

**THE INFLUENCE OF SOCIO-ECONOMIC ACTIVITIES ON
WEMBERE WETLAND FISH RESOURCE IN TABORA REGION**

YOHANA ROBERT

MASTER OF SCIENCE IN NATURAL RESOURCES MANAGEMENT

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**THE INFLUENCE OF SOCIO-ECONOMIC ACTIVITIES ON
WEMBERE WETLAND FISH RESOURCE IN TABORA REGION**

By

Yohana Robert

A Dissertation submitted in partial fulfillment of the requirements for the Degree of
Master of Science in Natural Resource Management

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CERTIFICATION

The undersigned certifies that, he has read and hereby recommends for acceptance by the Senate of University of Dodoma a research report entitled; ***“The Influence of Socio-Economic Activities on Wembere Wetland Fish Resource in Tabora Region”*** in partial fulfillment of the Requirements for the Degree of Master of Science in Natural Resource Management.

.....

Dr. Ahmad Kanyama

(SUPERVISOR)

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DEDICATION

This dissertation is dedicated to my mother Christina Ndalo Kahamba, my father Mzee Robert Makolo, my son Junior Makolo and the whole Makolo family who fill my life with joy and whose presence encourages me to fight my battles earnestly so as to up heave them.

ABSTRACT

About 10% of Tanzania area is covered with wetlands and some wetlands are very rich in fish resources. However, there is increase of socio-economic activities that put threats to these ecosystems. This study was conducted in the Wembere wetlands to investigate the influence these activities have on wetland fish resources. 100 respondents were used 94 picked simple random samplings and 6 were purposefully sampled. Descriptive statistical analysis was used to analyse data. Trend of fish resource and number of fishermen were analysed by using linear regression model and the findings show a very slight increase of total catch ($R^2=4.9\%$) while the amount of fishermen increased dramatically ($R^2=.97.4\%$). This data suggests the decline in CPUE. Thus, CPUE suggests the decline in wetland fish resources. Also, questionnaire data show 97.3% of respondents answered catches per hour (C/h) to fall to less than 10kg/hour in 2016, while in ten years ago C/h was more than 10kg/hour answered by 89.5% of respondents. Illegal fishing methods such as bottom trawling and the use of small casted nets affect the wetland fish resource. Poor farming methods such as river diversion, clearing of hydrophytes, water pumping has affected water lagoons/pools which are wetland fish habitat. Livestock grazing and deforestation cause sedimentation on swamps which led to reduction of the depth of wetland swamps. Generally, interventions to combat these impacts from human activities are poor. Increase of population, lack of education, poor financial ability for patrolling to mention few are challenges facing Wembere wetland fish resource management. It is recommended that, land evaluation should be conducted in order to set a new land use plan in the wetland to rescue fish resource.

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LIST OF ACRONYMS

ANCA	Australian Nature Conservation Agency
CPUE	Catch Per Unit Number
EPA	Environment Program Agency
ESRF	Economic and Social Research Foundation
FAO	Food and Agriculture Organization
FGD	Focus Group Discussion
GDP	Gross Domestic Product
IKII	In-depth Key Informant Interview
IUU	Illegal Unprotected and Unregulated
IVS	Inputs Voucher System
IWM	International Water Management Institute
LCLUC	Land Cover Land Use Change
MSY	Maximum Sustainable Yield
MVP	Millenium Village Projects
OECD	Organization for Economic Co-operation and Development
PIN	Personal Identity Number
PSR	Pressure State Response
SMUWC	Sustainable Management of the Usangu Wetland and its Catchments
SRS	Simple Random Sampling
TASAF	Tanzania Social Action Fund
URT	United Republic Of Tanzania
USA-NRI	United States Natural Resources Institute
WCED	World Commission on Environment and Development

WWF

World Wild Fund for Nature

WWF-SA

World Wild Fund for Nature South Africa

CHAPTER ONE

INTRODUCTION TO THE PROBLEM

1.0 Chapter overview

This section presents background information to the study, problem statement and justification, research objectives, research questions, significance of the study, the scope of the study and it winds up by showing how the study is organized. This study intends to explore trend of fish resources in Wembere wetland in the prevailing increase of socio economic activities in the wetland.

1.1 Background of the problem

Wetlands form a major inland fisheries resource in the world (Raburu, Okeyo-Owuor, and Kwena, 2012; Barbier, Acreman, and Knowler, 1997; URT 2014; URT, 2003a). They support subsistence and livelihood to thousands of people through fishing and other activities (Zedler and Kercher, 2005; McCartney, Rebelo, Senaratna and Silva, 2010). However, wetland ecosystems are declining globally (Raburu, Okeyo-Owuor, and Kwena, 201; Barbier et al, 1997; URT, 2014).

The destruction of wetlands is a big global concern (Gray et al., 2013). It is reasonable to assume that most remaining wetlands are impacted to some degree by human land use (Salum 2007; McCartney et al., 2010; Gray et al., 2013). Several major studies have shown a direct link between the collapse of wetlands and its services decline (Funlayson, 2005). Overfishing, habitat alteration, water pollution, illegal fishing and by-catch put threats to fish stock and alter their supporting ecosystems both marine and freshwater ecosystem (Salum, 2007; URT, 2015; Jackson et al. 2001; Christensen 2006; and Myers & Worm, 2003).

A number of authors, extrapolating current trends of wild fish resources have suggested that the world's wild fish resources will collapse by the middle of this century if the current patterns of exploitation continue (Swartz and Pauly, 2008; Alfani and Nyambika 2008; FAO, 2014). This resource is classified as fully exploited, with an increasing number deemed over-exploited, in collapse, or in recovery (FAO, 2006). The collapse of fish stocks in the world forced more artisanal fishermen to opt wetlands and shallow lakes fishing sites (Hamido, 2012). Swamps, rivers and reservoirs play a very important role in total fish supply because of their wide distribution (Kamkara, 1993).

Developing countries are the major inland fish producers whereby China is the global leading country while in Africa; Tanzania is leading (FAO, 2010). Although, inland fisheries are important in Africa, counting to one-third (2.7 million tonnes) of total capture fisheries production, "inland waters fish production" particularly wetland production remains the most difficult to obtain reliable stocks and capture production statistics (FAO, 2014), while these wetlands continue to face the environmental challenges their status on fish resources yet uncovered.

The state of wild inland fish resources in these wetlands is poorly known but reflects a much greater environmental status of these wetlands (Swartz and Pauly, 2008). The environmental status of Tanzania wetlands is affected by different anthropogenic activities (URT, 2014). Environmental concerns are important for sustaining fish status. Habitats such as pools and swamps in the wetlands contribute much number of species of the wetlands. These species some are endemic species (Millennium Challenge Corporation, 2005). However, protecting wetlands to maintain their

pristine state is not always feasible, especially as population pressures increase (Seyedahmadreza et al., 2011).

Ecological change alongside climate variability events is affecting the abundance and distribution of fisheries resources and suitability of geographical locations for aquaculture systems (FAO, 2016a). Several examples in developing countries show the declining fish resources in the coastal wetlands (Rahman, Imam, Snelder, and Sunderland 2012; Iftekhhar and Takama 2008; Zwarts et al., 2005; McCartney *et al.*, 2010).

Raburu, *et al.*, (2012) has shown the richness of wetland fish resource in East Africa and are very common everywhere. The Tanzania National *Fisheries* Policy of (2015) states that, fresh water bodies contribute about 85 percent of the total annual fish landings, whereby wetlands are included, although, statistically, fish production suggests there has been a decline URT (2015).

Tanzania has area of wetland approximately 10% of her total area (Ntupwa, 2010). Many wetlands of Tanzania have been described as potentials for fish stock both larger and minor wetlands (Bwathondi and Mwamsojo 1993; Hamido, 2012; URT, 2015; Masija 2000; URT 2014; URT 2003a; Kamukala and Crafter, 1993). However, these minor freshwater fish resources remain important for people in the hinterland, although they remain poorly studied or not studied per se (URT, 2014). Eventually, these factors have been increasing day after day, therefore putting pressure on fish resource directly and/or indirectly.

The water resources of wetlands of Tanzania are under pressure from competing uses (URT, 2014). Use of water by some is causing changes in the hydrology of the basin

and in the availability of the resource to others both within the basin and downstream (SMUWC 2001a). Due to this competing uses fishing activities and fish resources in the wetlands and the rivers are under vulnerability (Kikula, Charnley and Yanda,1996).

Agricultural expansion in forested areas is very common in many areas in Tanzania (Madulu, 2004). Since time immemorial, pastoralists Sukuma and Tatoga of ethnics use wetland and the riparian areas for farming and grazing (1998a). But currently, these activities are increasing in the wetland. Regionally, the rate of deforestation was estimated to be very high due to tobacco curing. Also, the main source of energy for cooking in Uyui District is firewood where by 95% of people use. Thus, deforestation is rated to be very high in the district (ESRF,2013).

Wembere wetland is contributing very significant ecological make up of Uyui district. The wetland is famous in fish production within and beyond the region (URT, 2008). Different human activities such as fishing, rice cultivation, grazing, and forest harvest have taken pace compared to the past. These activities continue to take place in the wetland and the riparian areas. This might have been added effects to the wetland fish resources.

1.2 Statement of the problem

More than two thirds of the fish we consume are dependent on coastal and inland wetland areas FAO (2010). However, wetlands have been reduced and disappeared in many countries due to the rapid increase of human socio-economic activities; therefore, threatening wetlands fish stocks in the world (Zedler and Kercher, 2005).

In Tanzania, fish resources have been partially documented in these minor wetlands, although they have abundance and diversity of fishes (Bwathondi and Mwamsojo, 1993). These abundance and diversity of fishes are threatened by different anthropogenic factors such as fishing activities, rice cultivation, mining, deforestation and grazing.

There have been increasing human activities on Wembere wetland today because of the population increase in the area which lead to wetland degradation (URT 2003a; URT, 2014; ESRF 2013). These impacts have been well documented by different scholar in Tanzania (Kikula *et al.*, 1999; Moirana and Nahonyo, 1996; IWMI, 2003; Kato, 2007; Kashaigili and Mahoo, 2005; McCartney *et al.*, 2010). Socio-economic activities such as agricultural activities particularly rice cultivation and grazing has adverse impact on wetland status especially hydrological system. For example, movement of people increased the population in the wetland compared to the past. Population was at 14.2% increase from 131247 in 1988, to 281101 in 2002 (ESRF, 2013) and 396,623 in 2012 the increase of 41.1% (URT, 2012). This increase in population leads to an increase in socio economic activities in the wetland (ESRF, 2013).

The stakeholders' efforts to improve livelihoods of people in Uyui Distric such as the Millenium Village Projects (MVP) and Inputs Voucher System (IVS) assisted the promotion of paddy in the district as the measure to escape tobacco farming which has been seen to be a tragedy to the environment (ESRF, 2013).

However, there is no critical study that documented the impacts these socio economic activities to the wetland fishery resources except a study by (Mbogoro and

Mwakipesile, 2010) that partially showed the impact of mining on status of the fish resources in Bahi wetlands. The increasing socio-economic activities in Wembere wetland mainly rice cultivation, grazing, fishing and deforestation may have impacted wetland fishery resources since the status is not known. This study aims to investigate the influence of fishing activities, rice cultivation, deforestation, and grazing on the status of Wembere wetland fish resources in Tabora region.

1.3 Research objectives

1.3.1 General objective

The general objective of this study is to explore the influence of rice farming, grazing, fishing, and deforestation on Wembere wetland fish resource.

1.3.2 Specific objectives

- i. To identify the trend of fish resources.
- ii. To assess the impact of socio-economic activities (rice farming, grazing, fishing, and forest harvest) on fish resources
- iii. To assess the intervention and challenges facing the community and government in sustaining fish resources.

1.4 Research questions

- i. What is the trend of fish resources?
- ii. How do the socio-economic activities impact the trend of fish resources?
- iii. What are the intervention and challenges the community and government use in sustaining fish resources?

1.4 Significance of the Study

Sustainable fisheries management requires sufficient knowledge and information on the status of resources base. Currently fisheries management is being constrained by adequate human capacity to enable acquisition of data and information; adequate documentation of indigenous knowledge; centralized database system; adequate information exchange and dissemination (URT, 2010).

Minor water bodies in the country have a significant contribution amount in the national fish stock National fishery Policy (2015). The study conducted by Bwathondi and Mwamsojo (1993), recommended the importance of conserving swamps, especially in the hinterland drainage system, as they are a major source of freshwater fish and they should not be used for rice growing.

Graff and Middleton, (2001) stated that, studies on fish resources are required for several reasons, including: those management entities; it is no longer permissible to overfish; and there are currently increased demands for adopting a "precautionary approach" and incorporating "ecosystem considerations" into resource assessments and fisheries management.

In Tanzania wetland fishing is not intensively documented especially those wetlands located in hinterlands such the Wembere wetland, although they contribute very significant to the livelihood of the people as a source of food. Management of fish resources on these water bodies is not known hence puts the resource itself at a plight of degradation. This study aims to contribute very significant in providing information about the status of fish resources in the situation of increasing socio-economic activities in the Wembere wetland. Therefore, helps to inform management entities about the threats which are imposed by human on wetland fish resources.

1.6 Scope of the study

This study was conducted in Uyui district within one selected ward and three villages; the selected ward is Miswaki and the selected villages are, Miswaki, Igudi and Mwamdalagwiwe. These villages have high number of fishermen who mostly depend on fishing. They are along the wetland while some hamlets in the villages are located in the wetland as fishing stations as temporary residences during fishing seasons. The distance from Miswaki village to Igudi is 11km southward while from Igudi to Mwamdalagwiwe is 23km southward. The targeted population is household members whose are engaged in fishing activities in Miswaki ward in the selected villages of Miswaki, Igudi and Mwamdalagwiwe.

Wetland fish resource in the study which was covered includes any kind of fish that is traditionally used by people as food and must be extracted from water. The catch and effort data is often collected as a species complex rather than on a species specific basis; which means all fish catches are a single catch irrespective of their different specific species. The study mainly bases on four socio-economic activities which are rice cultivation; livestock grazing; fishing; and forest harvest as the activities operating in Wembere wetland where fish resource is present. These activities were analysed on how they affect Wembere wetland.

1.7 Organization of the study

This report has been divided into five chapters. Chapter one through three provide the introduction, literature review and methodology, while findings and discussions are presented in the fourth chapter. Finally the summary, conclusion, recommendations and areas for further studies are presented in Chapter five.

CHAPTER TWO

LITERATURE REVIEW

1.0 Chapter overview

This section examines different literatures which are related to the subject under the study. The first part gives the definitions of the terms used in the subject, some characteristics of wetland. The second part discusses relevant theory which is applicable in the study and the last part denotes the empirical revision of the study.

2.1 Definition of the key concept

2.1.1 The concept of Wetland

There is great uncertainty about the number and extent of wetlands globally (Rebelo, Finlayson, Nagabhatla, 2009). This is due to the different interpretations of what constitutes a wetland around the world (IWMI, 2014). The Ramsar Convention (1971) and Finlayson & D'Cruz (2005) defined wetlands as "areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, brackish or salty, including areas of marine water the depth of which, at low tide, does not exceed six meters". Also it "may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six meters at low tide lying within the wetlands".

In Tanzanian context, wetlands can be defined as a continuum or system of areas which are flooded or saturated by surface or ground water at a frequency and duration sufficient to support a prevalence of organisms typically adapted for life in saturated soil conditions (URT200, 3a). The major wetlands of Tanzania include Usangu flats, Ugalla, Malagarasi, Ruvu, Kilombero/Kibasira, Wami, Mara,

Wembere, and Bahi to mention a few which cover 10% of total country area (Kamkala & Crafter, 1993).

2.1.2 Fish Resources

Fishery Resource: In general, refers to elements of a natural aquatic resource (e.g. strains, species, populations, stocks, assemblages) which can be legally caught by fishing. It may sometimes be taken as including also the habitat of such resources (FAO, 2017). In this study fish resource refers to those fishes which are fished from Wembere wetland by artisanal fishermen for human consumption. This includes the lung fish and the common catfish that are most fished in the wetland.

2.1.3 Wembere wetland

The Wembere wetland is located in Tabora region. Its administrative units cover the districts of Igunga in the North and Uyui in the centre and Southern fringe covering the area of about 200,000 hectares (URT 2014; URT 1998a). It is formed by Wembere and Manonga streams and is connected with Lake Eyasi through seasonal streams (Bwathondi and Mwasonjo, 1993). This wetland is categorized as inland wetland formed due to the geomorphologic processes happened many years ago (URT, 1998a). The wetland is dominated with swamps, river pools or lagoons in which fishes inhabit therein.



Plate 1: The Wembere wetland (pictureby Author)

2.2 Theoretical review

Different theories have been applied by scientists to explain the relationship between humans and their environment, thus concluded that, “human domain and the biophysical domain are interdependent” (Mung’ong’o, 1995; Mungongo and Mwamfupe, 2003; Walker, Holling, Carpenter, and Kinzig., 2004; Walker and Salt, 2006). This study uses the theory of thresholds in resilience thinking to explain the relation of social ecological system.

2.3.1 Thresholds theory in natural resources systems (System Thinking Theory)

In many disciplines, human actions are often viewed as external drivers of ecosystem dynamics; examples include fishing, grazing, cultivating, water harvesting, and polluting. Through such a lens the manager is an external intervener in ecosystem resilience (Folke, Carpenter, Walker, Scheffer, Chapin, and Rockstrom, 2010).

Understanding the relation between man and environment, one could understand the Threshold theory in “Resilience thinking” (Chapin, Kofinas, and Folke2009).

For natural resource systems, resilience implies that not only the relevant ecosystem, but also the corresponding human and management systems, are able to absorb perturbations, such that the system as a whole remains able to sustain (on average) a reasonable flow of benefits over time (Charles, 2004).

In our discourse, a threshold is defined as “a breakpoint between two regimes of a system” (Walker and Meyers, 2004). It is the level or amount of a controlling, often slowly changing variable, in which a change occurs in a critical feedback, causing the system to self-organize along a different trajectory, that is, towards a different attractor or force that pull (Pisano, 2012).

Though social-ecological systems are affected by many variables, they are usually driven by only a handful of key controlling (often slow-moving) variables Brown and Williams (2015). If the system moves beyond a threshold it behaves in a different way. Once a threshold has been crossed it is usually difficult (in some cases impossible) to cross back. This state is known as regime shift (Pisano, 2012; Brown and Williams, 2015).

