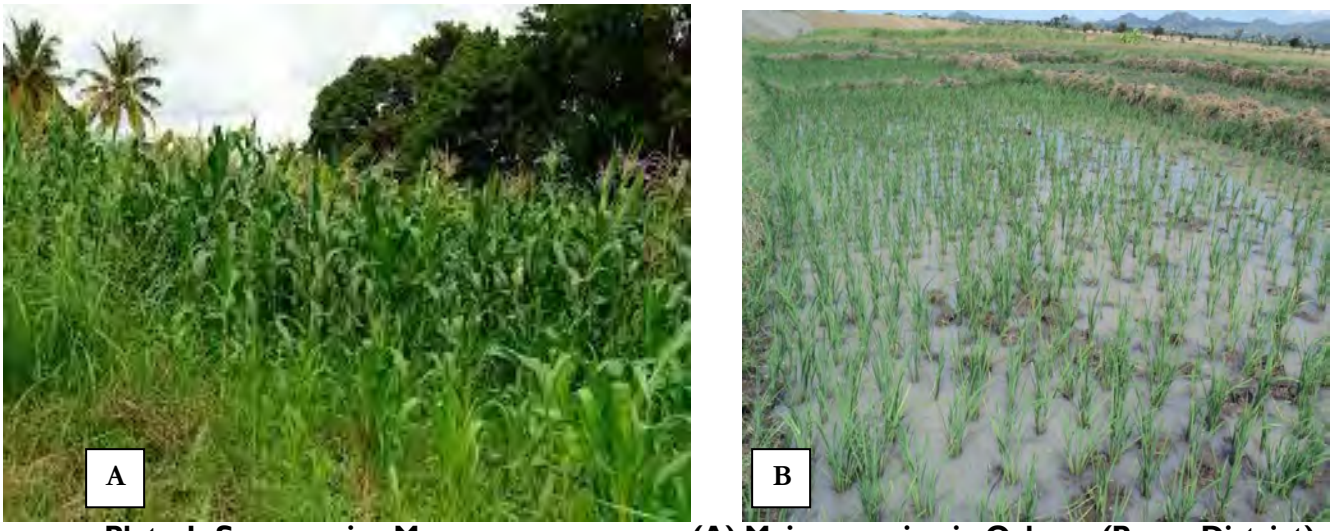

Plate 1: Some major Mara crop resources: (A) Maize growing in Ochuna (Rorya District) and (B) Paddy growing in Ochuna (Rorya District

Source: Munishi (2007)

Plate 2. Tomato produce being prepared for the market within the Mara Wetlands

2.3.1. Cash Crops

Soils and climatic conditions of the Mara wetlands region are suitable for many cash crops including coffee, cotton, sunflower and groundnuts. There is however an over dependence on cotton, which is the main cash crop. Coffee is grown by approximately 3,500 households in Tarime District, with a total pulp coffee production estimated at 2.4 billion tons per year. However, this study did not establish the presence of any cash crop grown in the wetlands.

2.3.2 Livestock Production

From the 2011/12 statistics, it was estimated that 51% of households in the Mara Region keep cattle, which is ranked as the second most important contributor to the region's Gross Domestic Product (GDP). The region has an estimated livestock population of 2 million. Of the three districts, Butiama produces the most livestock (refer to Table 2.4). However, the livestock kept are mainly local breeds kept for milk, beef and traditional ceremonies, and the sector is negatively impacted by poor productivity and yields.

Table 2.4: Estimated livestock production in Butiama, Rorya and Tarime districts (2014)

Livestock Type	Livestock Population in Numbers		
	Butiama	Rorya	Tarima
Cattle	327,843	162,027	171,628
Goats	154,343	189,856	106,625
Sheep	38,350	37,763	45,329

2.3.3 Beekeeping

Beekeeping is not very popular within the communities living adjacent to the Mara Wetlands. The trade is not well organized. It is estimated that Butiama has about 176 beehives; Rorya has 400 beehives while Tarime has about 80 beehives.

2.3.4 Fisheries resources

The entire Mara region produces around 39 million tons of fish annually contributing about 2.7% of the country's GDP. The sector employs around 40% of the regional labor force. The fish catch is both for export and domestic consumption. However, the fisheries sector in the region is not well developed as most of the fishing methods use low level technology (mainly canoes).

2.3.5 Forests resources

The Mara Region has low forest cover and its woodlands are heavily exploited for charcoal, firewood and construction materials. These are time consuming activities as a lot of time is spent in collecting firewood and making charcoal mainly using low technology kilns. The upper hills have been deforested mostly through charcoal production resulting in massive land degradation with observable major environmental changes including scouring of the riverbed and silt build-up near the lake causing back-water flow from the lake up to 40 kilometers inland (Mutie, 2005). In addition to the Tanzania Forest Service (TFS), there are various government and non-governmental organizations including Vi-Agroforestry, World Wildlife

Fund for Nature (WWF) and the Anglican Church Diocese that are involved in agroforestry and the establishment of woodlots.

2.3.6 Water resources

It is estimated that over 52% of the population in the Mara Wetlands does not have sufficient access to clean and safe drinking water. In 2013, most of the water used was ground water from deep and shallow wells distributed by the District Governments. The estimated sources of water in 2013 in the three districts are as shown in Table 2.5.

Table 2.5. Sources of ground water

Water Source	Butiama	Rorya	Tarime
Deep wells	39	9	34
Shallow wells	216	51	254
TOTAL	**355**	**60**	**288**

Source: URT 2013

This rapid valuation assessment relied heavily on Hoffman (2008), who estimated water demand in the Mara Wetlands in the rural standards of 20 liters per person per day as compared to demand for water in urban areas that is normally between 40 to 60 liters per person per day. Estimated water demand is shown in Table 2.6 below:

Table 2.6. Estimated consumption of water in the MRB in 2008

Water use	Consumption ("000 cubic meters)
Human	4,820
Livestock	4,054
Wildlife	1,837
Tourism	153
Irrigation	12,323
Mining	625
TOTAL	23,812

Source: Hoffman, (2008)

2.4 ECOSYSTEMS SERVICES

Wetland ecosystems are important to humans as well as the surrounding ecosystems in a number of ways. A review of literature showed that wetlands are an important source of natural resources as they provide a range of goods and services as well as posses a variety of valuable attributes for society, including provisioning, regulating, cultural, and supporting services (RCS, 2006; MEA, 2005; Barber, 1993). The Millennium Ecosystem Assessment (MEA) categorized the range of services provided by the wetlands into 4 as follows: (1) ***Provisioning services*** including wild foods and medicinal plants, wood based biomass and energy from natural forests and from cultivated species; (2) ***Regulating services*** among them: watershed protection and hydrological services, carbon sequestration, habitats for fauna species, pollution control, pest control and seed dispersal; (3) ***Cultural services*** including: natural based research, recreation and

education and (4) ***Supporting services*** among them ecosystem services necessary for the production of all other ecosystem services and it includes soil formation, photosynthesis and nutrient cycling. It is clear that the water, land, soils, plants, hydrological and ecological characteristics of the wetlands directly support economic activities. These economic activities can be grouped into two major categories; those which are based on wetland resources and those which depend on wetland services.

Through a participatory process, the study team members identified the Mara Wetlands ecosystem services (refer to Figure 2.2) in accordance with the Millennium Ecosystem Assessment (MEA, 2003; Emerton, 2014). This process was undertaken in a workshop held between 15 and 21 November 2015, which identified the ecosystem services and methods of valuation, the classification and prioritization of the data needs for the prioritized ecosystem services, the valuation methods for data analysis, and the location and methodology for data collection (these are summarized in Table 2.7).