A shift occurs when internal processes of the system (i.e. rates of birth, mortality, growth, consumption, decomposition, leaching, etc.) have changed and the state of the system (defined by the amounts of the state variables) begins to change in a different direction, toward a different attractor (Walker and Meyers, 2004). Such attractor can be establishment of large scale agriculture which can change the

ecosystem due to the need of product optimization which creates the ‘optimal state’ to a single product while other components may decline (Walker and Salt, 2006).

The recognition of thresholds of abrupt change separating alternative system states makes it important to account for them in decision making, in order to reduce the likelihood that some disturbance will shift the system into a less desirable regime from which it would be difficult to recover (Walker and Salt, 2006). Again, understanding the kind of disturbances and current system states will help in managing and assessing the systems.

With resilience as an objective, management must focus on the system drivers and management interventions that can influence long-term system viability (Zellmer and Gunderson, 2009). In general terms, resilience thinking is about appreciating the social-ecological system that one is interested in (and is a part of) as a complex adaptive system, and defining its key attributes (Walker and Salt, 2006).

From management point of view, the most crucial lesson from studies of thresholds establish social-ecological systems to be typically vulnerable thus “likely to change to a new state in response to a stress or disturbance” (Holling and Meffe, 1996; Walker and Salt, 2006). Such stressors can be anthropogenic or natural. A “resilience orientation” suggests that decision making should be more attuned to the potential for systems to change, and to uncertainties that underlie the risks of unintended outcomes. (Pisano, 2012) argue that, by understanding adaptive cycles, it is possible to: gain insight into how and why a system changes; develop a capacity to manage for a system’s resilience; and, most importantly, learn where and when various kinds of management interventions will, and will not, work.

Brown and Williams, (2015) argue that, human interventions in conserving, harvesting, and regulating biological resources are linked to diversity, productivity, and resilience of ecological and social systems, and knowledge of these linkages is a key requisite for managing ecosystems and understanding how regulations affect human use patterns and ecological systems. Stressing the importance of effective use of the theory in natural resource management, (Chapin et al., 2009) notes that” recognition of these changing properties of a system through the lens of thresholds suggests that effective long term management and policy-making must be highly flexible and adaptive, looking for windows of opportunity for constructive policy shifts”.

2.2.2 Linear Regression Model

This model involves only one independent variable and states that the true mean of the dependent variable changes at a constant rate as the value of independent variable increases or decreases (Rawlings, Pantula, and Dickey, 1998). The linear regression model enables to calculate the effect of one independent variable on one dependent variable (Cohen, Cohen, West, & Aiken, 2007).

The trend is evaluated and reported when the slope of the regression line is demonstrated to be statistically different from zero. A positive slope indicates an increasing trend and a negative slope a decreasing trend.

2.3 Empirical review

2.3.1 General trend of fish resources

Although there is a slight increase of fish catch, global records have shown the decline of global fish resources due to the decline of fish stock (FAO, 2014).

Thailand's catches have fallen markedly owing to depletion of some marine resources by overfishing and environmental degradation in the Gulf of Thailand, and therefore leads to cessation of fishing operations by Thai vessels in Indonesian waters since 2008. Also currently Japan fish stock has fallen tremendously due to overfishing especially cetaceous species such as shark FAO (2014). All these contributed to the global decline of fish resources in marine and inland stock. Trends in the Southwest and Southeast Atlantic have been variable in the last decade but in recent years both areas have been recovering from the catch decreases of the late 2000s.

The Maximum Sustainable Yield (MSY) is currently (2014) estimated at 2,143,211 metric tonnes which is accumulated from Lake Victoria (1,550,211), Lake Tanganyika (295,000), Lake Nyasa (168,000), Marine Territorial Sea (100,000), and other minor water bodies (30,000) where wetlands regions are included (URT, 2015).

2.3.2 Trend of the wetland and wetland fish resources

A different study has shown the global decline of wetlands (Barbier et al., 1997). A wetland does not need to be entirely lost to reduce its value (Barbier et al., 1997). For instance the Yala Swamp in Kenya has been described as a biological museum because of its rich diversity of haplochromine cichlids, most of them threatened or thought to be extinct in Lake Victoria (Aloo, 2003).

While in other area showing the global decline of wetland, there are other areas showing the improved status of wetland. In USA, in Central region the palustrine and estuarine wetland have increased from 3366.9 acres to 33927.7 acres from 1992 to 2010 respectively. This is because of intentional measures to upgrade the status of

the wetland (USDA-NRI Report, 2013). At Nijhum Dwip in Bangladesh communities were forced to quit fishing and consider alternate livelihood measures such as poultry, livestock and crop farming, handicrafts, and nonfarm day labor. This was contributed by the decline of fishing in the wetland (Rahman et al., 2012).

In Africa for instance in the Inner Niger Delta, annual fish production has been affected by rice cultivation that affected both the magnitude and timing of the annual flood fish production (Zwarts et al., 2005; McCartney et al., 2010). The shoreline and river mouth wetlands of Lake Victoria, in Kenya, Uganda and Tanzania which constitute about 37% of the total wetland surface area with number of fishes species but due to different activities fish resources in these wetlands are declining (Koyombo and Jorgensen, 2006; Katua and M'mayi, 2001).

2.3.3 Tanzania wetlands and Fishing activities

In Tanzania, wetlands contribution on fishing stock of state is crucial. While small, the Ihefu fishery has proven productive when the swamp is flooded. The study conducted by Bwathondi and Mwamsonjo (1993) presented the data on annual production from major freshwater wetlands in Tanzania from 1983 to 1989 (table 1). Annual fish production increased in Lake Nyasa from 19,500 t in 1983 to 39,300 t in 1988 (Table 1). All wetland fish productions illustrated a significant increase from 1983 to 1989 despite the overtime decline in Lake Tanganyika. The total highest harvest of Tanzania annual fish production from wetlands was witnessed in 1984.

The Usangu wetlands and their hydrology also support artisanal fisheries in the Ruaha River (for which no catch data are available) and Mtera Reservoir. (SMUWC, 2001b) report catches averaging 700 tonnes per year. It should be noted however,

that fishing is illegal in Usangu Game Reserve. Catch recorded in Mtera from 1990-95 ranged between 98 and 5,000 metric tonnes (Coppolillo et al., 2006).

The majority of fishermen use simple equipment such as gill nets, cast nets, traps, hooks and seine nets. Simple crafts, dugout canoes, dhows, outrigger canoes and planked canoes are used as well as modern wooden boats using outboard or inboard engines (Bwathondi and Mwamsonjo, 1993).

Table 1: Annual fish production from major freshwater wetlands in Tanzania (1983-1989)

Wetland	1983	1984	1985	1986	1987	1988	1989	%
thousand tonnes								
lake Victoria	72.6	99.7	100.8	217.2	159.9	205.5	207.5	54.2
Lake Tanganyika	99.4	107.1	115.2	70.0	93.7	62.7	53.5	31.0
lake Nyasa	19.5	18.1	27.0	35.9	30.0	39.3	34.5	10.4
lake Rukwa	4.8	4.6	4.6	5.9	8.1	5.8	8.9	2.2
Nyumbaya	3.4	1.8	1.8	2.0	2.0	5.0	3.9	1.0
Mungu								
Mtera Dam	2.4	3.6	2.4	3.3	3.4	3.8	4.3	1.2
Total	202.1	234.9	251.8	334.3	297.1	322.1	312.6	100

Source: Bwathondi and Mwamsonjo, (1993)

The total catch in Tanzania declined from 375,535 tons (2005) to 335,674 tons (2009) whereby fish export has also shown the trend decline from 57,289 tons (2005) to 41,148 tons (2009) (URT, 2015).

2.3.4 Global fish resources

Global total capture fishery production in 2014 was 93.4 million tonnes. 31.4% of fish stocks are estimated as overfished (fished at biologically unsustainable levels)

(FAO, 2016b). Illegal, unreported and unregulated (IUU) fishing remains one of the greatest threats to marine ecosystems, undermining national and regional efforts to manage fisheries sustainably and conserve marine biodiversity (FAO, 2014).

In developing countries, rice production contributes significantly on degrading or changing the ecological role of many wetlands in the world (Rogers et al., 1993). An estimated 55% of South Africa's wetlands to date have been significantly damaged primarily due to poorly managed agriculture (WWF-SA, 2016). Gamelsrød (1992 in Barbier et al., (1997) showed that runoff and hence shrimp numbers have decreased. These are important for fish habitat and food.

2.3.5 Socio-economic activities in wetlands

The impact of rice cultivation on wetlands depends on wetland type, the intensity of drainage and agronomic practices (type of farming system) including the use of fertilizers (Chisara, Katondo, Hongo, & Mdamo 1999; Oonyu, 2011). Since 1989, the land area planted to rice has increased by about 2.4% per year leading to the problems of soil degradation, water pollution, loss of habitat and wetlands in one of the countries with the greatest biodiversity in the world; and loss of traditional rice varieties (Tuyen, 2003).

In Kenya, The Yala Swamp Wetland Chemicals used in aerial spraying of rice fields impose a threat to water purity in Lake Kanyaboli and River Yala as well as other streams (Thenya, 2006). Also black soot from burning of papyrus to clear ground for rice fields causes air contamination (Owiyo et al, 2012). Weirs, dams, dykes, and canals constructed for irrigation purposes lead to reduced water levels in the lakes and rivers downstream also burning of or cutting the papyrus destroy the natural

habitat and lead to water pollution and reduced fish production in Lake Kanyaboli (Owiyo et al 2012; Thenya, 2006).

Like other developing countries, Tanzania despite these benefits accrued, wetlands degradation in Tanzania is much more documented (SMUWC 2001b; Moirana and Nahonyo, 1996; Kikula et al., 1996). Water extraction for uranium mining of the Bahi wetland is expected to pose a significant threat to the ecological integrity as well as the livelihoods of many of the people who depend on it (Mbogoro and Mwakipesile 2010) and an increase in rice irrigation development in Usangu plans is expected to pose a significant threat to the ecological integrity (SMUWC, 2001b). Kikula et al. likewise highlight the large growth in irrigation and the uncontrolled diversion of river flows as being an important factor.

Moirana and Nahonyo (1996) and Kikula et al., (1996) were perhaps the first studies to report water resources problems in Usangu wetland due to different human activities. They identify the Usangu wetland as being an important but fragile ecosystem which has been degraded by human encroachment, overstocking, farming, tree felling and uncontrolled hunting (SMUWC, 2001a). Hazelwood and Livingstone, (1978) recognized that the development of irrigation (rice cultivation) would seriously deplete downstream flows and cause an impact on downstream users such as Wildlife in Ruaha National Park including fish resources in Great Ruaha and in Mtera dam. The construction of the schemes, such as Kimani, Kapunga and Madibira, has nearly always involved the man-made diversion of rivers from their natural courses around the edges of the schemes (SMUWC, 2001b). All these increased the threat to the fish resources in the wetland.

Moirana and Nahonyo (1996 in SMUWC (2001c) list the threats to the existence of the Usangu system of wetlands. These include excessive use of water resources for irrigation, destruction of water catchment areas (by overstocking and deforestation) disturbance of the natural water reservoir of the wetland and lack of a comprehensive land use management plan for the area.

They also list the indicators of degradation on the Usangu wetlands. These include the following hydrological indicators: high floods and complete cessation of flow in the dry season, late discharge into the Great Ruaha River (displacement of over two months), reduced water retention capacity in catchments and in the swamps, particularly the Ihefu swamp, low water levels in the swamps and rivers and increased water evaporation.

Kikula *et al* suggest that silting of the Usangu wetland is occurring as a result of increased erosion around the plains and desilting of irrigation canals, causing a reduction in storage capacity. All the flow in the Mbarali and Kimani rivers being diverted into the Mbarali and Kapunga rice schemes so that no flow was reaching the Usangu wetlands from these rivers at that time (Kimani Irrigation Project 1993). Therefore, Ansari *et al.*, (2001) and (2009) and Seyedahmadreza *et al*, (2011) conclude that, loss of wetland has disastrous important fish stock and fish species.

2.3.6 The intervention and challenges the community and government are facing in sustaining fish resources

Globally, wetland ecosystems have being undergoing degradation because of increasing human activities therefore their management systems become very complicated (Barbier *et al.*, 1997; Mc Cartney *et al.*, 2010). To guarantee the best

possible supplies of fish resources for future generations, the Code of Conduct stresses that all people involved in fisheries should strive to maintain or restore fish stocks to levels capable of producing reasonable amounts of catch both now and into the future. They should work together to conserve and manage fish resources and their habitats (FAO 2016a). Wood et al. (2002) asserts that, in developing countries, where food security and poverty reduction receive higher priority than environmental protection, wetland conservation is difficult if the local communities do not understand the value of the wetlands.

Also, the absence of information about wetlands is contributing to the mismanagement of wetland (Finlayson, 2000). In Northern Australia, a broad scale inventory is lacking, although much information has been collated in the national wetland directory (ANCA, 1996). Information on rates of wetland loss and reasons for this loss has proved invaluable for promoting sustainable management of wetlands (Finlayson, 2000). This puts challenges on sustainable utilization of wetlands.

For the people to make a wise use of wetlands they should be wise with the values of resources. Lack of awareness of the value of wetland resources created the situation for fish resource degradation (Barbier et al., 1997). Charles, (2004) documented that, many problems with resource utilization and management have been due to a lack of general understanding of the policy and institutional aspects involved in managing natural resource systems. In western Nepal, in Ghodaghodi Lake, due to poor policy, community participation in natural resources is comparatively low. This causes the wetlands management approach to appear a top-down approach (Pramod, 2015). The

poor policy may influence unsustainable utilization of wetlands or any resource in question.

Kecha, Ochieng, Lekapana, and Macharia (2001) mention out the challenges of sustainable utilization of wetland resources in Kenya as lack of management plans, policy and legislation dimension, acculturation, overexploitation of resources and change from subsistence to commercial exploitation of wetland resources. In Tanzania also the challenges of sustainable utilization of wetland resources are alike to those mentioned by Kecha *et al* (URT 2003a; URT, 2014).

For seeking important measure for wetland resources problems such as fish resource in developing countries, livelihood diversification options to the community should be undertaken without harming the livelihood of dependent resource users (Rahman and Begum, 2011). For two wetland communities in the Marituba and Guapore valleys, Brazil, Diegues (1991) found that if the cultural aspects and needs of the local users were met, then it was very likely that full economic use of wetland resources such as fish resource could be achieved along with conservation goals.

2.4 Knowledge gap

Wetland interference in developing countries is increasing significantly due to population change, food cultural change, and climatic change factors (Oonyu, 2011). Poor technology and lack of financial resources by community to buy improved vessels for marine fishing have reduced the ability to catch up the increasing community fish demand. Artisanal fishermen are increasingly invading minor water bodies such as wetlands in the hinterland while other activities such as agriculture,

grazing, deforestation and mining are increasing at alarming speed (URT 2008a; ESRF, 2013; URT, 2003a).

The present few studies on wetlands in Tanzania concentrate on major wetlands of large economic performance such as Hydro-power projects and Ramsar Sites while little attention is pressed on wetlands outside protected areas (URT, 2014). Studies which document the status of fish resources on Wembere wetland are limited. Therefore, like other wetlands of the hinterland that provide potential fish resources their status is unknown. Therefore, this study covers the knowledge gap existing between ongoing activities operating in Tanzania wetlands with the existing fish resources situation, and how the situation is managed.

2.5 Conceptual framework

This study use the conceptual framework of Pressure-State- Response (PSR) adapted from Yang *et al*, (2006). The PSR model is thus established for wetland resources assessment, as shown in *Figure 2. 1* is adapted from (Wang et al, 2011). The pressure influencing the wetland resources such as fishes mainly comes from different uses of wetland, such as agriculture and fishery (Yang et al., 2006).

According to OECD, (2003a) environmental indicators of resource degradation are classified following the PSR model: indicators of environmental pressures, both direct and indirect; indicators of environmental conditions; and indicators of society's responses. Considering both pressures and stresses, certain responses should be made by the government to recover a healthy ecosystem, such measures involve policy-making, financial support, etc (Mai et al., 2005; Yang et al., 2006; OECD 2003; Wang et al., 2011). Generally, the framework implies that drivers of

wetland (PRESSURE) would lead to degradation of the wetland resources (STATE) if no any measure (RESPONSE) is made.

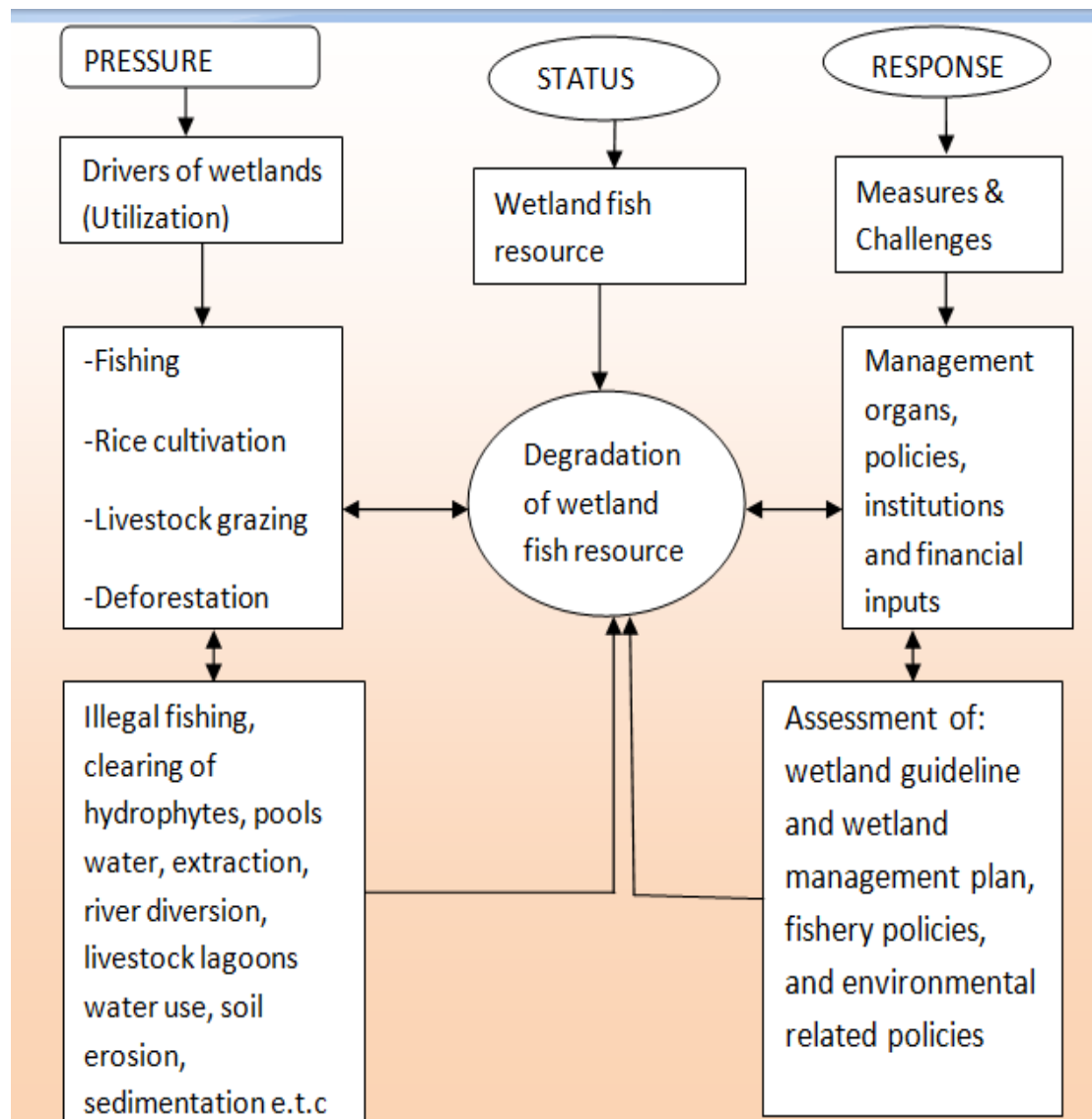


Figure 1: A conceptual framework

Source: Adapted from Yang et al, 2006 (with modification)

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Chapter overview

This section will describe the research design, the study area, targeted population, sampling procedures, sampling unit, data collection methods, data analysis, reliability and validity.

3.1 Research Design

Research design is a comprehensive plan for data collection in an empirical research Project (Bhattacharjee, 2012). According to Trochim (2005), research design “provides the glue that holds the research together”. The design is used to structure the research, to show how the major parts of the research work together to try to address central questions of the research. Kothari (2004), research design is the conceptual structure within which the research is conducted; it constitutes the blueprint for the collection, measurement and analysis of data. The research design represents research strategy and presents the connection between theoretical and methodological perspectives at data collection and highlights as a shed at research question and guide of this research proposal.

This research project used the descriptive design with cross sectional study and involved two types of data, which are; primary data and secondary data. Also, in this study a researcher interacted with participants through household questionnaire survey, interview and focus group discussion.

3.2. Study setting

3.2.1 Location of the study Area

Uyui district is one of the districts of Tabora region, located in central Tanzania and measured at 4⁰, 55'S and 32⁰, 50' (URT, 2008). The district forms part of the vast central plateau of Tabora region, an area of flat and gently undulating plains broken in some places by prominent hills.

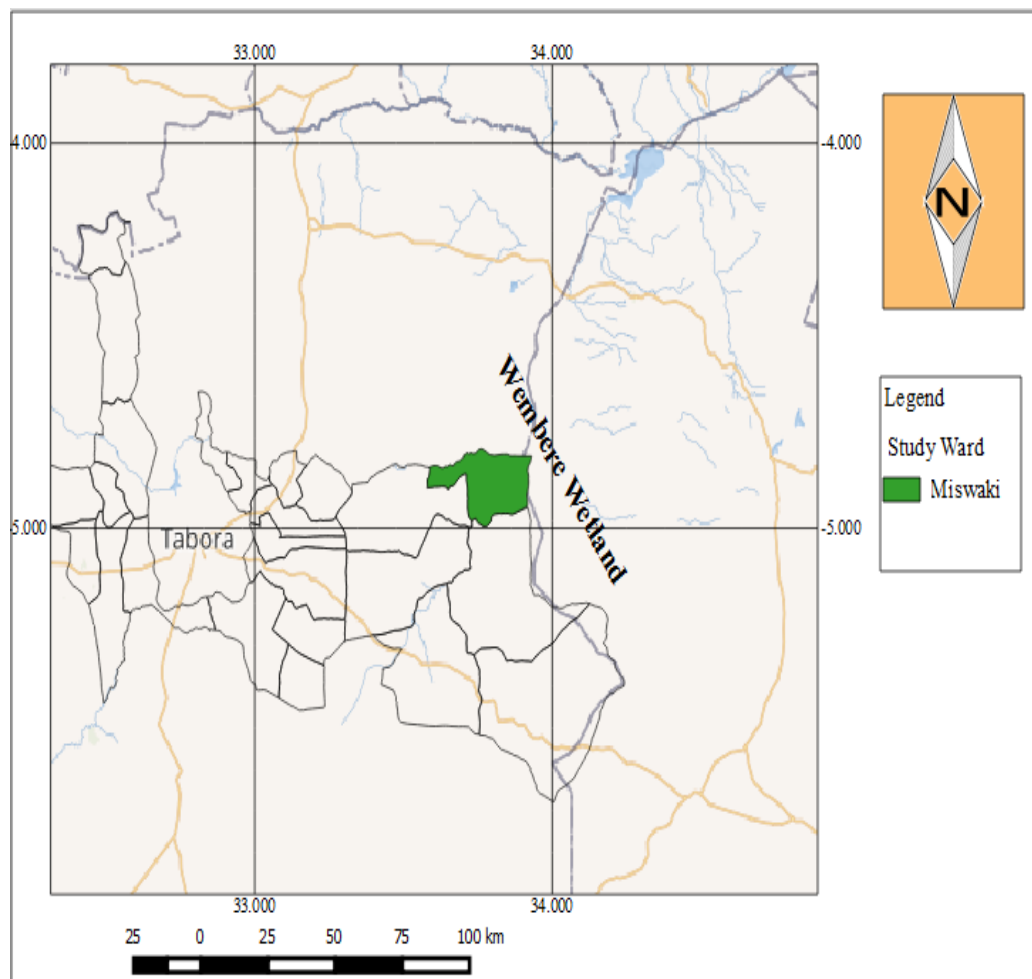


Figure 2: Topographical Map of Uyui District showing location of the Study Area

Source: Adopted from www.googlemaps.com and modified by author

Most part of the district lies between 1,100 meters and 1,200 meters above sea level and forms the main watershed separating rivers flowing north eastward into the Manonga River and the Wembere Swamps. The district has the second largest basin in the region, that of the Manonga river and Wembere Swamp, draining ultimately into Lake Eyasi (ESRF, 2013).

3.2.2 Physical characteristics

Uyui district has two distinct agro-ecological zones, namely, the western zone and the central eastern zone (ESRF, 2013). The terrain of the Western zone is low lying with soils that support paddy cultivation. This zone is the main paddy producing area in the region. A small part of this zone has appropriate conditions for tobacco growing, while the northern part is suitable for growing cotton. Soils are sandy loam and alluvial. The zone is about 80 percent tsetse fly- free and therefore it has good range land for cattle rearing (URT, 1998a).

The Central Zone lies in the central eastern part of Uyui district and is covered with alluvial soils. The zone has low rainfall of between 750 mm and 850 mm and hence limits maize yields leaving groundnuts and paddy as the major cash crops. Cattle rearing is practiced in this zone and fishing activities in the wetland (ESRF, 2013).

3.2.3 Selection criteria

This ward is among of 24 wards in the district making the Uyui district (URT, 2012). The selections of Miswaki ward as the area of study, is due to the factor that, the ward is alongside Wembere wetland. Miswaki ward is located in this zone whereby fishing activity is predominant. It is bordering the Wembere wetland in the Eastern side of the district enabling it to be one of the districts which produce rice from the

wetland in its wards such as Loya and Miswaki (URT 1998a). As the wetland extends north to south it borders Rungwa game reserve. Nyahua River originated from this PA and it pours its water to this wetland making very important reserve of fish resource of the wetland during dry seasons. Fishermen use the wetland water pools for fishing as the most accessible area compared to the river.

The community in this area depends on Wembere as the source of livelihood mainly for fishing due to the existence of swamps/pools that retain water seasonally and permanently. There are four villages in the ward but the chosen villages (Miswaki, Igudi and Mwamdalagwiwe) have most of the residents dependent on wetland for fishing and rice cultivation while other neighbouring wards such as Loya and Itumba are mainly involve in other activities like rice cultivation, grazing, and forest harvest. Miswaki ward is selected because most fishermen are located in this ward and fish harvests are most landing in different areas (URT 2008). So, it was convenient for getting wetland fishery data.

3.3 Research Approach

In this study the researcher used a combination of the two approaches in collecting data; qualitative approach was used as when the researcher use In-depth Key Informant Interview (IKII) Household Survey and Focus Group Discussion methods and in collecting qualitative data from difference respondents. Cooper and Schindler, (2006) assert, that on understanding how (process) and why (meaning) things happen as they do then qualitative approach research is suitable. In quantitative approach data were collected through household survey methods which were quantitative in nature such as socio demographic characteristics and documentary review was used

to extract statistical information on fish resources, past demographic information, and the number of fishing nets in the field.

3.4 Data

Data is a fact which enables the appropriate decision making. In research there are two types of data, namely, primary data and secondary data (Adam & Kamuzora, 2008). The major sources of data and information were from primary and secondary source. In this research interview, focus group discussion, site visit method as well as households questionnaire survey were used as primary data collection methods. Information from 2006 to 2016 period was collected through IKII and household questionnaire survey. Secondary data were used from different written materials concerned with this research revenue log books to extract fish amounts and books such as The District books profile since 2006 to 2016. These books and other documents played an important role to bring statistical data into this report.

3.5 Sample design

This study employed a combination of techniques which ranged from random sampling to purposive sampling. The reason to apply two techniques was to achieve the requirement of the type of respondent and information on the subject matter.

3.5.1 Study/Targeted Population

The study investigates all the households which are living along the wetland at Wembere and in one way or another their livelihoods depend on fish resource from wetland either for consumption or direct fishing. The rationale of targeting this group is that, they are the only who provided information pertaining to wetland fish resource.

One respondent in each household aged between 25 years to 70 years was covered. This is because the selected ages gave appropriate respondents who could give accurate information about the Wembere wetland since 2006.

Targeted population also was village ward extension officer, fish district fishery officers and District fishery officer. These stakeholders were assumed to be knowledgeable on issues relating to fish resources in Wembere wetland.

3.5.2 Sampling unit

The sampling unit is the basic unit containing the population to be sampled. Sampling unit may be a geographical one such as Region, District and Village (Kothari, 2004). It may be a construction unit such as house, flat and buildings. It may be a social unit such as family, club, school and community. In this research project the sampling unit is a ward, Miswaki ward.

3.5.3 Sampling frame

Sampling frame is a complete list of all units or elements from which the sample is drawn (Kothari, 2004). Sampling frame was drawn from the entire study area population which included the list of fishermen's households in the ward. Such a list was comprehensive, correct, reliable and appropriate. It was representative to all households that utilize the wetland by fishing or using wetland fish resource. In this study the sampling frame listed all households in Miswaki, Mwamdalagwiwe and Igudi village.

3.5.4 Sample size

According to population data available Miswaki village has 6238 residents, Mwamdalagwiwe 1902 and Igudi has 2,487 residents, the number of households

were 836, 282 and 346 respectively (Field data, 2017). This study used 100 sample size, which 94 of them were from 1464 households from three villages as shown in table 1 below and 6 Key informants. In this study, the sample size for these households is derived from Yamane (1967) formula which is:

Total **Number of household** =1464

Therefore, the number of households is 1464

$$n = \frac{N}{1 + N(e)^2}$$

Whereby n =Sample size (?) N =total number of the household/population e was level of Precision (0.1)

$\frac{1464}{1 + 1464 (0.1)^2} = 93.6 \sim 94$ P - Total population (households) of 3 villages which was selected.

3.5.5 Sample size distribution

Each village provided a sample which was proportion to its population. Israel formula for proportional sampling was used to unveil the sample size for the 3 villages in a ward as indicated in the equation below.

Israel formula $n = \frac{N \cdot p}{p}$, Where n -sample contribution/proportion; N - Sample size; p – population (household) of a village

The formula gives a total number of 94 representative persons picked from 1464 households in the ward.

Table 2: household sample size distribution table

Ward	Village	Number of Households	Proportion of each village
Miswaki	Miswaki	836	53.67~54
	Mwamdalagwiwe	282	18.10~18
	Igudi	346	22.21~22
Total		1464	93.98~94

Source: Author's computation, 2017

Six key informants were added in the sample. These were three village executive officers, ward extension officer, district forest officer and district fishery officer. This amount with inclusion of household survey's respondents made total amount of 100 respondents. The sample size is reasonable for the study with other factors which were considered such as, funds available and the ability of the sample size to give reliable findings.

3.5.6 Unity of analysis

The unit of analysis is the major entity that is being analyzed in a study. It is the 'what' or 'who' that is being studied. In social science research, typical units of analysis include individuals (most common), groups, social organizations and social artifacts. In this study the unity of analysis was household of Miswaki ward who provided information, Village executive officers, ward extension officer, district forest officer and district fishery officer.

3.5.7 Sampling procedures

This refers to the technique to be used in the selection of the items for the sample. In fact, this technique or procedure stands for the sample design itself (Kothari 2004). The study used probability and non probability sampling method.

3.5.7.1 Probability sampling approach

This is randomization, or random selection. In probability sampling people place or things are randomly selected (Kombo and Tromp, 2006). Every household in the ward engaging in fishing has an equal chance to be selected.

3.5.7.1.1 Simple random sampling (SRS)

In this sampling, the sample units are selected by means of a number of methods like personal Identification Number (PIN) (Kothari, 2004). The reason for simple random sampling is to ensure that each household involved in fishing acquires an equal chance to be represented. In this study respondents were picked randomly from the list of fishermen households from each village office as provided by village leaders.

3.5.7.2 Non probability sampling

3.5.7.2.1 Purposive in Sampling

Purposive sampling is deliberate selections of particular unit of the universe for constituting a sample (Kothari, 2004). Purposive sampling as element of non-probability sampling is selecting a sample “on the basis of your own knowledge of the population, its elements, and the nature of your research aims”, the researcher is then able to select participants based on internal knowledge of said characteristics (Latham, 2007). This was used in the selection of the key Informants who were village executive officers, ward extension officer, fish district forest officer and

district fishery officer. The ward also was purposively selected from 24 wards simply because it is adjacent to the wetland. Similarly, the three villages among the four in the ward were selected considering that fishing is major economic activity in the ward and being adjacent to the wetland.

During FGD, members were selected purposely from those elders who appeared during household survey in each village and all village leaders were purposely reselected to be included in FGD.

3.6 Data gathering methods

The task of data collection begins after a research problem has been defined and research design or plan chalked out Kothari (2004). This study uses five methods of data collection which are survey method, Focus Group Discussion, interview method, documentary review and field site visits.

3.6.1 Household Survey Method

The total of 94 questionnaires were prepared and administered to the respondents. Though, the concept of the **household**, however, posed some methodological problems for this study. The simple husband-wife-children- relative household structure usually found among crop cultivators was not totally relevant to all fishermen situation except to some families. A fisher's family is sometimes a group of bloodily unrelated people adjoined with the fishing goal. They live in fishing camps traditionally known as *makambi*. One *Kambican* host different families which do not share food, income or a working command from any one in or outside that *Kambi* even if members live under a single roof or within a single compound. Most of this form of life includes people who come far away for fishing and they go back

to their homes any time. Similarly, some farmers become the fishermen at certain times of the year when they fish for domestic and sale purposes. Therefore, they establish these camps when fishing activities are far away from their normal residence; therefore they construct camps with several apartments wherein any fisherman can live with her or his family.

Apart from *Makambi*, another **household** was simply treated as a husband-wife-children-relative household structure usually found among crop cultivators traditionally known as *Kaya*. This form of household was understood as comprising a person, or a group of persons, generally bound by ties of kinship, who may or may not live together under a single roof or within a single compound, but who share a community of life, in that they are answerable to the same head and share a common source of income and livelihood. Most of this kind of household engages in fishing and other economic activities like rice cultivation.

Kambi was treated as the composition of households which do not share a common life; the same head and a common source of income and livelihood. Thus, one *kambi* was possibly separated into several households that give several respondents. Finally *Kaya* was directly chosen and treated as a household in this study while *kambi* was separated to fit household characteristics such as sharing in income, working command and livelihoods.

The questionnaires were distributed to the herd of households to be answered. Some of the questions were open ended questions to give freedom to respondents by giving their perceptions and views according to their understanding capacity to the topic under the study. Closed end questions dominated the questionnaire to enable

respondents to give such dichotomous and multiple responses. These questions are easily handled, simply answered, quick and relatively inexpensive to analyse. Open ended question gave the freedom to respondents to express themselves more to the question.

3.6.2 Key informant interviews

Key informant Interview was conducted to village executive officers, ward extension officer, district fishery officer and District forest officer. These people have special knowledge on a given topic and data is expected to be available. The method was in-depth personal interview with a face-to-face interrogation. The tool that was employed is the checklist with non structured questions which contained questions for key informants.

3.6.3 Documentary review

Documentary review was used to collect secondary data by critically analyzing different documents such as books, journal papers, district report archives, internet sources and other published and unpublished data for instance dissertations/theses government publications and reports. The objectives of secondary data review enabled researcher to get general understanding of research thematic area and secondary data on different land use activities in the wetland since 2006.

3.6.4 Field site visits

Field site observations were used to authenticate fishing activities and other human and natural factors that affect the fish resource in Wembere wetland. Field site visits were organized in collaboration with the local leaders in the study area. Camera was used to record information including fishing tools, rice irrigation and other observable facts.

3.6.5 Focus Group Discussion (FGD)

According to Cohen et al., (2000), the Focus Group Discussion method is used purposely to obtain in-depth information on the concepts, perception and ideas of group members about the socio-economic activities which impact fish resources on wetlands.

The participants of FGD were chosen from the study area considering the experiences in fishing activities, leadership and age of discussants. For each village, four fishers of any of the above characteristics were purposely selected from all respondents of household survey for FGD. The inclusion of fishermen in the discussion groups was reasonable because fishermen were the most targeted people whose livelihoods were affected by other groups of Wetland users. In comprehending management issues on fishery resources in the wetland, the FGD included village executive officer from each village.

3.7 Data Processing, Analysis and Presentation Plan

3.7.1 Data processing

After the collection of data, a manual method was used to process that data. This involved data editing in the field, official or central classification of data and tabulation.

3.7.2 Data analysis and presentation

Due to the nature of obtained data, all data were not in numerical or quantitative form, that is, in the form of numbers. Descriptive statistics were used such as measures of central tendency like mode (frequency). Analysis of correlation was done through the use of chi square test to test casual and effect relationship of some variable. Those data in numerical form, summarization of patterns and trends of findings were carried out by using regression analysis;

$$y = a + bx$$

Where amount of fish catch in tone; x-year; and y-number of fishermen; x-year.