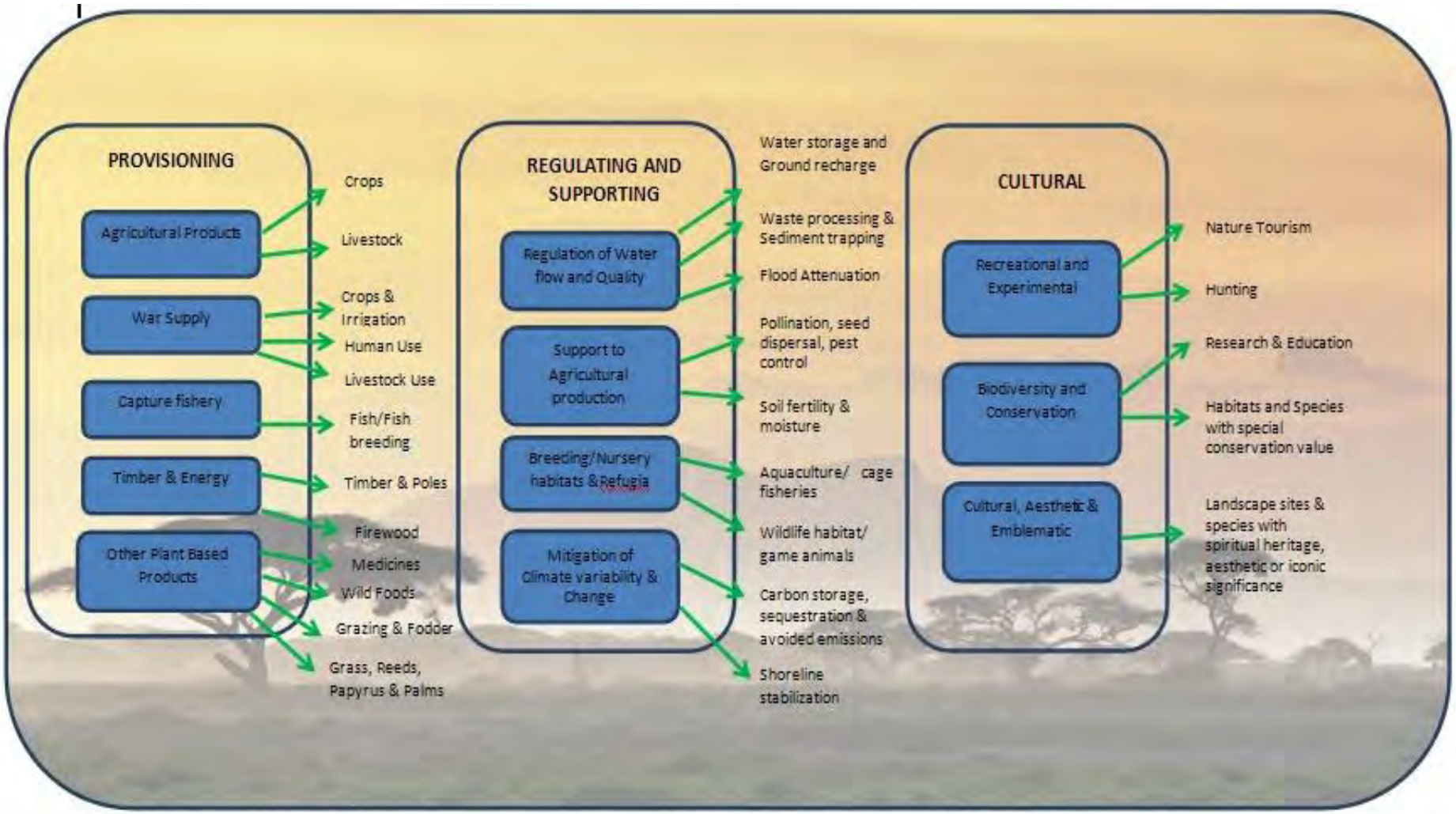

Figure 2.2. Schematic presentation of the main ecosystem services identified by the Tanzania team members

Table 2.7. Mara Wetlands ecosystem services and methods for valuation

Ecosystem services	Methods to be used	Key data needs	Where/how data would be sourced
Timber	Market price	Quantity and costs of timber per unit, quantity used per household, no. of households	Secondary sources Tanzania Forest Service (TFS), Tanzania Forestry Research Institute (TAFORI) national statistics, expert interviews, household surveys
Firewood and papyrus	Market price (travel cost method)	Quantity and costs of firewood per unit, quantity used per household, no. of households	Secondary sources TFS, TAFORI national statistics, expert interviews, household surveys
Charcoal and poles	Market price	Quantity and costs of charcoal per unit, quantity used per household, no. of households	Secondary sources TFS, TAFORI national statistics, expert interviews, household surveys
Construction materials	Market price (price of substitutes)	Quantity and costs of material per unit, quantity use per household, no. of households	Secondary sources TFS, TAFORI national statistics, expert interviews, household surveys
Medicinal herbs	Contingent and market	Quantity and costs of herbs per unit, quantity used per household, no. of households, willingness to pay	Secondary sources TFS, TAFORI national statistics, expert interviews, household surveys
Fodder (grass)	Market price	Quantity and costs of fodder per unit, quantity use per household, no. of livestock, acreage, productivity, biomass	Secondary sources TFS, TAFORI national statistics, expert interviews, household surveys
Honey	Market price	Quantity and costs of honey per unit, quantity used per household, no. of households	Secondary sources TFS, TAFORI national statistics, expert interviews, household surveys
Bush meat	Market prices of substitutes	Quantity consumed, cost of proxy per unit, no. of species	Secondary sources TFS, TAFORI national statistics, expert interviews, household surveys
Wild fruits	Market price with surrogate/contingent	Quantity, costs, market price of substitute	Secondary sources TFS, TAFORI national statistics, expert interviews, household surveys
Water provision	Market price/ replacement	Price per unit, cost per unit from alternative sources	Water board, and expert interviews
Culture (worship, ceremonies, rites)	Travel costs to cultural sites (e.g. Ngorongoro)	Costs of modes of travel, travel expenditure, expenditure on site	Household surveys, verification from travel companies
Soil conservation	Replacement (loss in productivity)	Costs of import, quantity of harvests, costs of farming inputs	Ministries of water and agriculture, Agricultural Research Institute (ARI), Fertilizer boards
Flood regulation	Damage/avoidance costs	Costs incurred due to damage, costs of mitigating infrastructure	Construction companies, Ministry of Public works
Carbon sequestration	Market price/avoided cost	Carbon prices, carbon stocks	Global carbon price, biophysical assessment, secondary data sources, Geographical Information System (GIS) Maps
Recreation	Travel costs	Travel and expenditure costs	Travel companies and agents, interviews and ground-truthing
Breeding grounds	Replacement and travel cost	Travel costs and expenditure, costs of artificial structure/substitute	Travel companies and agents, interviews and ground-truth, costs of substitute structures from construction companies and govt. agencies
Aquatic			
Water provisioning	Market price	Quantity per household and unit price	Water boards, interviews

Ecosystem services	Methods to be used	Key data needs	Where/how data would be sourced
Water quality/purification services	Replacement costs	Costs of artificial purification systems	Water infrastructure companies, Ministries of Water and Service boards
Underground water recharge	Replacement/market method	Costs of artificial purification systems	Water infrastructure companies, Ministries of Water and Service boards
Reeds/fiber	Market price		Market survey, household surveys
Fish (food)	Market price		Market survey, household surveys

2.4.1. Wetland Provisioning Services (Direct Use Values)

Wetland resources include the water, land, soils, plants and animals contained within the wetlands, all of which provide goods which can be used to generate subsistence, income and employment. In the Mara Wetlands, the use of wetland resources for fisheries, construction materials, wood based energy (firewood, charcoal), timber, game meat, papyrus harvesting, pasture, hunting, brick-making and fish farming are of particular economic importance to surrounding communities. Wetlands are also an important source of pasture and fodder for livestock, especially during the dry season. Similarly, the wetlands provide important habitats for fish and therefore fishing, most of which is done by small canoes and boats. The fish from the wetlands are caught for household consumption and sale within the local markets.

The resources contained in the Mara Wetlands also support various subsistence and income-generating activities. These activities are carried out mainly by the residents of the low-cost settlements which directly border the wetland. By far the most significant use of wetland resources in the Mara Wetlands is for small-scale cultivation by the surrounding populations. In addition, over 90% of households in the Mara Wetlands depend on firewood and charcoal as their main source of cooking energy and most of houses are grass thatched mud houses built using poles and wood, with most processed timber being sourced from the upper edges of Tarime District Council. The Wetlands are also important sources of domestic water supply to local communities. Most of the households depend on boreholes and wells although some draw water directly from the river. Some of the farmers also use the river water for irrigation and the river is an important source of water supply for domestic use and livestock production.

The wetlands provide an important source of non-wood/non fish wetland products mainly for household consumption and sale. Papyrus is harvested mainly for mats (*matete/matende*), while grass is used for fodder and thatching houses. Though not on a large scale, harvesting of wild plants and fruits for medicinal purposes and food also takes place. It is important to take note that although very many wetland resources were identified, the rapid assessment focused only on living resources, wild species and productively natural habitats. This implies that sand mining, building stones, clay extraction and brick making were not valued. The study is therefore focused on the sustainable use of the Mara Wetlands' natural resources.

The global, national, regional and local importance of the Mara Wetlands has led to various studies aimed at establishing mainly their biological and economic significance. According to Munish (2007), the wetlands are known for being home to 81 terrestrial bird species, 30 wildlife species and 14 types of fish species, in addition to the *Cyprus papyrus* (Matende/Matete) and *Typha domingensis* (mubilibili). Studies at the East African Community level, for example, have led to the classification of the Mara Wetlands as one of the eight critical ecologically sensitive areas under focus.

It is also noted that in most studies only market values are taken into account, while total biodiversity values and ecosystem services are often ignored (Munishi, 2007). This is often the case when investment decisions are made on land that is under open access regime (where there is absence of any defined property rights and therefore free and open access to the resource by everyone) or common property (where the resource is held by community users who may apportion or regulate access by members or exclude non-members). These forms of property rights differ from state ownership, where the resource is held by the government who may regulate access or grant public access, and private property, where individuals own the property and have the sole right to exclude others from accessing the resource.

Plate 3. Cyperus papyrus (matende/matete) harvested for use in (handcraft) making of mats

The Mara Wetlands are mainly under open access or common property rights and are therefore subject to limited formal control in terms of access or investment decisions on wetlands products. For example, *Cyperus papyrus* are subject to open access harvesting where harvesting is not controlled or managed by any formal organization, which can potentially lead to over harvesting and resource collapse. The lack of an effective institutional management authority to a large extent implies that the resources therein are under the jurisdiction of local communities. As a result of the interviews undertaken during this rapid assessment, the researcher found that investment decisions have traditionally been based on a very narrow view of environmental values based solely on the commercial earnings associated with the extractive utilization of natural resources and conversion of wild habitats to "productive" uses. By helping to value the broader ecosystem values, this study assists decision makers to manage these natural resources in a way that takes account of the economic benefits associated with the conservation of the natural ecosystems and the economic costs attached to their degradation and loss.

2.4.2 Wetland Regulating and Supporting Services (Indirect Use Values)

The regulating / supporting services include the hydrological and ecological functions of wetlands, which support and maintain economic activities and human settlement. Some of the most important wetland regulating and supporting services include the purification and treatment of wastewaters, flood control services, carbon sequestration, provision of suitable breeding habitats for fisheries resources and increased soil fertility for crop production among others. For instance, the wetlands act as sinks for wastes and residues and protect human and natural production systems. The wetlands play a key role in terms of water flow, water quality and water recharge. The vegetation also helps to regulate the release of water therefore helping to avoid extreme flooding from the highland areas in Kenya. In addition, the wetlands help with nutrient cycling, diluting and purifying waste water and other effluent discharge from the upper agriculturally productive regions, mining areas and heavy tourism establishments, and help to trap silt and

sediments that would otherwise be deposited in Lake Victoria. In addition, the natural wetland vegetation provides services of climate mitigation including carbon stocks and carbon sequestration.

Plate 4. Small scale gold processing by use of mercury in Morito Village

These regulating services provide economic benefits which accrue throughout the Mara Basin. Without these functions, the dangers of chemicals from crop production, mercury and other heavy metals mainly from waste water from gold mines and chemicals from cattle dips could be disastrous.

Plate 5. Waste water ponds in small scale gold processing in Morito Village

In addition, the Mara Wetlands ecosystem processes and functions provide a variety of indirect services that support crop production. Without the wetlands, agricultural production would be limited to dry land crops or irrigation. For example, the Mara wetland has fertile deposits of soils that support agriculture. The wetlands also provide an important breeding area or nursery for fish and some wildlife species. It is also noted that the wetlands contribute to crop production through pollination, pest control and the decomposition process.

Insects and wind pollinate plants and trees which is essential for the development of fruits and vegetables. Animal pollination is an ecosystem service mainly provided by insects but also by some birds and bats. About 87 of the 115 leading global food crops depend upon animal pollination including important cash crops such as cocoa and coffee (Klein *et al.,* 2007). Ecosystems are also important for regulating pests and vector borne diseases that attack plants, animals and people. Ecosystems regulate pests and diseases through the activities of predators and parasites. Birds, bats, flies, wasps, frogs and fungi all provide natural controls.

2.4.3. Mara Wetlands Cultural Services (Existence Values)

There are various cultural sites of great significance to the local communities. These sites are managed through traditional systems. Aesthetic appreciation of nature and inspiration for culture has been intimately related throughout human history and a number of areas in the Mara Wetlands are considered sacred or have religious meaning. Nature is also a common element of all major religions, while traditional knowledge and associated customs are important for creating a sense of community and belonging.

Some of the wetland cultural services known as existence values include recreational and experimental services which are of importance to the tourism industry, game hunting, biodiversity and conservation. These values are often of importance due their educational and research purposes. While other aspects are important due to the cultural, aesthetic and emblematic services they provide, for example landscape sites and species with spiritual heritage, aesthetic and/or iconic significance.

2.5. VALUATION METHODS

This study sought to use the market price approach to estimate provisioning services and benefit transfer approach for estimating regulating/supporting and cultural services offered by the wetlands. The market price approach is most often used to obtain the value of provisioning services, since the commodities produced by provisioning services are often sold in agricultural markets for example. The price of a commodity multiplied by the marginal product of the ecosystem service is an indicator of the value of the service, consequently, market prices can also be good indicators of the value of the ecosystem service that is being studied.

The benefit transfer method is used to estimate economic values for ecosystem services by transferring available information from studies already completed in another location and/or context. For example, values for recreational fishing in a particular region may be estimated by applying values of recreational fishing estimated by a study conducted in another region. Thus, the basic goal of benefit transfer is to estimate benefits for one context by adapting an estimate of benefits from some other context. Benefit transfer is often used when it is too expensive and/or there is too little time available to conduct an original valuation study, yet some measure of benefits is needed. It is important to note that benefit transfers can only be as accurate as the initial study. The benefit transfer method was selected in this case for two main reasons. First, due to time constraints to conduct site-specific benefits studies and second, due to the fact that values for recreational uses are relatively easy to transfer.

2.6 BENEFICIARIES OF THE MARA WETLANDS

The Mara Wetlands is well known as the home to diverse biological resources and as demonstrated above offers numerous ecosystem services of international, national, regional and local importance. Some of the key local beneficiaries of the wetlands are women's groups, mainly conducting small scale agriculture, mat (*Matete/Matende)* making, beekeeping, water harvesting, and brick making. Local stakeholders of the Mara Wetlands include the district authorities, government agencies, local NGOs, religious organizations and community based organizations.

During the rapid assessment, the local communities could easily identify various resource user groups like the water users associations, brick making groups and fishing groups depending mainly on the related activities. Likewise, it was evident that the local communities could easily identify government institutions and their roles and responsibilities in the management of the wetland resources. The support activities by WWF, Vi-Agroforestry, International Union for Conservation of Nature (IUCN), African Medical Research Foundation (AMREF), the East African Community, the Nile Basin Initiative, the United States Agency for International Development (USAID), the Food and Agriculture Organization of the United Nations (FAO) and the World Bank were also cited as contributing to the sustainable conservation and utilization of the Mara Wetland resources.

2.7 CHALLENGES FACING THE MARA WETLANDS

The challenges facing the Mara Wetlands ecosystem can be attributed mainly to ecosystem degradation and resultant decline in ecosystem services. The degradation and decline in the ecosystem services can be largely attributed to:

i) Land use changes due to conversion, including encroachment on wetlands' floodplains and expansion of agricultural lands into the wetlands

ii) Soil erosion due to livestock, wildlife and deforestation. Soil erosion is also very common on steep slopes where there is vegetation clearing, intensive cultivation, and poor land management practices. This leads to expansion of wetlands due to siltation.

iii) Pollution (both point source and diffuse)

iv) Water resource allocation i.e. diverting water for irrigation while ignoring environmental flow requirements.

The above mentioned challenges have implications on the status of the wetlands and their sustainability. This therefore calls for a very coordinated approach on awareness creation related to the broader values and importance of the ecosystem. It is expected that this study will contribute to that initiative.

CHAPTER 3: METHODOLOGY

3.1 INTRODUCTION

Prior to the commencement of this rapid assessment study a review of literature was carried out. The application of a TEV framework provides useful evidence to support habitat conservation policies by quantifying the economic value associated with the protection of biological resources. Hanley and Shogren (2001) and Pearce (2001) argue that the measurement of the economic value of biodiversity is a fundamental step in conserving this resource, since "the pressures to reduce biodiversity are so large that the chances that we will introduce incentives without demonstrating the economic value of biodiversity are much less than if we do engage in valuation". By assigning monetary values to biodiversity, the benefits associated with biodiversity can directly be compared with the economic value of alternative resource use options (see also Nunes and van den Bergh, 2001). The TEV concept was subsequently selected as the best environmental valuation framework to apply for estimating the value of the Mara Wetland.

The data and information collection process started with training of ten officers from both the Tanzania Government team and nominated officials from the respective district councils (refer to Annex 1). Through the PREPARED project, the Tanzania Governmen team members had already undergone preliminary training on valuation of ecosystems. The team had also benefited from additional training by the regional consultant undertaking the Sango Bay–Minziro Forest valuation exercise in October and early November, 2015. In addition, the participation of technical officers from the three districts provided the additional technical expertise required for data and information collection. During the training for this study, participants went through the identification of biodiversity and ecosystem values, the ranking process, the tools for valuation and the data analysis process. Appropriate examples were provided of similar work undertaken within the East African Community and elsewhere.

The field surveys to collect the socio-economic data were done using two major rural survey tools; questionnaires and PRA techniques. Questionnaires were administered to 30 randomly selected households from Kirumi, Ketesakwa, Ryamsaga, Wegoro and Kongoto in Butiama; Marazibora, Kinesi and Kwibuse in Rorya and Nyangoto and Mrito in Tarime District Councils.