This was done under computer special programs such as SPSS IBM, 20 and Excel. For example the trend of fish catch was analyzed. Then an explanatory analysis also was carried out to explain the experiences of the individual participants. Finally, different methods of presenting data were used. These include tables, graphs, and charts.

3.8 Data quality control

This includes reliability and validity.

3.8.1 Reliability

Triangulation technique was used to ensure information collected is reliable. This is an involvement of different data collection methods which are household survey, IKII, FGD, Field site visits and documentary review.

3.8.2 Validity

In order to ensure validity, instrument for data collection such as questionnaires and interview guide was clearly clarified by a researcher. Also, careful formulation of questions and the pre-testing of tools was observed and applied respectively. The questionnaires were pre-tested to ensure their validity before actual data collection.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Introduction

The various activities which were taking place in Wembere wetlands influenced the researcher to assess their influence on fishery resources present in the wetland. The researcher raised this concern following his long time observations in the wetlands during his research.

Following the increased wetland encroachments due to the competing uses of Wembere wetlands which have led to land cover/land use change (LCLUC), the researcher got the opinion that, these activities may have adverse impact on fishery resources in these swamps. This experience from the field and other related places through literature review, immensely contributed to the researcher's concern on this topic.

The preceding chapters dealt with the background of the problem in chapter one, Literature review in chapter two and selection of appropriate research methodology for this research was done in chapter three.

The current chapter presents the findings of this study; it provides demographic details of the respondents, it also presents the main findings and discussion in a chronological order of the research objectives.

4.1 Demographic Characteristics of Respondents

The administered questionnaires have given demographic characteristics of respondents in the field ranging from age, education, sex, marital status to economic

status of a respondent. The purpose of choosing these characteristics is to obtain different information corresponding to fishery resources in Wembere wetland.

4.1.1 Sex of the respondents

In this study, during the households' survey, , both males and females were involved. Findings show that 21.3% of the respondents were females and 78.7% of respondents were males. This data is well presented in *Table 3*. The difference between genders is very remarkable due to the nature of fishing activities where traditionally women are not attracted to deal with fishing activities.

Table 3: Sex Distribution of the respondents

sex	Frequency	Percent
Female	20	21.3
Male	74	78.7
Total	94	100.0

Source: Field data, 2017

Women around wetland fishing sites collect fishes from shallow lagoons during day time, contrary to men who go far away with their fishing vessels both during day and night. The contribution of women in fishing activities remains significant by performing other off water duties like preparation of fish for smoking, frying and smoking.

Hamido, (2012) argues that, the role of women in fishing sector is unnoticeable in Tanzania marine artisanal fisheries. Traditionally, men have fished both inland and marine water bodies while few women traditionally concentrate inshore fishing activities like collection of octopuses and seashells in coastal areas. Also they play a very great role in fish processing and trading within their locality. The nature of

fishing areas and their development has played a crucial role in promoting gender disparities (Medard *et al.*, 2002).

4.1.2 Age of respondents

Age was among of the key demographic characteristics of this study. The findings show that, a total of 24 respondents had age group of 25-34 years old. In Miswaki village 15 respondents among 24 aged between 25-34 years old while the remaining came from Igudi and Mwamdalagwiwe. Respondents aged between 35 to 44 years were 17 while the age from 45 to 54 years old were many compared to other age groups. The highest age surveyed was 65 to 70 whereby only 5 respondents were surveyed. Mwamdalagwiwe village had no respondents of 65-70 years old (see Figure 3).

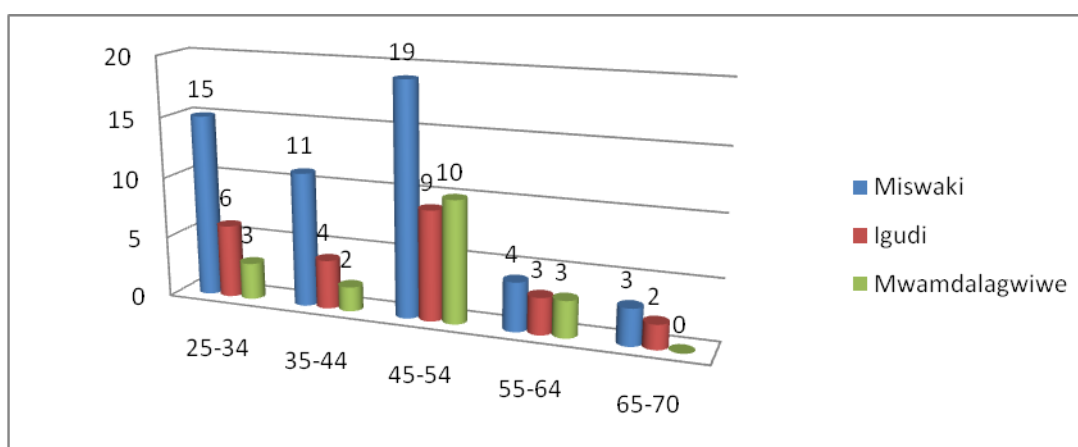


Figure 3: Result of the age of the respondents

Source: Field data, 2017

These research findings give a picture that many people aged from 45 to 54 years old opt to employ themselves in fishing activities compared to other age group. This is possibly due to inability of working in other tough activities. This data is contrary

from the finding by Cowxet *al.* (2003) reveals that, most of fishermen in Lake Victoria are Youths.

4.1.3 Level of education of respondents

According to National census of 2012, Tabora region was ranked as one of the region with the lowest literacy about 59% of its people are literate. The data from the field suggest that 58.5% of respondents had got informal education, 35.1% had attended primary school level while 6.4% had secondary level of education (*see* Table 4).

Table 4: level of education of respondents

Level of education	Frequency	Percent
Informal education	55	58.5
Primary education	33	35.1
Secondary education	6	6.4
College	0	0
University/college(bachelors degree and above)	0	0
Total	94	100.0

Source: Field data, 2017

The level of education is an important factor in a person's life because it has a great influence in someone's thinking, reasoning, interacting with others, reflecting, judging, the ability to make solution or decisions with regard to the problem he/she encounter in his/her life and the like. This data is not far contrary to that of national census conducted in 2012. Therefore, the rate of illiteracy in the region is still very high particularly in Miswaki ward where this data was collected. It suggests that, the communities in the ward do not prioritize education as an important component in their life.

4.1.4 Procedures of acquiring fishing property right regime in the wetland

Like any other water body in Tanzania wetland fishing is an open to access to everyone. Although the government insists fishing license (URT, 2015), majority of people have no fishing license in Wembere wetland. The field data reveal that, people who fish in the wetland 31.9% have fishing license and 63.8% have no fishing license and according to the law of the land they are subjected to illegal fishermen. (see Figure,4)

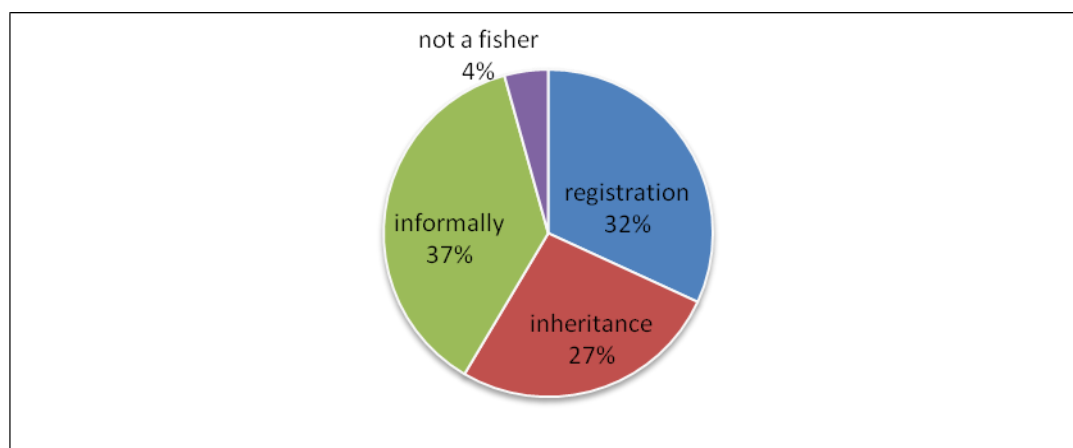


Figure 4: Methods of acquiring fishing property regime

Source: Field data, 2017

Information from a key informant revealed that, the number of fishermen in the wetlands who are not registered is very high compared to those who are registered and have acquired fishing license. Although, it is stated by key informant that, the amount of registration for fishing license is cheap (Tshs. 15,000/= per year), people are not willing to have this license, this leads to more illegal fishing practices. Because it is very difficult to access fishing license from Fishery district officer due to the distance from fishing areas to the Municipal council offices, village and ward executive officers have the authority to issue these license on behalf of responsible authority.

4.1.5 Number of members in the household and level of income

All 94 respondents from chosen households were interviewed on their daily income from fishing activities in the wetland. The findings were cross-tabulated with the number of members in the household within how much shillings they get to test their association. The findings unveil that respondents who earn less than Tsh. 2700 were 60% of those households with 1 to 4 members of households where most come from Mwamdalagwiwe, while those who earn more than Tshs.10,000/= were 26.8% in this group where by most of them come from Miswaki village. In group of 5 to 8 number of members in the household 60% earns Tshs.2,700/= - 4,900/= in which most of them come from Mwamdalagwiwe and the members of household who are more than 8 and who earn more than Tshs.10,000/= were 39% and this is the most group that earns much income per day in the wetlands compared to other group (see Table 5).

The output from cross-tabulation identify that, many fishermen from Miswaki village earn more income compared to other villages. It is significant to say Miswaki village is economically the wealthiest village in the study area

Based on Pearson chi-square test, it can be confirmed that, there is a significant association between number of the members in the household and amount of income generated per day when all members are involved in fishing ($X^2 = 16.18$, $P=0.013$). The increase of income in the household depends on the number of members in the household.

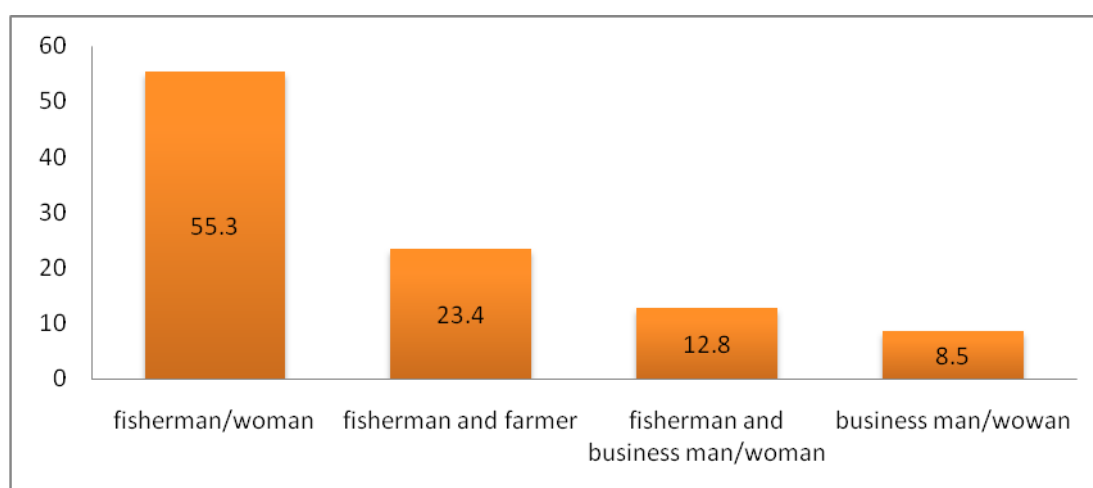
Table 5: Income generated from fishing in wetland

	Less than 2700/=	2,700 - 4,900/=	5000- 10,000/=	more than 10,000/=	Total
Miswaki	5	2	17	28	52
Igudi	3	1	9	11	24
Mwamdalagwiwe	7	7	2	2	18
Total	15	10	28	41	94

Source: Field data, 2017

4.1.5 Primary occupation of the respondents

In Wembere wetland different activities take place such as farming, grazing, fishing, firewood collection *etc. etc.* During the household survey, respondents were asked to mention their occupation in the study area. The Data in *Figure 5* have shown that 55.3% of respondents were fully depending on wetland for fishing activities, 23.4% respondents were fishermen/woman and farmers, 12.8% respondents were fishermen and businessmen/women. In the study area, fishing was mentioned as the major economic activity.

**Figure 5: Primary occupation of the respondents**

Source: Field data, 2017

Occupations in the wetland differ from one person to another as the way each person perceives the means of acquiring wetland wealth. The source of livelihood to many inhabitants of wetlands ecosystems in Tanzania is therefore opportunistic and has been and still is based on direct exploitation of the wetlands natural resources including forests, fisheries, wildlife and agriculture (Ntupwa, 2010). Furthermore, majority of the population in many Tanzania wetlands earn their livelihoods through fishing and farming in the wetlands. According to (Magembe, 2007), the type of activity a person performs has an impact on the wetland resources extraction.

4.1.6 Types of fish available in the wetland

Wembere wetland fish resources comprise Mudfish (*Clarias* sp.) species which is the most available fish in the wetland whereby among 94 respondents 95.7% of them mentioned it. Their abundance overwhelms other species of the wetland. Also findings point out that, abundance of Lungfish (Kamongo) is next to the mudfish (figure 6) this fact makes the most common fish species of the wetlands to be mudfish and lungfish. Tilapia and Ningu was mentioned to be less abundant species in the wetland.

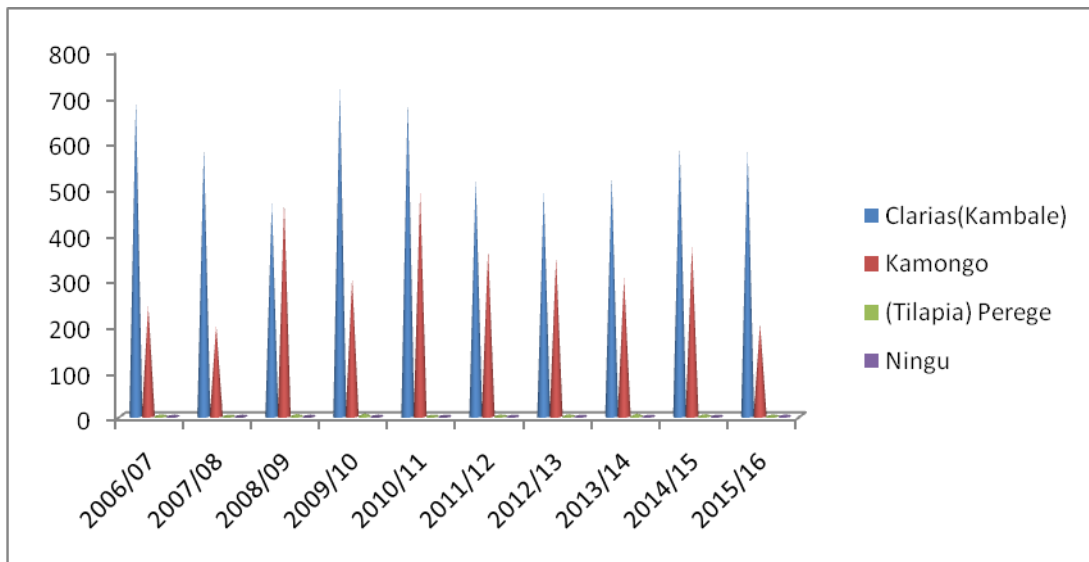


Figure 6: Fish species of the wetland

Source: Field data, 2017

These two types (Tilapia and Ningu) of *Oreochromis* species contribute very few tonnes of fish to the district but these tonnes contribute very significant on proteins intake on the community in the district. Therefore despite of their scarcity, they are highly demanded. This finding is not far from Bwathondi and Mwamsojo, (1993) and Mbogoro and Mwakipesile, (2010) who reported that, major fish resources in minor waters consist mainly of riverine genera, such as *Oreochromis* and *Clarias*.

4.2 Trend of fish resources harvest in Wembere wetland.

The trend of fish stock of the wetlands in consideration to their total catch amount was collected by different ways such as surveying the household view about the ongoing trend of the fish availability. Fish availability may be for food or for commercial uses. The views on trend of catch per unit effort were collected through house hold survey. Also sites visits were done to collect information of fish landing of different fishing sites.

There were data on surveys of catch landings, which were conducted at selected landing sites of the wetlands. These data were collected in different years and others from Village office, ward office, district fishery documents and district council reports for different years. All these information was collected to get accurate statistics of fish caught per year in different years from 2006 to 2016. Finally, data were presented through graphs showing the trend of fish catch in the wetland.

Data on catch for the period 2006/2007 –2015/176 show that, the total catches from the Wetland of all species have slightly increased ($r^2=4.9\%$) over the time period but generally have fluctuated throughout the period (figure 7).

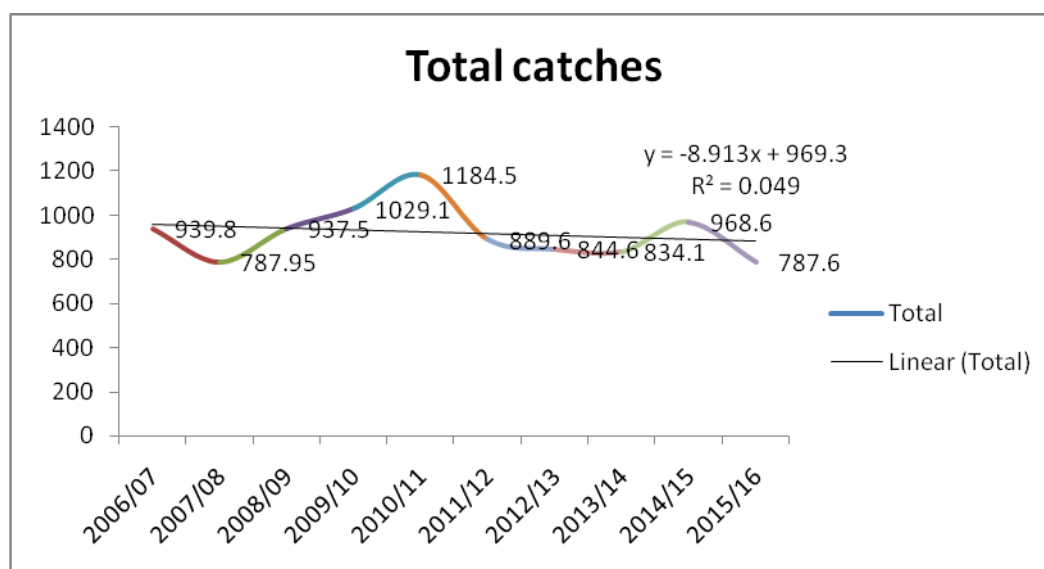


Figure 7: Trend of total fish catch (in tons)

Source: Field data, 2017

From year 2006/2007 to 2007/2008 the amount of fish catch declined from 939.8 metric tons to 787.95 metric tons. From 2007/2008 the amount of catch went up before another decline in 2011/2012 and next consecutive years despite a slight catch rise in 2014/2015 year.

4.2.1 Trend of Catch per Unit Effort

Also, interview with key informants suggests that, data on catch and associated effort and the catch size have declined in the wetland. In past ten years ago, Catch/hour was generally greater than ten years later in all villages. 18.2% of the respondents responded that catch per hour during ten years ago was more than 20kg/hour; 23.9% of the respondents replied that during ten years ago, catch per hour was between 20kg/hour to 15kg/hour; 47.4% of the respondent answered catch/hour was 14kg/hour to 10kg/hour and lastly, 10.5% of the respondents answered less than 10 kg/hour is the catch (see figure 8).

When the respondents were probed to give the current catch amount per hour their answers were as follows; generally, 0.3% of the respondents responded that catch per hour during ten years ago was more than 20kg/hour; 0.7% of the respondents replied that during ten years ago, catch per hour was between 20kg/hour to 15kg/hour; 1.7% of the respondent answered catch/hour was 14kg/hour to 10kg/hour and lastly, 97.3% of the respondents answered less than 10 kg/hour is the catch (see figure 8). Also, the average catch per day computed from data of amount of catch (figure 4.5) and those of number of fishermen in the wetland (figure 12) indicate catch per fisherman in a day declined from average of 16kg in 2006 to average of 4.6kg a day. This data is not far from that given by respondents during HHS.

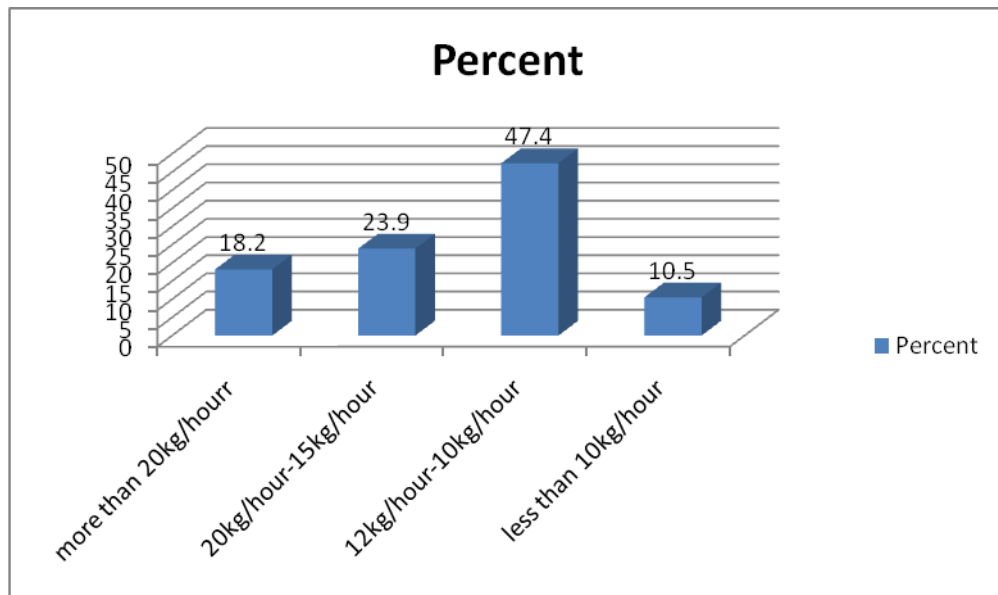


Figure 8: Findings of the amount of fish catch per hour 10 years ago

Source: Field data, 2017

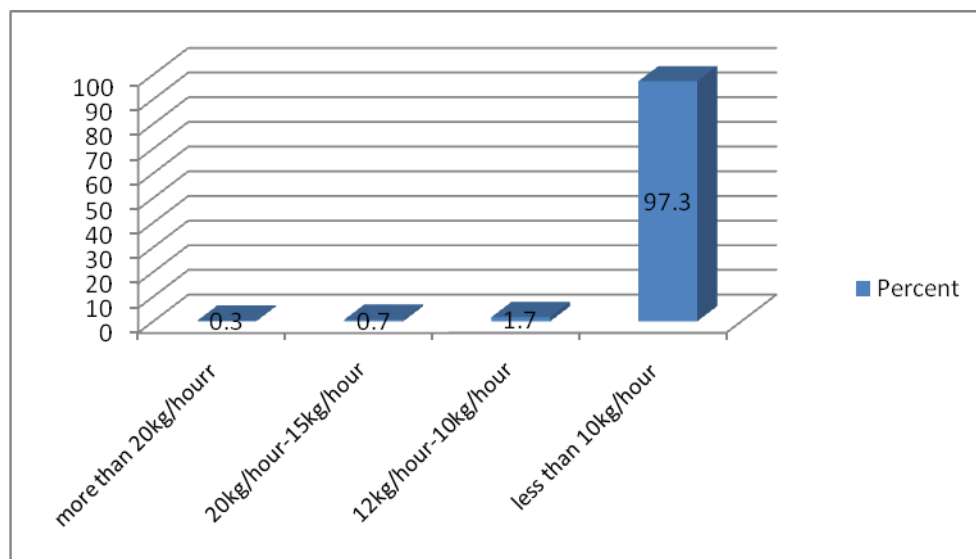


Figure 9: Findings of the current amount of fish catch

Source: Field data, 2017

The decline of catch per hour suggests the decline in wetland fish stock and it is suggesting decline of CPUE. This is because the time used to fish a certain amount

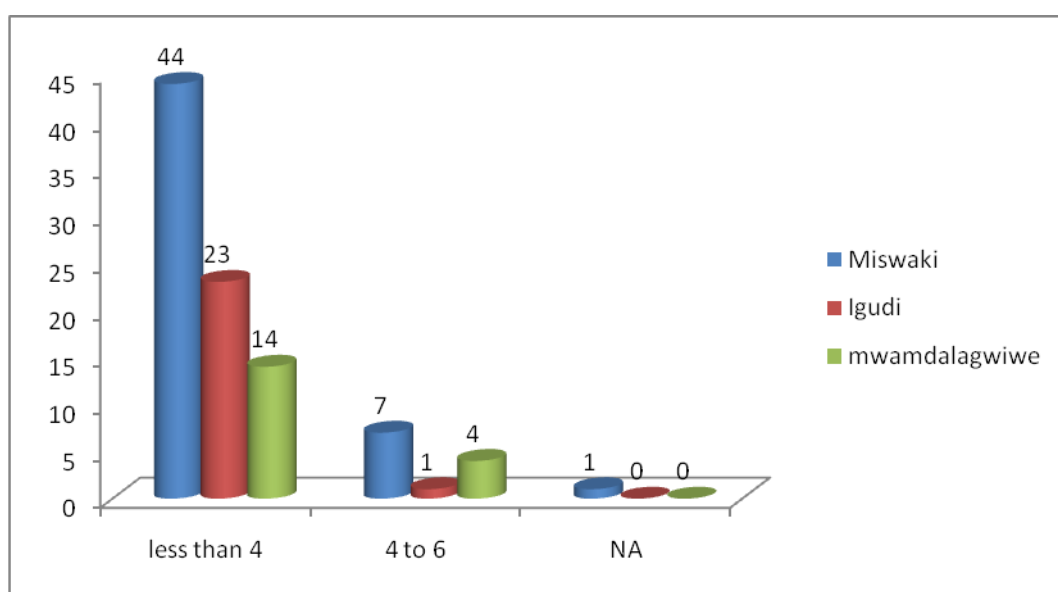
of fish has increased while the amount of fish fished remained constant. In her study, Hamido, (2012) substantiates that CPUE is a good indicator for stock abundance and this indicates that the fishery resources is likely to have reached its exploitable potential and any further increase in effort will not lead to an increase in catch.

Also, information from FGD reveals the shortage of fishes for domestic uses. Discussants were proclaiming on the life hardship due to the shortage of fish for food in recent years compared to the past time. When they were asked if this shortage was contributed by commoditization of wetlands fish most of the rejected confidently pointed out the causes of shortage of fish was due to decline of amount of fish. The current decline of fish production in Tanzania in major water bodies (URT, 2015) may reflect the current status of fishery resources in wetland of the hinterland.

4.2.2 Trend of fishnets in the wetland and catches

In 10 years ago in Miswaki village, 44% of fishermen owned fishing nets less than 4 while those who owned 4 to 6 nets were 7%. The situation was the same to other two villages which indicated that, many fishermen owned less than 4 numbers of nets while few people owned more than 4 fishing nets. On other hand, the current (2016) amount of fishnets owned per fishers has increased in the wetland (*see figure 4.9*). 37% of respondents mentioned that they own four and above fishnets while those who own less than 4 fishnets their number has declined from 44% of the respondent ten years ago to be 9% of the respondents currently. In Mwamdalagwiwe village the percentage of fishermen who own 4 to 6 fishnets increased from 4% to 9% from 2006 to 2016 and new number of fishnets was reported to exist in recent years. This verifies that CPUE was very high in the past 10 years compared to the recent years.

In figure 4.8 below the data shows that the number of fishnets possessed by the fisherman in the past ten years was very few compared to the current. This implies that it was unnecessary to own many fishnets while fishes were abundant. The fish abundance was contributed by stability of wetland's ecology compared to the current situation. This data is contrary with those probed to be estimated ten years later (see figure 10). Data illustrates that, from 2006 to 2016, the number of fishnets has increase tremendously in the wetlands.



NA*Not Answered

Figure 10: Ten years past respondent's fish nets amounts possession

Source: Field data 2017

Therefore, fishing activities increased too. The increase in number of gears present in wetland tells increase of fishing activities subsequently, fishing pressure increases.

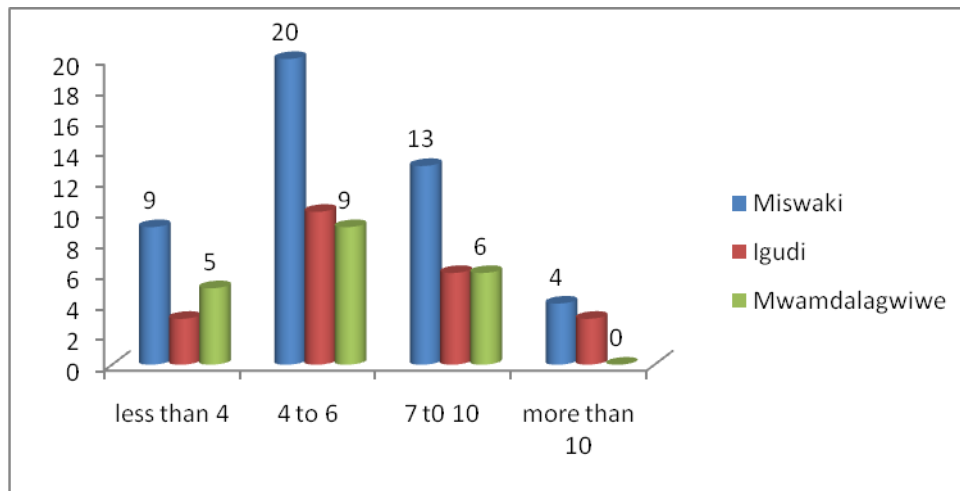


Figure 11: Current respondent's percentage of fishnets quantities

Source: Field data, 2017

Data from district fishery officer shows increase of registered fishnets in the wetland from 1845 recorded in 2006 to 2721 in 2016. This increase fostered the decline of fish resources in the wetland. Thus, in order to maintain CPUE (Catch/net) the addition of more fishnets seemed to be a solution.

During In-depth interview with District fishery officer, he reported that, there is increase of commercialized fish demands regionally and nationally in Wembere wetland fish resources in recent years. Fish traders inside and outside the region, have been promoting trade on wetland fish resources. This also, has been contributed by the increase of all season roads which pass through the wetland. Fishery resources in the wetland have been commoditized and became a preference for most people. Due to this commercialization, wetland attracts more people purposely for fishing but eventually others fall into other activities like rice cultivation.

During FGD in all villages, it was frequently stated that, there is a challenge of availability of traditional canoes for fishing. Fishers have changed from using large

tree wooden canoes (*Mihama*) to simple timber canoes since construction of canoes from these trees has been restricted by the government to protect these trees which are mostly affected and they take time to regenerate.



Plate 2: Traditional canoe made of big tree (Mhama) in Wembere Wetland

Therefore, opting to increase the number of fishnets is said to be adaptation measures towards the shortage of fishing vessels.

The number of fishing vessels in recent years has generally remained constant despite of the very slight increase. This is contributed by the decline of forest in the region which contributed to the manufacturing of canoes. Although, in Coastal wetlands, (Hamido, 2012) found that, the numbers of vessels have been going up with a sharp increase coinciding with trends in fish value, it is contrary to the wetland where despite the value of fish increases the number of vessels have remained constant. Gordon, (1954) assumed that the number of fish caught with any given level of effort is a linear function of (and therefore proportional to) the fish stock.

4.3 The impact of socio-economic activities on fish resources

In Tanzania, detailed studies are needed on possible habitat destruction on wetland fishing ecosystems which are caused by different human activities including fishing itself. Following the introduction of '*Kilimo kwanza*' slogan, rice production in the country has been increasing while its environmental impacts remain under assessed. In wetland ecosystems, particularly the Wembere ecosystem fishing activity, agriculture and forest clearing has been the factors that might have impacted the wetland in one way or another. Wembere wetland as the habitat for wild fishes, this habitat is threatened by human activities. The National fishery policy claims that, detailed studies on possible habitat destruction are not readily available therefore; this investigation documents the plights of human activities on wetland (URT, 2014). The following investigation provides tangible evidence on how economic activities have affected the wetland fish resources.

4.3.1 Fishing activities in the wetland

In marine wetlands, most of inshore fishing takes place on the continental shelf where productive areas such as coral reefs, reef flats, sea grass beds, mangroves and estuaries are located. These habitats have been reported to be subjected to heavy fishing pressures from artisanal fishermen (Guard *et al.*, 2000). In most cases, Tanzania wetlands and shallow lakes fishes are caught from dugout canoes with traps, hooks, gill nets, weirs and occasionally beach seines (Bwathondi and Mwamsojo, 1993; Hamido, 2012). Some of the gears used can be detrimental to the ecosystem (URT, 2015).

4.3.1.1 Trend of number of fishermen in the wetland

The trend of number of fishermen in the wetland has been illustrated in *Figure 12* below. This trend shows a sharp increase of number of fishermen in the wetland by $R^2 = 97.4\%$. This trend is contrary with that of the trend fish catch which shows the slight increase of $R^2 = 4.7\%$. Despite the increasing number of fishermen the amount of fish landings remained unchanged with very slight decline. This data suggests the decline in CPUE (catch/hour) from 2006 onwards. Thus, the decline of CPUE suggests the decline in wetland fish stock.

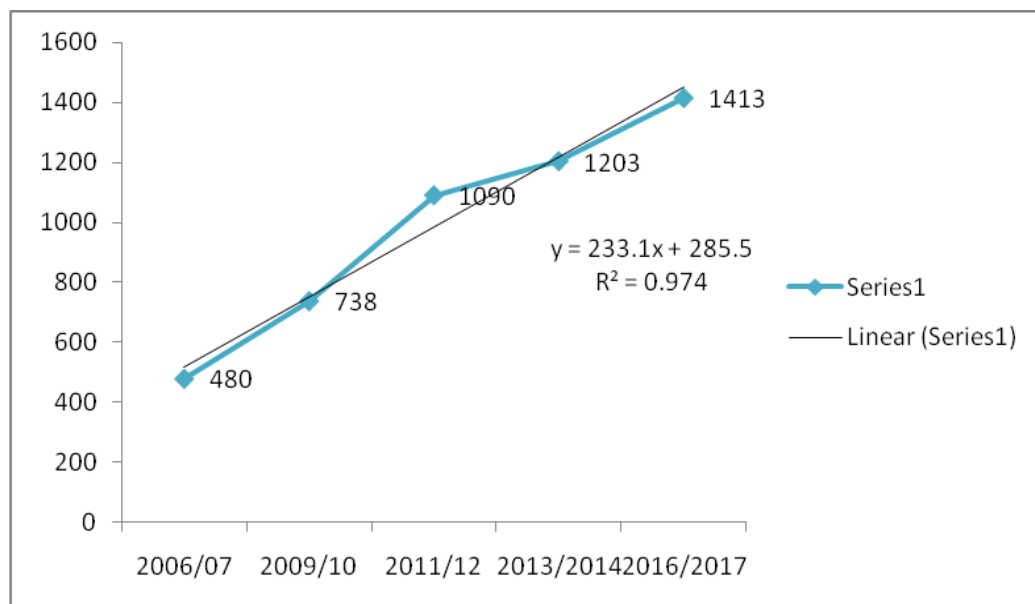


Figure 12: Trend of fishermen in the wetland

Source: Field data, 2017

The shape of each yield function indicates that as the fish stock increases, a given number of fishers can catch proportionately more fish. As the number of fishers increase, an even larger number of fish can be caught at each level of fish stock.

Fishing competition in Wembere fish resources has increased because of the population change in the area. From 2002 to 2016 the population in the study area has increased from 2268 (Tanzania population census report, 2002) to 10627 (Field data, 2017). This change has increased the number of fishermen in the wetland. The number of fishers is a straightforward measure of the level of fishing effort; any increase in number of fishers affect wetland fish stock Gordon (1954).

The impact of population increase over resources is well known. Tobey and (Torell, 2006) agree that, increasing of population would increase the number of fishermen who in turn increase the competition for fish resource due to a rising number of both local and visiting fishers. Therefore, due to the increase in current population in Wembere wetland, fish exploitation also increased simultaneously.

4.3.1.2 Fishing techniques in the wetland

Two methods of fishing i. e gillnetting and hooking both have scored 29.9% of response with 86.2% response of cases. Bottom trawl method scored 14.8% of responses. Artisanal fishers of the wetland rated as the fourth fishing methods thorough response cases of 42.6% while long lines and spear fishing scored 4.4%and 21.0% respectively (see Table 6).