Plate 6. Administration of the questionnaire to households in Morito Village

Focus Group Discussions (FGDs) were also undertaken in all three districts with professionals from different sectors within the districts, in particular the Natural Resources and Game Officers from Tarime, Ward Executive Officers, village government officials and village environmental committee members from each village involved. In the FGDs, information on both aquatic and terrestrial biodiversity resources from the wetlands was collected with a focus on resources of local economic, livelihood and/or welfare importance.

3.2 FOCUS OF THE RAPID VALUATION

The valuation study of the Mara Wetlands focused on agricultural productivity, water supply, capture fisheries, wood - based energy, timber and non-timber products and non-fish wetland products. In particular, it aimed at establishing the following values:

i) ***Agricultural productivity:*** Information on cultivation of (mainly) food crops was collected. As livestock keeping is a major economic activity, the study also collected information on seasonal grazing patterns.

ii) ***Water use:*** The study collected information on water use in urban settlements, industry and households.

iii) ***Fisheries:*** Given that most fishing in the area consists of small-scale, artisanal fishing, information on fisheries resources was also collected. In addition, data on commercial and small-scale artisanal fishermen was sourced.

iv) ***Wood-based energy and timber:*** Most of the local households use firewood and charcoal as their main sources of energy. The study therefore collected information on household energy use.

v) ***Non-timber products:*** Information on the use of earth bricks, mud and clay for construction of buildings was also of interest to the study and was therefore included in data collection.

vi) ***Other data and information:*** In addition, the rapid assessment collected information on non-fish wetland products. Particularly those wetland products for home consumption or sale, such as wild plants for food and medicines and non-subsistence hunting. For example, harvesting of medicinal plants is a very common phenomenon in the villages due to the long travel distances required to access the available health centers.

3.3 THE QUESTIONNAIRE

The questionnaire was developed to collect information on the variables and indicators at household level (Annex 2). It sought to collect information on products being collected by the communities. The questionnaire included questions on quantities collected, magnitude and frequency of collection and estimated prices. Due to time limitations, flow values rather than the stock values were used to allow estimation of the benefits that accrue to the local communities from the wetland.

Discussions with the communities showed that they are aware of many of the non-consumption benefits that come from the wetlands, in particular flood control and watershed protection. The information collected therefore focused on their level of willingness to pay for/or participate in conservation activities.

To ensure that the questionnaire was relevant to the local context, the draft questionnaire was discussed and pre-tested in the field. As a result, additional information mainly on mining was added and the questionnaire was revised accordingly. During the review, it was also agreed that the sequence of questions be re-organized in order to create more time for priority questions and improve the flow of the interview process.

3.3.1 Site Selection

The following criteria was used for site selection for administering the questionnaire.

***a) Proximity of Villages*:**

Due to various challenges including time available for the field work, only sites that were easily accessible by the valuation team within a half-day two-way drive from Musoma were selected for the rapid assessment.

***b) Community Awareness of Valuation Approach*:**

It was also decided that the interviews should be focused on villages that had some level of awareness of the PREPARED project and therefore had a fair understanding of conservation activities being executed. The list of potential villages was therefore developed based on villages in the three districts where either the Tanzania Government team members had some previous experience, or those that had been involved during the background work done by WWF.

c) Proximity to the Wetland Resource and Level of Interaction with the Resource

It was also considered important that sites where local communities heavily depend on the wetland be selected as they could give realistic values of the resources.

3.3.2. Sampling Procedures

Convenience sampling technique was used to select respondents for the study. The size of the sample (no. of households) was kept relatively small because of the time available for the study. It was therefore agreed that the sample would constitute a minimum of nine households in every village. The selection was to include a variety of stakeholders, including village executives and small scale farmers and other wetland users. The survey was not meant to generate statistically significant figures across a wide sample population, but rather to come up with indicative estimates of wetland resources.

3.3.3 Focus Group Discussions

In all the villages visited, deliberate effort was made to have FGDs with the technical people at the district and village level (such as the Village Executive Chairman or Secretary). Resource users were also included in the FGD exercises. The purpose of the FGDs was mainly to get an in-depth understanding of community perceptions of the wetlands and wetland resources. This provided an essential supplement to the quantitative data collected using the household questionnaire. The purpose of the discussion was explained and species of natural resources were named and described in detail. The group was asked to describe how households gain access to resources, and any limitations on use. Information on the type of equipment used to harvest different resources, their prices and durability, and whether they are shared among households was also sought. The seasonality of different agricultural activities was also collected, as was information about the prices of each resource and the products made from them.

3.3.4 Administration of the Questionnaire

The three research teams (one for each district) worked in twos or threes to administer the questionnaire. A total of three districts adjacent to the Mara Wetlands were selected from which 10 villages were included in the study.

The questionnaire was administered in an open-ended manner, often probing to elicit details and clarify issues. Each household/group took about three hours to complete the process of administering the

questionnaire. Face-to-face interviews were carried out with interviewees at the village level. This approach helped to get more information beyond what was asked for in the questionnaire.

3.4 DATA ANALYSIS METHODS

All the data sheets that had been used in the field were examined to assess uniformity and identify any gaps in data capture. This was important as some of the units of measurement were different e.g. in bags, tins, bundles, sticks and head loads. It was therefore necessary to standardize the results into one unit of measurement for each of the variables.

To enable easy data analysis it was necessary to also code the variables measured in the field. A simple coding system was developed (*i.e.* for energy source: firewood = 1; charcoal = 2). Ranking was also employed to identify the difference between magnitudes of different variables.

3.4.1 Data Entry

Data was entered into a spreadsheet for all the coded variables and Microsoft Excel software used to analyse the data.

3.4.2 Data Analysis

Prior to analysis, data was sorted by households, distance from the resource, nature of wetland resources obtained and cost attached to each of the resources. Data analysis involved tabulation and generation of graphs and pie charts with an emphasis on presenting community relevant evaluation parameters such as:

i) ***Expenditure:*** To establish income levels by proxy and therefore determine the trends in the levels of dependence on the wetland resource.

ii) ***Products collected from the wetlands by the community:*** In order to get an idea of the direct values, which they place on the wetland.

iii) ***Quantities harvested per person, per given time and their associated prices.***

iv) ***Willingness to pay or receive compensation in respect of the wetland as a whole.***

v) ***Market prices as perceived by the communities.***

3.5 ESTIMATION OF ANNUAL PRODUCTION AND INCOME

3.5.1 Estimation of Annual Production

Annual production was calculated based on data collected from the Mara wetlands. The number of households was extrapolated for the whole community surrounding the wetland and for each product. This number was multiplied by the average annual quantity calculated for each household.

3.5.2 Annual Gross Value of Production

An average market price as perceived by the respondents was established for each of the products. The price was multiplied by the annual production established above to get the annual gross production value.

3.5.3 Estimation of Annual Income

Annual Income was calculated from the monthly expenditure items given by the respondents. The basic assumption was that annual expenditure for each household provides an estimate of its annual income and that local communities would spend the income that they get from sale of the Mara wetland products.

3.5.4 Estimation of Annual Cash Income

The average price established above was multiplied by the total annual amounts sold to get the annual cash income accruing to the communities from the wetlands.

CHAPTER 4: VALUATION OF THE MARA WETLANDS ECOSYSTEM SERVICES

4.1 INTRODUCTION

The valuation process considered the ecosystem services of the Mara wetlands in terms of provisioning, regulating and cultural functions. The wetland area was defined as the area that is adjacent to the waters of the Mara River and the populated areas within the river catchment. Population statistics using the National Census Report of 2012 in the three Districts (Butiama, Rorya and Tarime) including population size and the number of households was considered. The study also considered other services including agriculture and livestock production, water supply and capture fisheries. Wood-based and non-timber products (use of timber, fuel wood and charcoal) was also analyzed. Non-fish wetland products including use of *Cyperus papyrus* and grass were also valued. In all cases the calculations were based on projected 2014 production estimates since by the time of writing the report, the 2015 estimates were not available yet.

4.2 GROSS INCOME FROM AGRICULTURAL PRODUCTION

The value of agricultural production was calculated based on crop agriculture and livestock production. The Mara Wetlands are often used for agriculture because of their available water and high soil fertility. Although, it is noted that the National Agricultural Policy emphasizes small-scale irrigation schemes and rehabilitation of tradition irrigation systems, because they have a less negative environmental impact on wetlands services and functions, all the villages in the three districts predominantly focus on crop production, mainly due to soil fertility in the wetlands and availability of water. The value for crop production in the Mara Wetlands during the current rapid evaluation period was estimated at **US$ 1.39 million** per year or **US$ 29** per capita per year (See Table 4.1).