The findings of IBM SPSS 20 analysis (chi-square) from field data have shown that fishing activities in the wetland have impacted wetland fish resources (chi-square=21.4, df =12, p=0.04). This result suggests that any increase of fishing pressure would compromise the future of fishing resource of the wetland.

Table 6: Fishing methods Frequencies

Fishing method	Responses	Percent	Percent of Cases
Bottom trawl	40	14.8%	42.6%
Gillnetting	81	29.9%	86.2%
Longlines	12	4.4%	12.8%
Spearfishing	57	21.0%	60.6%
Hooking	81	29.9%	86.2%
Total	271	100.0%	288.3%

Source: Field data, 2017

Hooking was mentioned to be a non-destructive method for fishing. Gillnets were mentioned to be very destructive fishing methods when the nets which are used are less casted nets which allow to catch very young and juvenile fishes.

Trawling has been mentioned to be very destructive to fish resources. This method is illegal according to the law of the land (URT, 2003b), but key informants in Mwamdalagwiwe village reported that, this method is widely and openly used as a fishing method in the wetlands. These methods usually catch smaller and juvenile fish which makes the fishery unsustainable (URT, 2015). FGD with fishermen and village leaders in all villages have shown that catches are declining in the wetland. This decline perpetuated the increase of illegal fishing methods. In the Coastal wetlands (Berachi, 2003) find out that, competition among the fishermen and decreasing CPUE has led to fishermen resorting to fishing methods such as beach seining, small meshed gillnets and other unsustainable methods like dynamite.

Also, it is openly discussed in all villages that, the use of trawling methods in the wetland is very common and it is said to be very effective method of increasing

catches. Other methods are commonly used simply because they are legally accepted. Francis, and Bryceson (2007) pointed out that, the overfishing techniques such as the use of bottom trawling; in which nets are dragged along the bottom of ocean are highly destructive to all kind of benthic (bottom dwelling) life. In coastal wetlands Hamido (2012) states that, the nets are weighted and dragged through the coastal reef flat, damage fish habitat of marine resource and also the net findings in the capture of many juveniles.

To understand the size of net meshes required for fishing in the wetland was very important to assess the size of fish caught in the wetland. The findings have shown that most of people (80%) use the fishnets meshed of with 3 Inches and above diameter. It is legally accepted to use the fishnet of this size in the wetland. The remaining percentages were using net size meshed less than 3 inches diameter. Therefore, In-depth interview with fishery officer concluded that, fish harvesting is allowed in Wembere wetland by using fishnets meshed from 3 inches diameter and above in order to avoid by-catches in the wetland.

4.3.2 Rice cultivation and wetland fish resources

Wembere wetland has been increasingly converted into rice fields due to the increased demand for food in the country and on commercialization of rice, many wetlands in the country have started to change their natural habit and more will be converted into rice fields (URT, 2003a). Regionally, Wembere wetlands as the multipurpose wetland has been serving for years now as the only area where rice can be grown with less cost due to its high amount of fertility (URT 2014; Kamkala and Crafter, 1993). Therefore, this cultivation has covered a wide range of the wetland and its riparian area.

The increasing demand for rice as a staple food in different areas of the country triggers the demand for more rice farms especially in the wetland. This increase has come as a result of the increase of population in the region and in the entire country (ESRF, 2013). This population change puts pressure to upland cultivation, consequently, forced people to move toward wetlands where rice cultivation was possible (FAO, 2015).

Indepth interview with ward extension officer reported that;

“Through ‘Kilimo Kwanza’ slogan, rice production in Wembere wetland has helped many farmers to cultivate with more advanced machines compared to the past”.



Plate 3: Fishing camp left by the fishermen after the decline of fishing activities at Mwamdalagwiwe village

He mentioned such machines as Hand tractors or Power Tillers and tractors. People from different parts of the region have been cultivating on the wetland leading to land conflicts and resources shrinking. One of the important affected resources is fish resource.

The study finds that 41(43.6%) of the respondents were neutral and those who agreed were 38 (40.5%) out of all respondents. While 8(8.5 %) out of all respondents strongly agreed that rice cultivation practices have adverse impact on the fish resources and 7(7.4%) rejected (see figure 13).

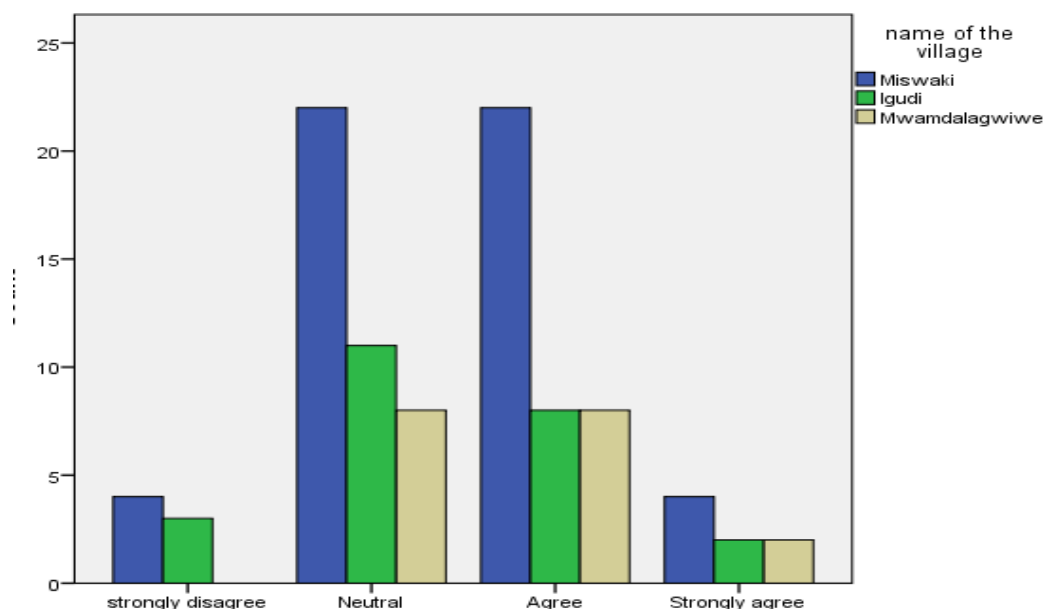


Figure 13: People's attitude on impacts of rice cultivation practices on fish resource.

Source:Field data, 2017

To identify the practices which affect fish resources in the wetland' respondent were given the chance to respond on three responses; river diversion, canalization of the river, and clearing of wetland hydrophytes. The finding identifies that the practices which affected more the wetland fish resource is canalization of the river followed by river diversion. The findings have shown that, Mwamdalagwiwe is most hit by canals constructed from rivers to farmland. Water pumping was very rarely mentioned practices because very few people were able to own the water pump

machines and because most of farmers harvest on time, the use of pumping machines was mentioned to be very rare in the wetland. (See figure 12).

The findings unveil that rivers of the wetland have been diverged from natural channel flow for irrigation purposes leading to the collapse of fishing activities in Mwamdalagwiwe village. Changes in channels are likely to have contributed in the past to changes in the hydrology of the Wembere plains, consequently affected fish resources of the wetland. Similar study by Adams (1985) asserts that, the predicted irrigation practices of the Delta dam led to the decline of fish population, with lower catches and smaller sizes forcing more and more households to abandon fishing. As a result, many people were forced to migrate from the area.

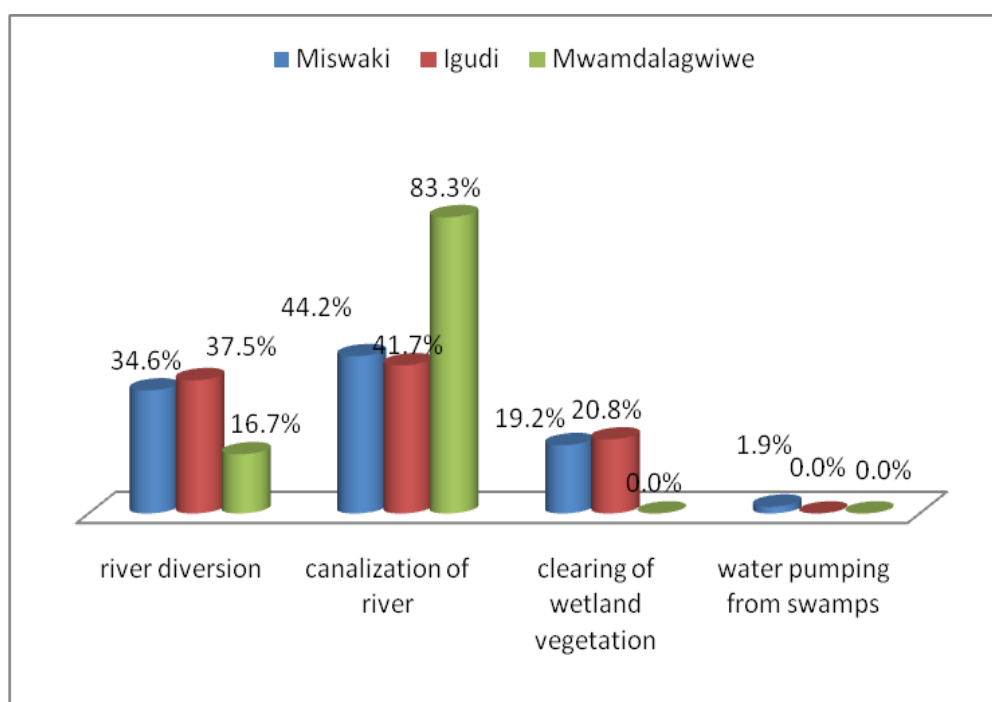


Figure 14: Rice cultivation practices that affect fish resource

Source: Field data, 2017

In this study, statistical analysis significantly has shown ($\chi^2=35.44$, $df=6$, $p=0.001$) that water lagoons which are very important habitat for fish during dry seasons have declined due to water abstraction and channelization from rivers which reduced the integrity of the rivers and wetland pools. This has led to the migration of some fishermen to Miswaki village as the measure to regain their fishing activities. For example, information from village leader in Mwamdalagwiwe village informed that, the number of fishermen in the village was declining, and this decline was caused by shortage of catch caused by rice practices.

Also, clearing of hydrophytes for rice fields has been contributing to the destruction of fish habitat and feeding sites in the wetland. The clearing of hydrophytes for expansion of rice field has increased water evaporation in the wetland leading to quick dry up. SMUWC, (2001a) reported that, evaporation from open water takes place at a rate approximately 25% greater than that from a surface covered by aquatic vegetation. This is caused by the change in the reflective capacity of the surface thus allowing less incoming radiation to be reflected back into the atmosphere.

Again, these conditions allow for an unstable hydraulic regime affected by deposition and erosion, with much evidence of previous river channels, now long since abandoned, and changes in size, volume and location of open water lagoons in the perennial swamp (SWMUC, 2001b). Therefore, drying up of the water pools in the Wembere wetland is a major problem for the aquatic ecology in which fish resource of the wetland are directly or indirectly affected.

During the time when rivers are following to enter the wetland plains, farmers tend to construct canals to exploit water from these rivers. These canals or channels take a

lot of water away from the natural stream flows. These practices affect the wetlands natural hydrology which is very important for fish habitats (SWMUC 2001b).

Also, During FGD in Igudi village it was noted that sometimes extraction of water is done through water pump machines. This extraction from different rivers' pools has affected these pools which were perennial making the perennial swamps in the wetland. Consequently, it affects fish resource. This water extraction is done by farmer when they need to water rice farms after cessation of rain season without harvest.

River diversion was mentioned as one of the practices that affect negatively, the wetlands fish resources. When the respondents were asked specifically to state whether water diversion from rivers affects fish resources, 80(85.1%) of the respondents agreed while 20 (14.9) of the respondents rejected.

Table 7: Responses of respondents on the impact of water divergence to farmland

Responses	Village name			
	Miswaki	Igudi	Mwamdalagwiwe	Total
YES	46 (88.5%)	20 (83.3%)	14 (77.8%)	80 (85.1%)
NO	6 (11.5%)	4 (16.7%)	4(22.2%)	14 (14.9)
Total	52 (100%)	24 (100%)	18 (100%)	94 (100%)

Source: Field data, 2017

The findings through Field Site observation and FGD show that, in Igudi village, seasonal rivers which drained into the wetland has been fully blocked and diverged to wetland plain terrains where rice production is prominent. This led to cessation of some pools which were before permanently present in the village.

This act has stopped some natural river lagoons and wetland pools to be drained by these rivers hence reducing the capacity to store water. This action has lead to conflicts between fishermen and farmers.

All important rivers which are entering into the wetland such as Nyahua, Ngh'wala and other small rivers which contribute very significantly to hydrological system of the wetland have been affected by big canals which diverged water to rice farms instead of directed to the pools which hosted fishes all time. In Usangu wetland for example, the drying up of the river and water pools due to irrigation activities has been causing widespread mortality of fish and some hippopotami and creating unaesthetic conditions in remaining pools (SMUWC, 2001a). Rice cultivation practices have left the wetland hydrology with unusual performance, leading to diminish fish resources of the wetland. The integrity of the water system has declined. The Study on Usangu wetland has proved a reduction in the species richness of the fish community (SMUWC, 2001c).



Plate 4: Ricefield encroaching wetland hydrophytes in Miswaki village

Source: Field data, 2017

4.3.3 Effects of livestock on wetland fish resources

When the respondents were probed about the trend of livestock grazing on the wetland 98% of the respondents agreed that the number of livestock grazing has increased and 2% rejected (see Figure 15). This data shows that there is a large number of livestock in the wetland.

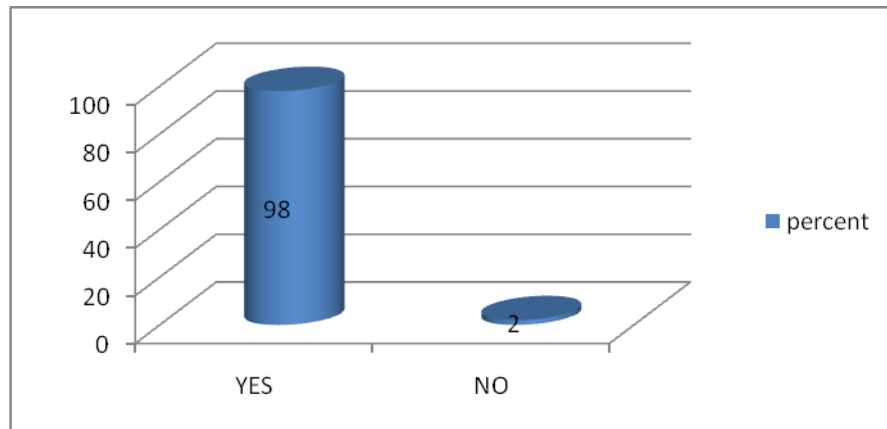


Figure 15: Findings showing response of the trend of livestock in wetland

Source: Field data, 2017

During In-depth Interview ward extension officer expressed that, the number of livestock owned by new comers in the wetland are many compared to the natives, the Tatooga tribe who are grazing in the wetland for centuries without degrading the wetland ecology possibly for their numbers or traditional ethics on environmental conservation. For the new comers, because of their rangelands were badly hit by climate change moving cattle to the wetland area is mentioned to be the traditional adaptation measures towards the collapses of upland grazing land (Rukwaya, 2016).

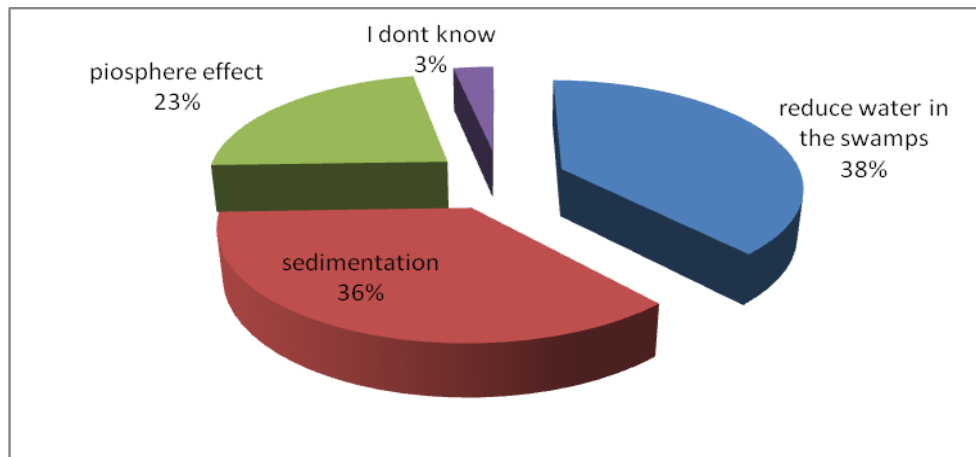


Figure 16: Findings showing the findings of the effect of livestock grazing in wetland

Source: Field data, 2017

The findings of respondents on the impact of grazing in the wetland have shown that, sedimentation and dry season's water reduction scored 38% of all respondent (figure 16). 23% of the respondents mentioned Piosphere effects as another effect of livestock grazing in the wetland.

These findings indicate that sedimentation and water consumption during dry seasons have great impact to the wetland fish resources. Livestock grazing in the upper courses disturbed soil fine and suspended sediment are carried by water from the wetland riparian to the lower part of the wetland. EPA, (2011) found that, the suspended sediments may clog waterways and affect fish and amphibian egg development. Also, During FGD, fishermen complain the increased livestock has contributed to the water reduction in pools that for many years were used as their fishing sites especially during dry seasons. Thus, wetland livestock grazing perpetuated high competition of water resource during dry seasons, consequently, many fishes snuff out.

Piosphere was mentioned as the effect caused by number of livestock concentrates in watering points such as lagoons and rivers. Water is one of the ecosystem services that is under intensive threat (Nampala et al., 2015). The information from the key informant also proves that, livestock concentration in the wetland reduced banks of the river and silted up the lagoons. This in return causes sedimentation and reduces water in the swamps and pools during dry seasons where fishes concentrate. Also, this leads to reduction of rivers of the wetland to retain water in their pools. Therefore, fish resources have been affected too.

Findings by analysis of the correlation between livestock grazing and siltation show they are statistically significant (chi-square= 45, df =12, p=0.001) that livestock grazing causes siltation to the swamps of the wetland leading to the decrease of depth of fishing swamps and lagoons of the wetland (see Table 8). Similarly, the Inner Niger Delta, grazing and irrigation schemes have affected the wetland, therefore has been estimated that average fish trade has been reduced as a consequence of these activities (Zwarts et al. 2005).