Table 4.1. Gross income from agriculture in the three districts (Butiama, Tarime and Rorya) combined (2015)

Crops	Harvest/HH	Total pop.	Av. No. of ppl per HH	Total no. of HH	% of HH growing crops	No of farmers/HH	Total production	Price/ Unit (Tsh)	Gross income (Tsh) per yr	Av. cost of production (Tsh)	Total cost of production (Tsh) per yr	Net income (Tsh) per yr	Net income (USD in mill) per yr
Butiama District													
Maize (bags)	5	16054	6.3	2548	51%	1299	6497	3600	23390640	230000	1150000	22240640	0.02
Beans (bags)	3	16054	6.3	2548	40%	1019	3058	85000	25982196000	210000	630000	259266000	0.20
Millet (bags)	2	16054	6.3	2548	30%	764	1529	48000	73382400	120000	240000	73142400	0.06
Cassava (bags)	2	16054	6.3	2548	30%	764	1529	30000	45864000	120000	240000	456244000	0.04
Sweet potatoes (bags)	5	16054	6.3	2548	30%	764	3822	42000	160524000	150000	750000	159774000	0.13
Vegetables (kg)	30	16054	6.3	2548	50%	1274	38220	500	19110000	160000	4800000	14310000	0.01
Tomatoes (kg)	20	16054	6.3	2548	20%	510	10192	600	6115200	25000	500000	5615200	0.004
Rorya District													
Maize (bags)	5	8577	5.9	1454	51%	742	3708	3600	13347720	230000	1150000	12197720	0.01
Beans (bags)	3	8577	5.9	1454	40%	581	1745	85000	148308000	210000	630000	147678000	0.12
Millet (bags)	2	8577	5.9	1454	30%	436	872	48000	41875200	120000	240000	41635200	0.03
Cassava (bags)	2	8577	5.9	1454	30%	436	872	30000	26172000	120000	240000	25932000	0.02
Sweet potatoes (bags)	5	8577	5.9	1454	30%	436	2181	42000	91602000	150000	750000	90852000	0.07
Vegs (kg)	30	8577	5.9	1454	50%	727	21810	500	10905000	160000	4800000	6105000	0.005

Tomatoes (kg)	20	8577	5.9	1454	20%	291	5816	600	3489600	25000	500000	2989600	0.002

Tarime District													
Maize (bags)	4	23983	6.3	3807	51%	1942	7766	3600	27958608	230000	920000	27038608	0.02
Beans (bags)	3	23983	6.3	3807	40%	1523	4568	85000	388314000	210000	630000	387684000	0.3
Millet (bags)	2	23983	6.3	3807	30%	1142	2284	48000	109641600	120000	240000	109401600	0.09
Cassava (bags)	2	23983	6.3	3807	30%	1142	2284	30000	68526000	120000	240000	68286000	0.05
Sweet potatoes (bags)	5	23983	6.3	3807	30%	1142	5711	42000	239841000	150000	750000	239091000	0.19
Veges (kg)	30	23983	6.3	3807	50%	1904	57105	500	28552500	160000	4800000	23752500	0.02
Tomatoes (kg)	20	23983	6.3	3807	20%	761	15228	600	9136800	25000	500000	8636800	0.01
Net income from crop production on the 10 villages around the wetland												**1,771,252,268**	**1.39**

Assumptions:

Harvest per household was obtained from study questionnaire
Total number of HH was obtained from the national census report (2007)
% of HH growing crops was obtained from the study questionnaire and an average figure computed for all the three districts since they did not show much variation Number of farmers / HH was obtained by multiplying the % of HH growing crops by the total HH population
Total production was obtained by multiplying harvest per HH by number of farmers
Price per unit of product was obtained from other recent studies in Tanzania
Total income was obtained by multiplying total production by price per unit of product
Average market price of products was obtained from the questionnaire
Net income was obtained by subtracting the average cost of production from total income.

Plate 7. Tomato plantation within the Mara Wetlands

4.3 GROSS INCOME FROM LIVESTOCK PRODUCTION

The Mara Wetlands are a rich source of grazing and fodder for livestock production, with most livestock in the three districts depending on the wetlands for grazing and watering. From the study findings, livestock is dependent on the wetlands for at least eight months during the dry season. During the wet season the livestock mainly graze in the highlands. The study considered only cattle, goats and sheep.

4.3.1 Gross Value of Water for Livestock

Butiama has the highest gross income from water use for livestock at **US$ 309,619 in 2015** compared to Tarime and Rorya that were valued at **US$ 242,406 and US$ 119,233** respectively (see Table 4.2). The total value of water for livestock in the Mara wetlands calculated on the willingness to pay basis based on the above assumptions was estimated at **US$ 671,259** per year.

Table 4.2. Gross returns from water for livestock use (2015)

District	Total Pop.	Total no of HH	No. of HH rearing livestock	No of livestock per HH			Total no of livestock			Water consumption per livestock			Total water consumed (per/day)	Returns from water (Tsh per year)	Returns from water (USD per year)
				Cattle	Goat	Sheep	Cattle	Goat	Sheep	Cattle	Goat	Sheep			
Butiama	16054	2548	1,300	6	3	1	7800	3900	1300	195000	15600	5200	215800	39385000	309619
Rorya	8577	1454	742	4	2	1	2968	1484	742	74200	5936	2968	83104	151664800	119233
Tarime	23983	3807	1942	3	2	1	5826	3884	1942	145650	15536	7768	168954	308341050	242406
Total returns from water for livestock														**853840850**	**671,259**

Assumptions on water requirements

That a household keeps on average 6, 4, 3 cattle, 3, 2, 2 goats and 1, 1, 1 sheep in Butiama, Rorya and Tarime, respectively (Regional commissioner's office, Musoma, 2012).
That 1 cattle consumes 25 litres of water a day, one goat consumes 4 litres per day and one sheep consumes 4 litres per day.
The percentage of household keeping livestock was estimated at 51% based on previous studies in the Mara Swamp (Regional commissioner's office, Musoma, 2012).
Average number of livestock types per household (HH) obtained from respondents using questionnaire.
Cost of 1 litre of water = 5 Tsh.
In estimating daily water requirements, it is best to stay on the high side.

4.3.2 Gross Value of Grass for Fodder

The Mara Wetlands provide important dry season grazing for livestock. However, the study found out that over 79% of the livestock are grazed in the wetlands even during the relatively wet season. Other studies in the region (Munishi 2007) describe the Mara Wetlands as key to livestock due to availability of pasture throughout the year, with some of the livestock grazing in the wetlands coming from as far away as 100 kilometers. It is therefore expected that the dependence on the wetlands for fodder will continue to increase as the region experiences increasing impacts of climate variability and reduced reliability of rainfall. For the purposes of this study, the livestock population considered is that from the villages adjacent to the wetlands.

The grass requirement for the wetland area was estimated based on the Tropical Livestock Units (TLUs) for each district (refer to Table 4.3 below). The total value of fodder was estimated at **Tshs. 503 million** per year or **US$ 395,397** per year. From the findings, it was clear that the Tarime District derives the highest net return from pasture and fodder availability as demonstrated in Table 4.3 and Figure 4.1 below.

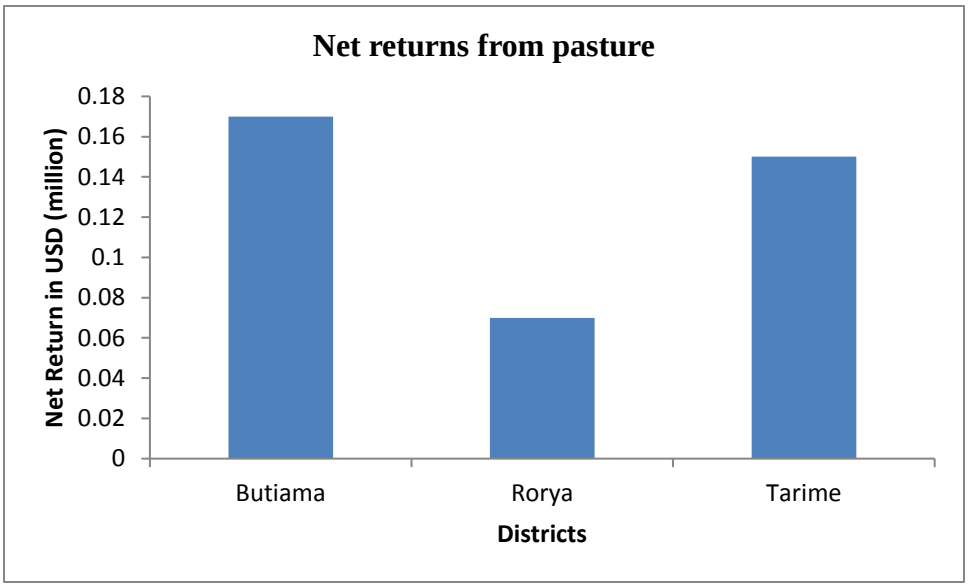

Figure 4.1. Grass requirement for the wetland area (estimated using TLUs)

4.4 GROSS RETURNS FROM DOMESTIC WATER SUPPLY

The valuation of water supply also considered water for urban settlements, water for rural households and water for industry. From the study findings, most domestic water users use about 20 liters of water per day. Most water used is from ground water, rain water or water harvested from the Mara River. The gross return from water in the industries was not calculated due to lack of industries in the three districts of Rorya, Butiama and Tarime. There are very few urban households in the three districts with an estimated rural population of 95%. However, within the 17 villages adjacent to the Mara wetland the population is 100% rural. The total domestic water value for the three districts was estimated at **US$ 555,421** per year equivalent to **US$ 11.52** per capita per year (Table 4.4 below).

4.5 GROSS RETURNS FROM WATER FOR IRRIGATION

There are no major irrigation projects within the Mara wetlands. However, the local communities use water buckets and small domestic water pumps for small scale irrigation. The crops grown are mainly vegetables for both household use and for sale. For purposes of cost estimates, the cost of water for irrigation was embedded in the valuation of agricultural produce.

Table 4.3 Gross value of grass for fodder

District	Total no, of HH	% of HH keeping livestock	No. of livestock per HH			Total no. of livestock			Total Livestock unit	Gross returns per TLU per year (Tsh)	Production cost (Tsh) per yr	Net income in Tsh per yr	Net income in USD per yr
			Cattle	Goat	Sheep	Cattle	Goat	Sheep					
Butiama	2548	1300	6	3	1	7797	3898	1300	16943	220170896	850000	219320896	172422
Rorya	1454	742	4	2	1	2966	1483	742	16943	87947724	850000	87097724	68473
Tarime	3807	1942	3	2	1	5825	3883	1942	16943	197375784	850000	196525784	154,501
TOTAL													**395,397**

Table 14.4 Gross returns domestic water supply

District	Total no of HH	Rural pop. using wetland water (%)	No. HH using wetland water	Av. no. of ppl per HH	Total no. of ppl	Water used per HH/day (liters)	Value of water per day	Value of water per year	Total labour cost per year (Tsh)	Returns on water per year (Tsh)	Returns on water per year (USD)
Butiama	2,548	40%	1019	6.3	6421	128419	642096	234365040	1095000	233270040	183388
Rorya	1,454	40%	582	5.9	3431	68629	343144	125247560	1095000	124152560	97604
Tarime	3,807	40%	1523	6.3	9594	191873	959364	350167860	1095000	349072860	274,428
Gross returns on domestic water supply											**555,421**

Assumptions:
That the amount of water consumed was 20 litres per person per day for rural populations as obtained from the questionnaire.
The cost of water per litre was Tsh 5 per litre.
Proportion of household not served with tap water and assumed to be using water from wetland was estimated at 40% (Mara Region: Investment Profile 2012).
That the entire population within the 10 villages was taken as rural population.

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4.6 GROSS INCOME FROM CAPTURE FISHERY

Fishing forms an important source of food and income to households living within the Mara Wetlands. Most of the capture fishery is artisanal and the fish that ends up in the market is sold within the local towns and Musoma. The total capture fishery in the Mara Wetlands was estimated at **US$ 414,393** or **Tshs. 527.1 million** (see Table 4.5).

Table 4.5. Gross returns from capture fishery in 2015

District	Total pop.	Total no of HH	No. fishing HH	Amount of fish (kgs) per HH per year	Gross income from fishing per yr	Total labour cost per year (Tsh)	Returns on fishing Tsh per yr	Returns on fisheries in USD per yr
Butiama	16054	2548	1147	687960	3783780000	3611790000	171990000	135,212
Rorya	8577	1454	654	392580	2159190000	2061045000	98145000	77,158
Tarime	23983	3807	1713	1027890	5653395000	5396422500	256972500	202,022
Gross Income from capture fishery							**527,107,500**	**414,393**

Assumptions:

That 45% of households across all villages carry out fishing and each fishing household captures 40 Kgs per week for 15 weeks per year.

The price of fish per Kg is taken as Tshs. 5,500.

Labour cost was taken as 30,000 per HH per day obtained from the study.

4.7 GROSS VALUE FROM WOOD-BASED AND NON-TIMBER PRODUCTS

The wood based and non-timber products in the Mara region are mainly used for construction of buildings. These include timber, poles, sand and clay. In addition, the communities living around the wetland are highly dependent on wood fuel (firewood and charcoal). It is estimated that 77% are dependent on firewood alone to meet their domestic energy demand. Most of this firewood and charcoal is from open woodlands managed by the communities or from government forests and open areas under community management. Some of the charcoal is also sold in the nearby towns. Over 90% of the households live in mud houses made from poles and wood. The wood based and non-timber products in the Mara region was estimated at **US$ 556,518** or **Tshs. 707.9 million** per year, equivalent to **US$ 11.45** per capita per year (see Table 4.6).

Table 4.6. Return from wood based and non-timber products in 2015

Wood based & non-timber products	Total population	Total no of HH	% of HH relying on products	No of Household relying on wetland products	Average per HH value of products in Tsh per year	Total value of products per year (Tsh)	Cost of labour	Total cost of labour per yr	Total returns in Tsh per yr	Total returns in USD per yr
Tarime										
Timber (M2)	16054	2548	0.40	1019	31800	32410560	2500	2548000	29862560	23477
Firewood (Bundles)	16054	2548	0.50	1274	127200	162052800	2500	3185000	158867800	124896
Charcoal (50Kgs bags)	16054	2548	0.35	892	89040	79405872	2500	2229500	77176372	60,673
Building Sand (Tons)	16054	2548	0.15	382	25440	9723168	2500	955500	8767668	6893
Total									**274674400**	**123224**
Rorya										
Timber (m2)	8577	1454	0.40	582	31800	18494880	2500	1454000	17040880	13,397
Firewood (Bundles)	8577	1454	0.50	727	127200	92474400	2500	1817500	90656900	71,271
Charcoal (50Kgs bags)	8577	1454	0.35	509	89040	45312456	2500	1272250	44040206	34623
Building Sand (Tons)	8577	1454	0.15	218	25440	5548464	2500	545250	5003214	3,933
Total									**156741200**	**123,224**
Butiama										

Timber (m2)	339693	3807	0.30	1142	31800	36318780	2500	2855250	33463530	26308
Firewood (Bundles)	339693	3807	0.32	1218	127200	1544960128	2500	3045600	151914528	119430
Charcoal (50Kgs bags)	339693	3807	0.25	952	89040	84743820	2500	2379375	82364445	64752
Building Sand (Tons)	339693	3807	0.10	381	25440	9685008	2500	951750	8733258	6866
Total									**276475761**	**217,355**
Wood Based & non Timber Products in 2015									**707891361**	**556,518**

Plate 8. Charcoal being packed and transported from Kirumi Village to Musoma Town

4.8 HONEY PRODUCTION

The total beehive population in the three districts was estimated at about 656 beehives. Most apiaries have traditional beehives and use fairly rudimentary traditional production technologies. This factor has implications on production per hive. Butiama achieved the highest returns from in honey production with a value of US$ 6,300 per year in 2015. The total annual return from honey was estimated at **US$ 11,140** or **Tshs. 14.17 million** per year (See Table 4.7).

Table 4.7. Total annual return from honey (2015)

District	Total population	N. of HH	No. of beehives	Production per beehive/yr (Kg)	Total honey produced per year (Kgs)	Av cost of honey per kg (Tsh)	Gross income from honey per yr (Tsh)	Returns from honey per year in USD
Butiama	16054	2548	371	8	2968	2700	8013600	6,300
Rorya	8577	1454	21	8	168	2700	453600	357
Tarime	23983	3807	264	8	2112	2700	5702400	4,483
Total annual return from honey							**14,169,600**	**11,140**

Assumptions:

No. of beehives in the study area obtained from respondents through questionnaire.

Production per bee hive obtained from other studies and the questionnaire.

The average cost of honey is obtained from other similar studies.

4.9 OTHER WETLAND PRODUCTS (NON-FISH WETLAND PRODUCTS)

Gross returns from non-fish products include harvesting of medicinal plants, bush meat, honey, water weeds (mainly *Cyprus papyrus*) and wild fruits. Papyrus was mainly harvested for mats while grass cutting was mainly harvested for house roofing (refer to Table 4.8).

In terms of value, travel cost to collect medicinal plants was applied. Medicinal plants have the highest value in Butiama at US$ 5,985 per year compared to US$ 4,005 in Tarime and US$ 2,285 in Rorya. The use of medicinal plants may be a good reflection of the relative long distances of households from organized medical facilities (e.g. government medical centers). As observed during the study, the distribution of government health facilities in the villages within the Mara wetlands is sparse. This situation may explain the relatively high use of medicinal herbs by the local people.

Despite the high regulation of bush meat trade, there was evidence of its availability and especially in Tarime where bush meat was available in some of the local markets though sold "under cover". Limited illegal hunting was observed in this study. Most of the animals hunted are herbivores, such as dick dicks, hippos and sometimes buffalos. This illegal hunting is mainly for subsistence and in most cases associated

with "problem animals". In terms of value, the total bush meat trade though illegal was estimated at **US$ 92,071** per year.