Table 8: Correlation between livestock grazing * siltation in perennial swamps

Chi-Square Tests	Value	dfAsymp.	Sig. (2-sided)
Pearson Chi-Square	45.540 ^a	12	.000
Likelihood Ratio	39.916	12	.000
Linear-by-Linear Association	2.987	1	.084
N of Valid Cases	94		

a. 14 cells (70.0%) have expected count less than 5. The minimum expected count is .32.

Source: Field data, 2017

Because wetland fish resources depend on the ecological stability of the wetland, any disturbance of wetland would impose adverse impact to fishery resources. The study

of Usangu wetland, described the contribution of surface runoff from the plains to the Usangu wetland is significant in relation to river flow originating from the high catchment and, connected to this, changes to surface runoff in the plains caused by livestock are equally significant (Moirana and Nahonyo, 1996; SWMUC, 2001b). The large concentrations of cattle roaming the *mbuga* at the downstream end of the alluvial fans will affect the soil by compacting the surface. This compaction may affect the infiltration capacities of the soil, and so change the surface runoff entering the wetland.

4.3.4 Effect of deforestation on fish resources

Before the current collapse of the forest, Wembere wetland was surrounded by dense Miombo forest in the western zone (URT, 1998a). All respondents agreed that the forest in the area has declined in the wetland and the riparian area. However, when respondents were asked to rate if deforestation causes adverse impact on the deforestation on fish resources, 50% of the respondents were neutral; 20.2% of respondents agreed; 7.4% of the respondents strongly agreed; 12.5% of the respondents disagreed; and 9.6% of the respondents strongly disagreed (*see figure 17*).

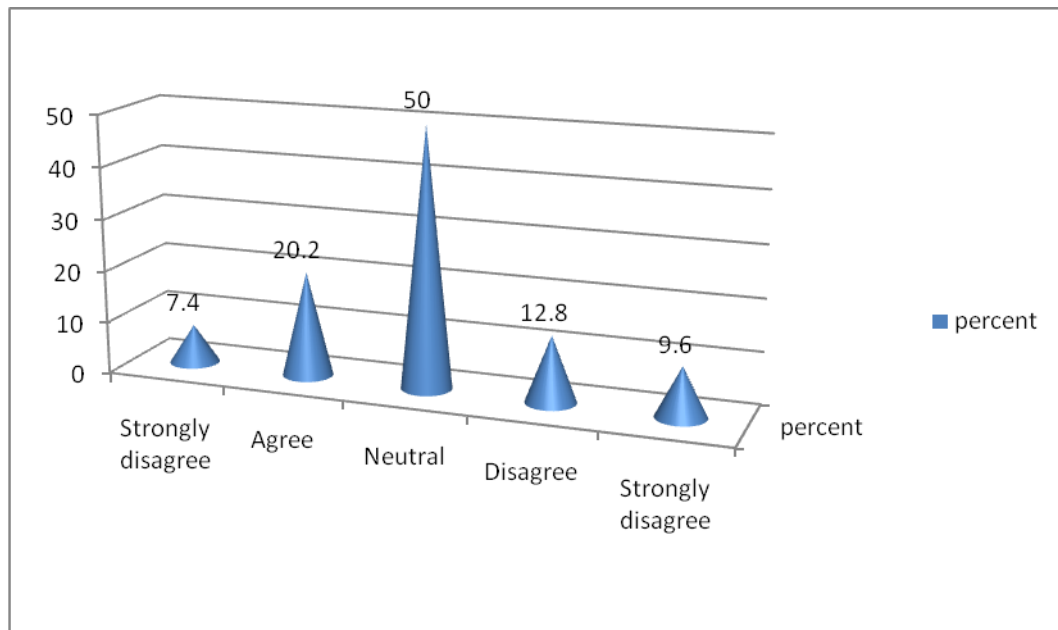


Figure 17: Findings showing how the respondents rate the impact of deforestation on fishery resources

Source: Field data, 2017

This implies that although all respondents agreed that there is a collapse of forest but most of them do not manipulate the adverse impact caused by deforestation to the fish resource. The contribution of forest in wetland ecosystem stability is very important to rescue hydrological regime of the wetland (SMUWC 2001a). For example, sediments entering the system arise from soil washed from land or eroded from river banks. The source of sediment can affect water quality as it brings in nutrients and pollutants causing eutrophication and toxic effects, whilst in suspension (Gattenlöhne et al, 2004).

The acts of clearing of forest for charcoal making and expansion of agricultural activities in the riparian of the wetland and rivers welcomed soil erosion which reduced the capacity of the lower levels of the rivers and wetland to store water for

longtime hence reduced the time of fishing activities in the wetland. Therefore, variations in water depth can change the growth of aquatic plants and their rooting substrates therefore threatening fish resources in wetland.

Also, respondents were asked to rate impact of sedimentation on fish habitats (lagoons, swamps and river) caused by deforestation when the answers were limited to strongly agree, agree neither nor disagree, disagree and strongly disagree. The findings obtained from respondents show that, the 58(61.7%) of the respondents agree, 15(16.0%) of the respondents strongly agreed; 6(6.4%) of the respondents neither agree nor disagree; 6(6.4%) disagreed and 9(9.6%) strongly disagreed that imposition caused by soil erosion from uplands reduced the depth of the fishing lagoons (*see table 9*).

Overall findings indicate that, deposition of sediments causes rivers and lagoons to silt up and leads to death of fishery resources. The findings suggest that, the increase by doing deforestation activities, in the wider wetland region, have led to the degradation of the ecological condition of the lagoons especially to the Nyahua river mouth. Gattenlöhne et al, (2004) finds that, sediment quantities can impact on fishing interests particularly where changing patterns of sediment deposition alter fish spawning substrates.

Similarly, Francis and Bryceson, (2007) reminds that, the impacts on fishery resources are caused by river runoff, which could cause siltation especially around river mouths. This siltation could change fish population.

Also, the In-depth interview from District Forestry Officer (DFO) proved beyond reasonable doubt that, due to the given rate of deforestation, the amount of

evaporation in the wetland, rivers and lagoons has increased in Wembere wetland nowadays compared to the period when the wetland and its riparian were covered by denser forest.

Table 9: Evaluation on sedimentation due to deforestation

Responses	Frequency	Percent
Strongly agree	15	16.0
Agree	58	61.7
Neither agree nor disagree	6	6.4
Disagree	6	6.4
Strongly disagree	9	9.6
Total	94	100.0

Source: Field data, 2017

Similarly, in Usangu system of wetlands, Kwadjosse, (2009), concludes that, net evaporation rate from the Ihefu wetlands may have increased when the vegetation was destroyed by livestock, therefore, reduced the time of fishing in the wetland. This implies that the increase of rate of evaporation led to the diminishing of water period existence in the wetland in a year.

4.4 Interventions and challenges community and government in sustaining fish resources.

The presented findings on *figure 18* illustrate the overall findings about when the respondents were asked if there are any interventions to rescue wetland fish resources. The responses were limited to ‘Yes’ or ‘No’ kind of response. The overall findings indicate that, 58(61.7%) of the respondents rejected while 36(38.3%) of the respondents agreed that there are some interventions to rescue fish resources in the wetland. These findings imply that, communities in the study area are not aware of

the interventions which are applied to protect fishery resources against socio-economic activities conducted in the area. This can lead to more conversion of wetland into unfavorable ecological condition for fish resources.

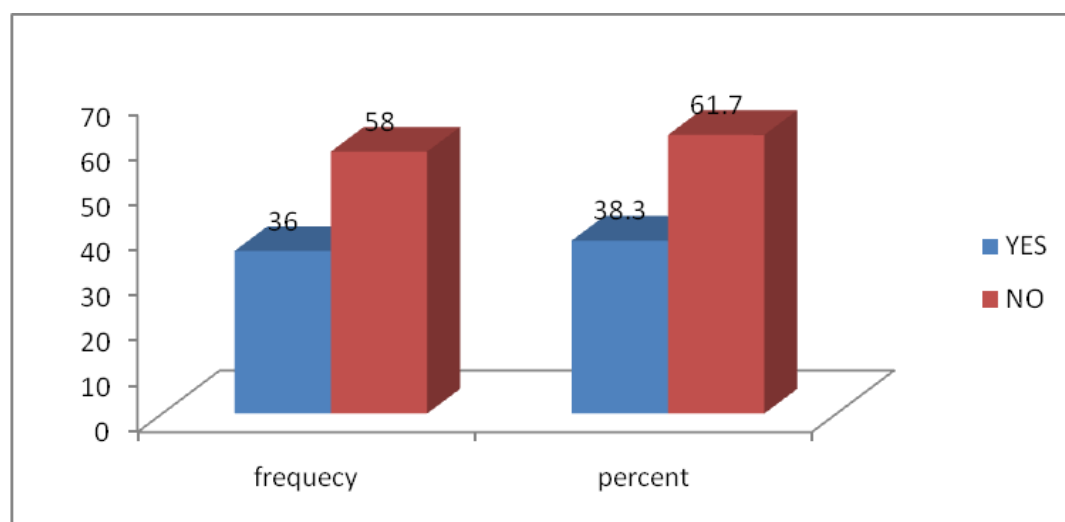


Figure 18: Findings of the responses on fishery resources intervention

Source: Field data, 2017

Since every activity operating in the wetlands operate differently from another and each endorses different or similar effects, interventions and challenges on attending to these effects also differ according to kind of socio-economic activity operating. This report has investigated the interventions and challenges both the community and the government face in sustaining fish resources of the wetland.

4.4.1 Assessing the interventions to monitor fishing activities in wetland

The investigation on the interventions specifically for fishing activities on wetland was conducted separately. The findings show that 88(93.6%) of the respondents agreed while 6(6.4%) rejected that, there is no measures on fishing activities (see Table 10).

Table 10: Responses on the presence of fishing interventions

Responses	Frequency	Percent
Yes	88	93.6
No	6	6.4
Total	94	100.0

Source: Field data, 2017

These findings indicate that, most of people in the study area recognize the presence of measures or interventions on fishery resources. This is can be very impressing start, in conservation of wetland fishery resources.

The findings discovered the measures on illegal fishing that restrict fishing juvenile fishes and the use of unfriendly fishing methods and small meshed fishnets. Actions such as to burn fishing nets which are not required by the law of the land were imposed to rescue wetland fishes against illegal fishing 55(58.5%); fines and penalties 14 (14.9%); suspending illegal fishermen from fishing 8(8.5%); and the respondents who do not know were 9(9.6%) (See Table 11).

The fishnets that were mentioned to be destroyed during operations are those meshed below 3inches. Fines and penalties to the offenders were introduced. Such amounts range from Tshs. 50,000/= to 100,000/=. This data was given by fishery officer during in-depth interview. Also fishermen who are caught doing illegal fishing practices are suspended and their fishing wares are taking over. For the responsible fisheries management, evaluation of fishing capacity and analysis of fisheries data must be known and monitored through collection of fisheries input (fishing effort) and output (fish catch).With accurate and reliable data it will be easier to know how much should be taken out from the stock by using reasonable effort (Hamidu, 2012).

Table 11: Respondents Identification of fishing measures

Measures	Frequency	Percentage (%)
Burning nets	55	58.5
Fines and penalties	14	14.9
Suspending from fishing	8	8.5
Not known	9	9.6
Total	94	100

Source: Field data, 2017

The process of assessing the implementation of the enforcement of the bylaws mentioned against illegal fishing was done through household survey and key informants interview. The findings from the household survey demonstrate that, 58% of respondents reported that, implementation is below average; 28% of the respondents reported that, the implementation is average; 10% of the respondents reported very poor implementation; 3% reported good implementation; and the last group of respondents reported very good were 1% (see figure 19).

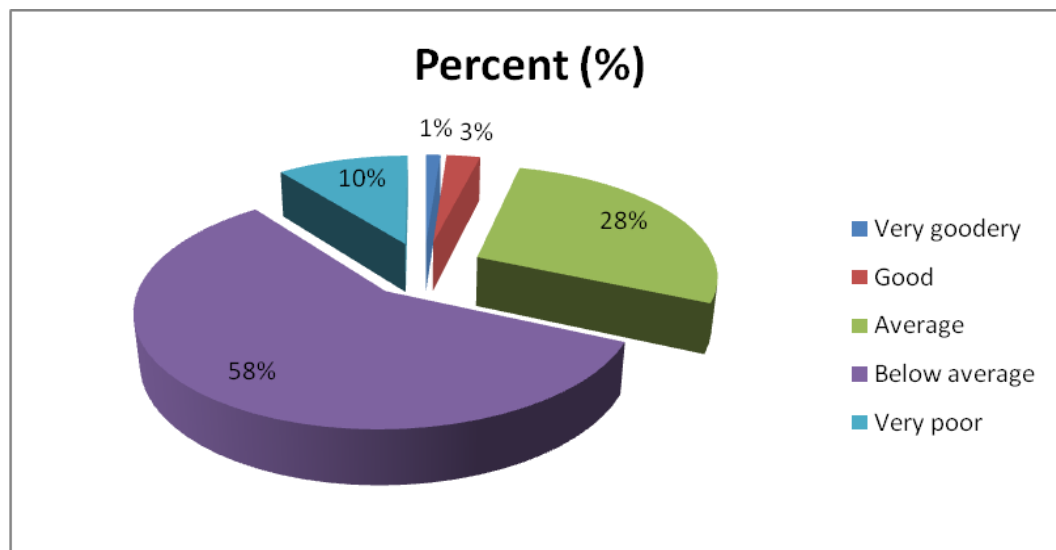


Figure 19: Findings of the implementation of bylaws on fishing activity management

Source: Field data, 2017

The findings above imply that implementation of enforcing laws on illegal fishing generally is very poor despite of being well comprehended by the community.

4.4.2 Assessing the interventions on the impacts of rice cultivation practices wetland fish resources.

In intervening inappropriate rice cultivation practices, respondents mentioned some measures which are taken to reduce adverse impacts of rice cultivation on the wetland. These measures include narrowing down the width of canals that extract water from the rivers of the wetlands; restricting more wetland encroachment for more rice fields; to abolish clearing of hydrophytes; and some stated that nothing is done to protect fishery resource (see figure 20).

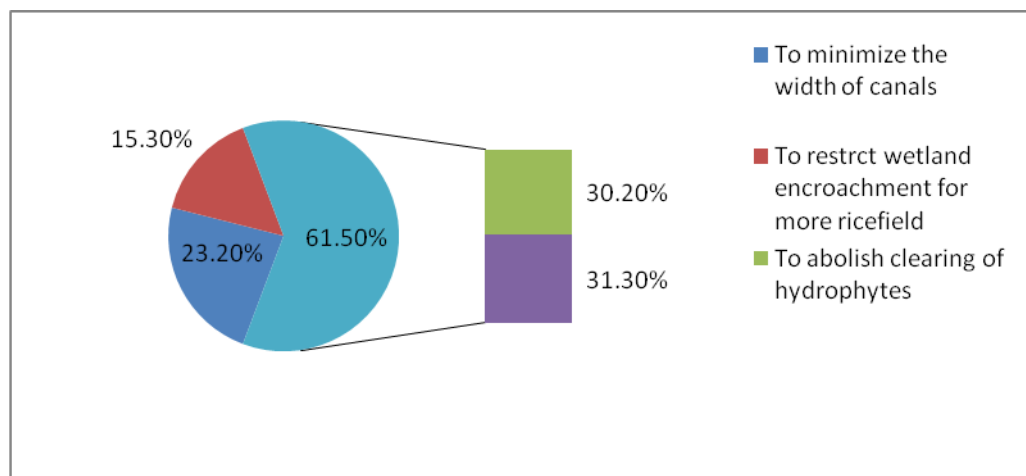


Figure 20: Findings of interventions of rice cultivating practices on fishery resources

Source: Field data, 2017

When these respondents were asked to rate the implementation of these measures which help to rescue wetland from adverse impacts imposed by the rice growing

cultivation the findings show that most of the implementation was rated below average 41 (43.6%), followed by 31(33.0%) of the respondents who responded average, 16 (17%) of the respondents rated very poor implementation while very few rated excellent by 2(2.1%) of the respondents (table 12).

This signifies that there is ongoing widening of the canals and wetland encroachment by clearing of hydrophytes. These lead to more change of ecological habit of the Wembere wetland, therefore leading to the collapse of fish resource in the wetland.

Table 12: Rating the implementation of farming measures on fish resources

	Frequency	Percent (%)
Excellent	2	2.1
Above average	4	4.3
Average	31	33.0
Below average	41	43.6
Very poor	16	17.0
Total	94	100.0

Source: Field data, 2017

4.4.3 Assessing the interventions on the impacts of livestock grazing on wetland fish resources

The findings of livestock grazing on wetland fishery resources discovered that there are adverse impacts of grazing on fishery resources. Respondents were probed to identify measures that are taken to intervene the situation. Respondents who mentioned destocking as the measure were 55(58.1%); those who mentioned prohibiting the use of water during dry seasons were 20(21.3%); and those who mentioned strictly prohibiting grazing around fishing swamps were 19(20.1%). (See Table 13)

These findings imply that a well comprehended intervention by the community was destocking. The information from the ward extension officer also supported saying that, the livestock keepers are always told to reduce the number of livestock, although the intention is not to rescue the status of the wetland fish resources but to rescue general environment of the wetland. Similarly, SMUWC (2001c) suggested relocation of number of cattle in Usangu wetlands thing which led to strictly prohibition of grazing in Usangu wetland.

Table 13: Measures to intervene adverse impact of livestock on fish resources

Measures	Frequency	Percent
Destocking	55	58.1
Prohibiting the use of water during the dry season	20	21.3
Strictly prohibiting grazing around fishing swamps	19	20.1
Total	94	100.0

Source: Field data, 2017

During dry seasons, lagoons change to be watering points of grazers. Prohibiting the livestock to water their cattle would assist to prolong the timing of fish habits in the lagoons and permanent swamps of the wetland. To restrict grazing around fishing swamps, in Miswaki village grazers were requested to move away fishing sites. This has been raising misunderstanding between grazers, fishermen and village leaders. All these activities are done by village leaders and ward leaders.

When respondents were asked to rate the implementation of measures against adverse impact of grazing on wetland almost all respondents rated the

implementation to be average below average and very poor implementation (see Figure 21).