It is important also to note the use of the papyrus, wild fruits and vegetables. These are collected from distances of about 5 kilometers and are mainly for home use and sale. The use of *Cyprus papyrus* mainly for making *matetes/matende* was more evident in Butiama (valued at US$ 11,219 per year) than the other two districts. The *matetes* are both for household use and for sale. The total value was estimated at US$ 23,008 per year. The wild fruits and vegetable trade was valued at a total of US$ 6,126 per year with Butiama accounting for almost half (48.8%) of the net income. This huge percentage may be attributed to the presence and proximity of the district to major towns. The total value of medicinal plants, bush meat, papyrus, wild fruits and vegetables was estimated at **US$ 133,479** equivalent to **Tshs. 169.8 million** (Table 4.8).

Plate 9. Game meat seller at Morito being interviewed

Table 4.8. Value of other wetland products in 2015

	Total No. of HH	% of HH dependent on resource	No of Households	Units	Qnty harvested per HH/day	Total harvested per day	Unit price Tsh	Gross income per resource user p/d	Hired labor & other costs P/D	Net returns in Tsh per yr	Net return in USD per yr
Tarime											
Medicinal herbs	2548	0.25	637	3kg bundles	4	2548	2000	5096000	1630	5094370	4,005
Bush meat (Kg)	2548	0.25	637	1kg pieces	6	3822	10,000	38220000	7000	38213000	30,042
Papyrus (Bundles)	2548	0.25	637	Bundles	3	1911	5,000	9555000	6000	9549000	7,507
Wildfruits and veges (Bags)	2548	0.25	637	Bags	2	1274	2000	2548000	5500	2542500	1,999
Rorya											
Medicinal herbs	1454	0.25	364	3kg bundles	4	1454	2000	2908000	1630	2906370	2,285
Bush meat (Kg)	1454	0.25	364	1kg pieces	6	2181	10,000	21810000	7000	21803000	17,141
Papyrus (Bundles)	1454	0.25	364	Bundles	3	1091	5,000	5452500	6000	5446500	4,282
Wildfruits and veges (Bags)	1454	0.25	364	Bags	2	727	2000	1454000	5500	1448500	1,139
Butiama											
Medicinal herbs	3807	0.25	952	3kg bundles	4	3807	2000	7614000	1630	7612370	5,985
Bush meat (Kg)	3807	0.25	952	1kg pieces	6	5711	10,000	57105000	7000	57098000	44,888
Papyrus (Bundles)	3807	0.25	952	Bundles	3	2855	5,000	14276250	6000	14270250	11,219
Wildfruits and veges (Bags)	3807	0.25	952	Bags	2	1904	2000	3807000	5500	3801500	2,989
Total returns from other wetland products in 2014										**169785360**	**133,479**

Assumptions:

The proportion of HH dependent on other wetland resources and the quantity of products harvested was obtained from study questionnaire.
Unit price was obtained from other studies and the study questionnaire.
Hired labour and other costs were obtained from the study questionnaire.

4.10 GROSS VALUE OF CULTURAL SERVICES

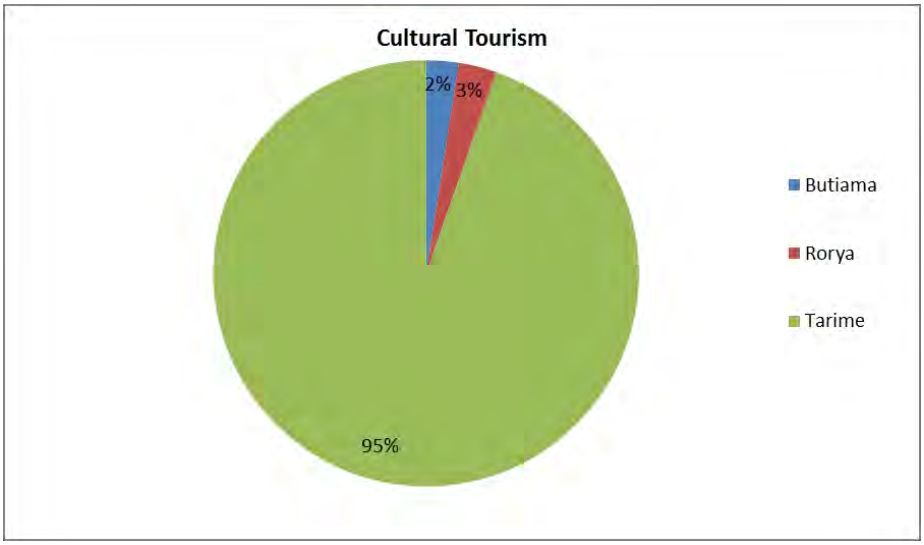
All the three study districts have some cultural sites of immense significance to the local people. These sites are used for special meetings and cultural events. In all the three districts, the travel cost to the cultural site was applied (see Table 4.9). Tarime's value for cultural sites was estimated at US$ 18,936 per year while that of Butiama and Rorya were US$ 504 and US$ 249 respectively. This information is demonstrated in Figure 4.2 below where Tarime takes 96.1% of the value while Rorya and Butiama takes 2.6% and 1.3% respectively. The total value of cultural tourism was estimated at **US$ 19,688** or **Tshs. 25.04 million** per year.

Table 4.9. Gross returns from cultural tourism

District	Total No. of HH	% of HH benefiting from tourism	No of household users	Unit price Tsh	Gross income per resource user per trip	Travel cost per HH per trip	Total travel cost per HH per year	Net returns in Tshs per yr	Net return in USD per yr
Butiama	3,807	2%	76	10000	761,400	30000	120000	641,400	504
Rorya	1,454	3%	44	10000	436,200	30000	120000	316,200	249
Tarime	2,548	95%	2421	10000	24,206,000	30000	120000	24,086,000	18,936
Total Cultural Tourism								**25,043,600**	**19,688**

Assumptions:
Visits were made averagely four times per year.
Travel cost was estimated at Tsh. 30,000 per trip.

Figure 4.2. Total value of cultural tourism



4.11 REGULATING AND SUPPORTING SERVICES

The Mara Wetlands are well known for their provision of economic goods such as timber, fish and natural habitats. They also provide economic services, which are provided by the functioning of these systems thus indirectly supporting local and national economies. They are therefore not directly felt or appreciated. The actual estimation of these values often requires complex and detailed information, the collection of which was beyond the scope of this study.

The Mara floodplains act as sponges which 'absorb' the headwaters of floods, by reducing flow velocity, therefore attenuating floods which may otherwise damage downstream areas. Without these wetlands, flood damage to infrastructure and fields in these areas would be more frequent and more severe. They also help to maintain dry season water supplies, because stored water is then released slowly. The Mara floodplains also play a role in the recharge of groundwater which is then drawn off beyond the area through boreholes.

The reduced velocity of water flow in wetlands' floodplains, combined with the dense vegetation cover, means that they trap sediments retaining them in the wetland area and preventing their transport downstream. The deposition of nutrient-rich silts in the floodplain adds to the productivity of floodplain agriculture. As a result, yields are often significantly higher in floodplain areas than in corresponding dryland areas and often require far fewer inputs in terms of water and fertilizer.

The Mara aquatic systems also play an important role in the removal or dilution of human -generated wastes. River flow serves to dilute the concentration of waste products, thereby reducing its potential effects. The aquatic vegetation both traps and absorbs some of the pollutants which enter aquatic systems from the entire catchment areas, notably those associated with human wastes and agricultural pesticides and fertilizers.

The Mara Wetlands are also an important carbon sink. Since the growth of plants requires carbon dioxide, vegetation acts as a net carbon sink for atmospheric gases (Winpenny, 1991). Watson et al. (1996) estimated that mitigation costs for carbon releases are in the range of $0.5 to $29 per ton of carbon, and most estimates usually fall within the range of $10 to 20. Pearce (1990) estimated the indirect use values associated with carbon storage by tropical forests to be US$ 1,300 per hectare. The value of carbon sequestration services for the Mara River wetlands is **USD 835,989** per year (Table 4.10).

Table 4.10 Value of carbon sequestration services

Vegetation	% Cover	Area coverage	Carbon sequestration (Ton/ha) per year	Total carbon sequestration	Value of carbon (US$/ha/yr)	Total value of carbon Tsh/yr	Total value of carbon USD/yr
Woodland/swamp forest	0.02	1,034	9	9,306	7	82860624	65142
Bush, palms and thicket	0.04	2,068	6	12,408	7	110480832	86856
Permanent grassland	0.06	3,102	6	18,612	7	165721248	130,284
Seasonally flooded grassland	0.05	2,585	6	15,510	7	138101040	108,570
Papyrus	0.07	3,619	9	32,571	7	290012184	217,140
Farmland	0.1	5,170	6	31,020	7	276202080	217,140
Total						**1063378008**	**835,989**

4.12 TOTAL GROSS RETURNS OF THE MARA WETLANDS

Arising from the above, the total value of the Mara Wetlands is estimated at **Tshs. 6,341 million** per year equivalent to **US$ 5.0 million** per year. This implies a per capita value of **Tshs. 130,438** per year or **US$ 103** per year (see Table 4.11).

Table 4.11. Estimated gross returns from the Mara Wetlands in 2015

Type of Service	Tshs (millions) per year	US$ (million) per year
Crop Production	1771	1.39
Water for livestock	854	0.67
Water supply for domestic use	706	0.56
Capture Fishery	527	0.41
Wood based and non-timber products	708	0.57
Grass for fodder	503	0.40
Honey production	14	0.01
Other Wetland products	170	0.13
Cultural Tourism	25	0.02
Carbon sequestration	1063	0.84
Grand total	**6,341**	**5.00**

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

5.1 CONCLUSION

The rapid assessment of economic values has attempted to demonstrate the importance of the wetlands by examining the direct and indirect values associated with this wetland. From the field data collection, the study observed that the understanding by the local population of this important resource was very limited. Likewise, the appreciation of the biodiversity and ecosystem benefits of the Mara Wetland is low in terms of informing decision makers and the local communities on the wise use of the wetlands. Capacity building in these aspects needs to be enhanced.

Based on the literature reviewed under this study and the analysis of data and information collected, it is evident that the Mara Wetlands are of immense global importance. This recognition has triggered the Tanzanian Government to seek Ramsar status for the wetlands.

The economic valuation of the Mara Wetlands conducted as part of this analysis also demonstrate that the Mara Wetlands make an appreciable contribution to local rural livelihoods both in terms of direct cash income and contributions to food security. The total economic value of the Mara Wetlands is estimated at **Tshs. 6,341 million**; equivalent to **US$ 5.0 million** per year. This implies a per capita value of **Tshs. 130,438** per year or **US$ 103** per year.

There are, however, observable differences in environmental and socio-economic conditions that result in significant variation in patterns of use. It is also observed that communities identify a wide range of biophysical and socio-economic constraints to the use of wetlands for agriculture. However, negative environmental impacts are not generally among them.

5.2 RECOMMENDATIONS

There is a need to develop integrated management plans for efficient utilization of the wetland resources. However, due to the complexity of the multiple uses of the Mara Wetlands, developing an approach to sustainably manage them – one that helps to conserve the biodiversity and ecosystem service values while allowing sustainable resource extraction and use – will require a participatory, multi-sectoral and interdisciplinary approach.

This study takes account of the complexity of the interaction of the local communities with the Mara Wetlands. Similarly, the sustainable and wise use of the resource is considered of local, national, regional and global importance. These considerations necessitate capacity building that may include and is not limited to:

1) Awareness and knowledge of the wetlands resources and wise use.
2) Integration of wetlands issues in local and national decision making processes.
3) Development of a wetlands inventory, status assessment and ongoing monitoring.
4) Strengthened institutions and institutional linkages for the sustainable use and management of the wetlands resources.

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Annex 1: List of Participants for the Mara Wetlands Economic Valuation Training Held at the Acacia Hotel in Musoma between 15th and 21st November 2015

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Annex 2: Mara Wetland Management Questionnaire Tool for Household and Key Informant Survey

Note: *This is a guide only. Questions need to be adapted depending on who you speak to and on what issues they raise. Probe for further explanations where appropriate (what, how, why), and follow interesting leads even if it diverts from the questions, or the order of questions.*

Introduction to the project:

Before starting the interview, it is important to explain to the person you are interviewing what the project is about and why you are interviewing them. The following bullet points may assist in giving this explanation:

- The project background, purpose and coverage.
- Your response to this interview will help shed more light on the situation in this county, and help identify gaps and opportunities for improved governance of the Mara Wetlands.
- Once we have completed the interviews, we will analyse them to understand what the current practices and challenges and forward the results of our findings and our proposals.

Name of Interviewee (optional)…….

District……....……

Ward……

SOCIO-DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS			
N.	**Questions**	**Answers**	
11	Age	□15 – 25 □26 – 35 □36 – 45 □46 – 55 □56+	
22	Gender	□Male □Female	
33	What is the size of your household		
44	What is the primary economic activity for the family? ***(Record the principal economic activity)***	□ = None □ = Fishing □ = Crop farming	□ = Livestock rearing □ = Business □ = Other (Specify) _____
55	How many years have you lived within this community?	□ = Less than one year □ = 1 – 10 years □ = 11 – 20 years	□ = 21 – 30 years □ = Over 30 years
66	Indicate what construction materials you have used for your house	□ = Mud walled grass thatched □ = Mud bricks with iron sheets □= Stone walled □ = Others (Specify)	
RESOURCE OWNERSHIP AND UTILIZATION			
77	How much water do you use in your household?	What is the source of water (a) Piped (b) Ground water (c) River (d) Rain water	

88	What crops do you grow?	□ = Maize□ = Beans□ = Vegetables □ = Millet □ = Cassava □= Others (Specify ……		
99	Do you grow crops by irrigation?	□= Yes □= No		
110	If yes, how much water do you use per week? □= in litres □= Buckets □= Drum □= Others	(indicate Unit)		
111	What is the total harvest of crops per season/year? Please indicate (Multiple responses allowed)	□ = Maize in Kgs □ = Beans in Kgs □ = Vegetables in Bags □ = Millet in Kgs □ = Cassava in bags □= Others (Specify ……		
112	Please indicate quantities marketed and price per unit	Quantity	Price	
	Maize			
	Beans			
	Vegetables			
	Millet			
	Cassava			
	Others			
113	Do you own livestock?	□ =Yes□ =No		
114	What Livestock do you own? (Multiple responses allowed)	□ =Cattle Numbers ……. □ =Goats Numbers ……. □ =Sheep Numbers ……. □ =Pigs Numbers ……. □ =Poultry Numbers ……. Other (Specify)……		
115	What is the major problem regarding livestock rearing in your community?	□ =Lack of pasture □ =Cattle rustling □ =Livestock diseases □ =Inadequate grazing land Other (Specify)……..		
116	How much grazing land do you use (The size of the field in acres)	□ =0.5 Acres□ = 1.0 Acres □ =1.5 Acres□ =2.0 Acres □ =3.0 Acres 4.5 Acres □ =More than 5 Acres		
	ECOSYSTEM SERVICES			
117	Which Resources are available to you within the Mara Wetlands in quantities sold and price			**Price**

		Resource	**Quantity**	
		Timber		
		Firewood		
		Charcoal		
		Building Materials (Poles)		
		Medicinal Herbs		
		Fish		
		Fodder		
		Honey		
		Bush Meat		
		Wild Fruits		
		Papyrus		
		Others		
118	Do you have access to cultural /tourist sites/services within the Mara wetland ? Indicate approximate cost of travel	Ceremonies Cost of travel Meetings Cost of travel Tourism Cost of tour package Others		
FOR KEY INFORMANTS				
	ECOSYSTEM SERVICES			
119	Which Resources are available within the Mara Wetlands in quantities sold and price	**Resource**	**Quantity**	**Price**
		Timber		
		Firewood		
		Charcoal		
		Building Materials		
		Medicinal Herbs		
		Fish		
		Fodder		
		Honey		

		Bush Meat		
		Wild Fruits		
		Papyrus Reeds		
		Others		
220	Are there any cultural sites/ activities that take place in the wetland area	□ =Yes □ =No **If yes which activities;** □ =Worship - Cost of travel □ =Ceremonies - Cost of travel □ =Meetings - Cost of travel □ =Tourism - Cost of travel Others:.....		
221	For Soil Conservation, what are the main inputs used and what are the costs	**Item**	**Cost**	
		Fertilizers (Kgs) Organic manure (Kgs) Soil erosion control (infrastructure) Planting of tree (Nos) Others		
222	Are there any cost incurred in regulating floods	**Infrastructure**	**Cost**	
		1. 2. 3. 4.		
223	Are there any measures taken to conserve the (a) wildlife corridors, and (b) breeding grounds in the wet land areas	(a) □ =Yes □ =No (b) □ =Yes □ =No **Give cost estimates if any for each……..**		
	AQUATIC SERVICES			
224	The main sources of water in this area	Rainfall Boreholes Piped water Water Pans River/Stream Others		
225	Which water services are offered around the wetland	Service	Cost per Household	

		(a) Water vended in Liters per day (b) service provider (c) Piping Others	a) Cost of Water sold in liters per day (b) Cost of services (c) Cost of piped water Others
226	Estimates on Costs of water purification (Artificial)	Individual house hold……Tshs Water supply Company…… Tshs Schools ……Tshs Institutions and Organization……..Tshs Others	
227	Main resources harvested from the wetland	Resource	Quantity	Price
		Papyrus reeds Fish Sand Building Clay/Mud Building Gravel Others		
228	Identify critical stakeholders and their priority capacity building needs for Biodiversity Valuation	(a) (b) (c) (d)		(a) (b) (c) (d)

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