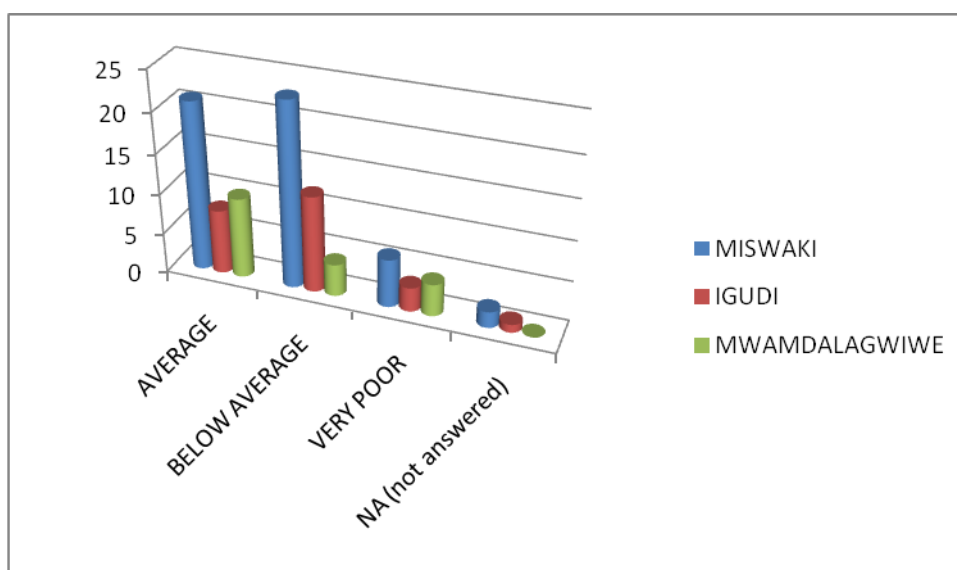


Figure 21: Respondent's attitude on grazing measures implementation

Source: Field data, 2017

These findings justify that there is ongoing wetland grazing which is environmentally unsustainable. This is the weakness of the environmental managers to implement the environmental policy which requires grazing activities to be environmentally sound.

4.4.4 Assessing the interventions on the impacts of deforestation on wetland fish resources

Measures on the adverse impacts of deforestation on fish resource were mentioned to be reforestation which scored 39.4% of the respondents and punishments was to the offenders scored 19.1% of the respondents. There are those who answered that nothing was done to intervene the impact of deforestation, these were 41.5% of the respondents (see table:15).

Percentage of respondents who mentioned that there is no any action to protect the forest reveals the above statement. However, in somewhat, in order to protect the status of the forest of the riparian, Uyui district is insisting to the community to plant new trees.

Table 14: Responses on intervention on deforestation

	Frequency	Percent
Reforestation	37	39.4
Punishments	18	19.1
No any action	39	41.5
Total	94	100.0

Source: Field data, 2017

This was mentioned by the respondents and mainly by the key informants during the in-depth interview. However it was mentioned that, this program was not practically implemented rather than being stated by community and leaders. These clubs are cared by the District Natural Resources office in both Uyui and Igunga district to operate activities such as planting trees.

Interview with Forestry officer stated that, it has remained very difficult to take action on the conservation of forest in the region. However, under TASAF, Participatory Forest Management (PFM) was implemented in the district. This initiative was aimed at reducing forest degradation thereby increasing ecosystem services; and to improve the livelihoods of local communities. This PFM was implemented through Joint Forest Management (JFM) and Community Based Forest Management (CBFM). During FGD in Igudi village, it was mentioned that, JFM was implemented in Unyambui forest (260 acres square) and Nzubuka forest. However

these forests cover a very small portion of the wetland and the forests are fragmented as if are unprotected. The effort to protect the forest would lead to protection of wetland hydrological system to maintain water for fish resource for local communities. District forest officer substantiated that, there are declared and gazetted village, group, and private forest reserves for both village land and private land. The ownership of trees is vested on the village council through the village natural resources committee, or a group or an individual regarding to the kind of ownership. This kind of forest management and conservation was practiced in many villages of the district e.g. Mpyagula and Mwajinjama forests and most of these villages somehow contribute very significantly to protect hydrological system of the wetland, therefore help to protect fish resource especially fish habitat against sedimentation.

When respondents of questionnaire survey were asked to rate the implementation of the measures to combat deforestation, most of the respondents replied that the implementation was below average by 42.7%; average was rated by 30% of the respondents; 12.3% of respondents rated good implementation; 13.8% of the respondents rated very poor while 1.2% of the respondents rated very good implementation.

Generally, the Ecosystem Approach to Fisheries (EAF) has been developed by FAO in response to the need to implement, in a practical manner, the principles of sustainable development (WCED, 1987). For sustainable development, Tanzania fishery resources management should be done through ecosystem approach. Since the requirements for Fisheries Management Plans to be consistent with the ecosystem approach to fisheries was recognised by the Government of Tanzania, this adoption helps to plan, coordinate and prioritise current and proposed activities. This approach

would enable the management by dealing with the whole components of wetland that obviously support fishery resource of the wetland.

4.4.7 Challenge of implementing fishery resources management

Despite some actions on managing socio-economic activities in the study area and the district in general, the major challenge of implementing measures mentioned by respondents is the increasing population in the wetland elevated by the demand of agricultural land, demand for grazing land, commercial fishing and other domestic demands such as charcoal and building materials like timber in the region and country wise. Lack of conservation education was mentioned as the challenge which is supported by lack of fund to convey this conservation education to the community living around the wetland (figure 16). Similarly ESRF, (2013), found out that, evidence reveals that population increase, poverty and low awareness in the local communities are among the major factors affecting the ecosystem in Uyui district.

Local communities are not informed of the linkage between the ecosystem and livelihoods. Thus, it has been difficult for the local population to appreciate the interventions and/or solutions addressing ecological challenges in their communities. Thus, it has been difficult for the local population to appreciate the interventions and/or solutions addressing ecological challenges in their communities

Table 15: Challenges of implementing protecting fishery resources

	Frequency	Percent (%)
Poor financial ability for patrolling	8	8.5
Unwillingness of the people	13	13.8
Lack of government support	6	6.4
Lack of education	12	12.8
Increase of population	55	58.5
Total	94	100.0

Source: Field data, 2017

The lagoons, estuaries and the many wetlands form breeding grounds for many marine fish. The decline of quality of these environments leads to the collapse of fishery resources (Kwadjosse, 2009). In Wembere wetland, the village governments around fishing sites are mostly responsible to monitor fish resources of the wetland. In Wembere wetland, there is a lack of interventions that base on the ecosystem approach simply, because it might be the lack of management education strategies.

In wetland areas data collection is the challenge because most of wetlands cover across different administrative units like regions and districts. In management duties, Wembere wetland is by Igunga District while it covers two regions namely; Tabora, and Singida. Data of fish catch in Singida and Tabora are not properly organized things which put limitations on how to manage this resource. Fishery office proclaimed the increase of number of livestock in the wetlands from neighboring region of Shinyanga which has resulted in the competition over the use of wetlands among groups of users. The investigation shows that, village governments which are given the power to manage fish resources of the wetland simply because of their closeness to the resources face problem of lack of management skills due to poor education on how the increase of cattle leads to management strategies. It is

contributed by the degree of remoteness from town where most of fishery managers are found and lack of fund that could be important in gathering fishery degradation of fish resources.

Again, lack of reliable data on catch emerged as the challenge observed by the researcher in the field. District councils lack this important information something that hampers management of wetland fishery resources. Singh *et al.*, (2005), conclude that, a sound fisheries management requires a good deal of reliable data on catch, fleet, fishing effort, fishery costs and earnings together with sound biological information on the fish populations. Lack of data put challenges to the natural resources managers to establish information from different fish landing sites of the wetland. Cowx, Knaap, Van Der, Muhoozi, and Othina (2003) studied artisanal data collection systems in fisheries operating in Lake Victoria and suggested improvement measures. In this study they found out that the fishery is well monitored, and adequate catch statistics are available. However they found numerous weaknesses with the output that was the lack of statistical data.

According to Sobo (2004), the National land policy of 1995 insists on protection of land resources from degradation for sustainable development. Since the jurisdiction of wetlands of Tanzania remain under general land, they are subjected to remain open access to all the community since they are common-property resources. Again fish is the common property resource (Gordon, 1954). Management of these ecosystems and its components such as fish resources remains a challenging duty. As it is known due to their fragility of these ecosystems, the National wetland management guideline of 2014 precisely direct the establishment of regional wetlands committees for those wetlands outside protected areas, this research find that there is no any specific organ dealing with wetland management.

The lack of management committee places the Wembere wetland into high risk of changing its natural ecology which affects fish resources that eventually lead to the threat of livelihoods which depend on fishes of the wetland. The absence of proper management organ results in lack of coordination between the institutions and sectors that deal with wetland use and management. This has further resulted into limited accountability, inability to respond to changes in wetlands, and failure to divide the responsibilities between institutions.

Wetlands being crosscutting in nature, their management responsibility has been left as a responsibility of many institutions in Tanzania. District Councils have the day-to-day management responsibility for wetlands outside protected areas as a part of overall natural resource management. District Councils are responsible for the coordination of extension services, revenue collection, law enforcement, capacity building, local priority setting, bylaws and monitoring of natural resources, and are key to wetland management implementation at local level (URT, 2003a). Inter-district management decisions are very crucial in managing wetlands such as Wembere which cover across a single administrative unit.

Information from the District fishery resource office insists that, efforts are made to encourage anyone who wants to fish in the wetland to seek and own fishing license from the district fishery officer, though it remains difficult to access because of the distance from fishing sites to the District fishery office. In her study Hamido (2012) found out that, lack of capital leads to lack of formal education and skills thus, the link between decline of fish resources and the degradation of fishing habitats due to use of destructive fishing methods is not easily comprehended.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Chapter overview

This chapter gives summary of the findings that were presented and discussed in chapter four. It also presents the conclusion and gives the recommendations of the study. Finally the chapter winds up with areas of further study.

5.2 Summary of findings

The summary of the findings is a part that submits brief statements of the main points of the study particularly the objectives of the study. As its main objective, this study intended to explore the influence of socio-economic activities which operate in Wembere wetlands fish resources.

Through specific objectives, this study succeeded to find out the trend of fishery resource in Wembere wetland, to investigate the impact of observed socio-economic activities operating in the wetland and finally to assess interventions and challenges that face management of this resource in the wetlands.

5.1.1 Trend of Fish resource in Wembere wetland

The collection of fish catches in different landing areas of the wetland for several years from 2006 to 2016 was done through catch landing survey and through different reports which were provided by different stakeholders. Also household survey was used to extract perceptions of the community on the trend of fish resources. All these methods helped to establish a clear trend during analysis.

Analysis on liner regression has proved there is a very slight increase of amount of fish catches landing from wetland ($R^2=4.7\%$). The comparison between the trend of

the amount of fish catches and trend of number of fishermen provide a clear picture that although the amount of fish landing has slightly increased, the number of fishermen is tremendously increasing ($R^2=97\%$). Also, despite the increase of amount of catches, CPUE has declined in the wetland; even fishes for food have become very scanty compared to 10 years ago. All these evidences confidently suggest that Wembere fish resource has declined.

5.1.2 Assessment of the impacts of socio-economic activities on Wembere wetland fish resources

This investigated four socio-economic activities which are fishing activities, rice cultivation, livestock keeping and forest harvest.

5.1.2.1 Fishing activity and its impact on Wembere wetland fish resource

Exploration on the impact of fishing activities on wetlands was done through investigation of fishing methods techniques and size of fish used. The study unveils that, trawling techniques is used as one of the most common fishing methods in the wetlands as 14.9% of the respondents mentioned. Also gillnets were mentioned to be used by 29.9% while majority (80%) uses fishing nets meshed from 3inches and above diameter.

During the interview with village leaders, they reported that illegal fishing is common in the wetland such as the use of bottom trawls, very small meshed nets and the use of dynamite.

5.1.2.2 Rice cultivation and wetland fish resources

On investigating the impact of rice cultivation on wetland fish resource, respondents were probed to rate if rice cultivation has adverse impacts on wetland fish resource.

Majority of respondents (43.6%) were neutral and those who agreed were (40.5%) out of all respondents. While (8.5 %) out of all respondents strongly agreed and (7.4%) rejected. Intensive questions which were asked gave the prominent practices which affect fish resource. River diversion, clearing of hydrophytes, canalization of river and water pumping water from perennial lagoons or swamps were mentioned. All these practices have led to the change of hydrological system of the wetland, thus affecting fish resources.

5.1.2.3 Livestock grazing and wetland fish resource

98% of the respondents agreed that livestock have increased in the wetland. Correlation between livestock grazing and siltation is statistically significant (chi-square= 45, df =12, p=0.001). The silting up of perennial pools leads to the collapse of some fishing sites especially those which are dependable during dry seasons. Grazing pressure causes phosphorus. This in turn causes disturbances such as sedimentation and reduction of water in the swamps and pools during seasons in which these swamps and pools host fishes. Water is one of the ecosystem services that is under intensive threat of depletion. The depletion of water resource by livestock leads to depletion of fish resource in the wetland.

5.1.2.4 Deforestation and wetland fish resources

All respondents recognized the decline of forest in the study area. This decline was mainly contributed by farmland expansion and charcoal making for commercial purposes. However, when respondents were asked to rate if deforestation causes the adverse impact on fish resources majority (50%) were neutral; 27.6% agreed; and 22.1% of the respondents disagreed. The findings obtained from respondents show that, the 73(77.7%) of the respondents agree, 6(6.4%) of the respondents neither

agree nor disagree; 15(16.0%) disagreed that imposition caused by soil erosion from uplands reduced the depth of the fishing lagoons.

5.1.3 To assess the interventions and challenges of community and government in sustaining fish resources.

5.1.3.1 Fishing activities

Interventions are made to manage fish resources of the wetland. In managing fishing activities, the findings of the study show that 88(93.6%) of the respondents agreed while 6(6.4%) rejected that, there is no measures on fishing activities. Measures which were named were to burn fishing nets, fines and penalties, and suspending illegal fishermen from fishing. Generally, the implementation of these measures in fishing is very poor.

5.1.3.2 Rice cultivation practices

In managing fish resource against rice cultivation practices, the findings suggest that, most respondents and key informants mentioned these measures; narrowing down the width of canals that extract water from the rivers of the wetlands; restricting more wetland encroachment for more rice fields; to abolish clearing of hydrophytes; and some state that nothing is being done to protect fishery resource.

5.1.3.3 Livestock grazing

In taking action against adverse impact imposed by livestock the following measures were mentioned; destocking as the measure were 55(58.1%); those who mentioned prohibiting the use of water during dry seasons were 20(21.3%); and those who mentioned strictly prohibiting grazing around fishing swamps were 19(20.1%). The implementation of these measures generally is very poor.

5.1.3.4 Deforestation

Measures on the adverse impacts of deforestation on fish resource were mentioned to be reforestation and punishments to the offenders such as paying Tshs. 50,000/=. The implementation of these measures is below average by 42.7% responses; average was rated by 30% responses; 12.3% responses rated good implementation; 13.8% responses rated very poor while 1.2% responses rated very good implementation.

5.1.3.5 Challenge of implementing fishery resources management

Findings of challenges which were frequently reported by different respondents through different methods are poor financial ability for patrolling, lack of manpower, lack of government support, lack of education, and increase of population. Lack of fish statistical data is more challenging to natural resource managers.

5.2 Conclusion

In a nutshell, Wetland fish resource of Wembere wetlands is a declining resource. All socio-economic activities investigated herein have been showing their negative influence on wetland ecosystem and eventually, have affected fish resources. Despite of some interventions mentioned, their implementation remained to be a paradox. Therefore, ongoing human activities on Wembere wetland affect adversely the fish resource and will lead to its collapse if things are left as business as usual.

5.3 Recommendations

Based on the findings from this study, the following recommendations are made:-

- i. According to the the increasing socio-economic activities in Wembere wetland/swamps, the government should conduct land evaluation in order

to set a new land use plan. Currently, land use in the wetland is uncontrolled and each group of user claims the right of land use and ownership. This would be a solution to protect fish resource against non-fishing activity like grazing and farming.

- ii. Because wetlands fish resources contribute immensely on Regional fish stocks and to the community livelihood in the area, by relying on the findings of this study, conservation and protection measures should be strengthened in order to save wetland fish resource all over the country not only in Ramsar sites.
- iii. Institutional arrangement for wetland management should be set according to the National wetlands management guideline of 2014 to make sure that all stakeholders are obliged to protect this resource.

5.4 Suggested future research areas

- i) In this study, it has been found that, rice cultivation has led to change of hydrological regimes of some rivers; therefore it is more significant for other researchers to investigate the impact of rice cultivation to the livelihoods of wetland livestock keepers.
- ii) Due to the limitation of funds and time, the study covered a small portion of Tanzania wetlands, it was conducted in one wetland in a single ward while wetlands cover across different administrative units; therefore it is suggested that, similar researches should be undertaken in other areas covered by wetlands especially those wetlands outside protected areas which managers pay a little attention despite their contributions to community's livelihood.

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APPENDICES

No

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Appendix 1: Questionnaires for households

Date

A. Location

1. Name of district.....
2. Division.....
3. Ward.....
4. Village.....

B. Demographic information about respondent

5. Age (a) 18-25 (b) 26-35 (c) 46-60 (e) Above 60
6. Marital status Married (b) Not married (c) Divorce (d) Widow (e) Widower
7. How long have you lived in this area
 - a) Less than 5 yrs (b) 6-10 yrs (c) more than 10 yrs
8. Number of family members in the household
 - a) 1-4 (b) 5-8 (c) above 8
9. Level of education
 - a) Informal education (b) Primary education (c) Ordinary secondary school (d) Advanced secondary school (e) College/ university
10. What modality do you use to be a fisher?
 - a) Registration b) adaptation c) other (specify) []
11. How many shillings do you get per day in fishing activities?
 - a. Less than Tshs. 2,700/= b) Tshs. 2,700/= less than Tshs. 5,000/= c) Tshs. 5,000/= 10,000/= d) more than Tshs.10,000/=

C. Research Questions

12. What are the types of fish present in Wembere wetland?

- a) b)..... c) d).....
e).....

13. How would you compare the current fish availability to that of the 10 years ago?

- a) Increasing b) constant c) decreasing d) not known

14. How would you describe the trends of fishes in the wetland?

- a) have increased tremendously [] b) have increased slightly [] c)
have remained the same [] d) uses have declined [] e) I don't
know []

15. What was the mean rate catch per hour 10 years past?

- a) more than 20 kg/hr b) 20kg/hr- 15kg/hr c) 14kg/hr- 10kg/hr d) less
than 10kg/hr

16. What is the current mean rate catch per hour?

- a) more than 20 kg/hr b) 20kg/hr- 15kg/hr c) 14kg/hr- 10kg/hr d) less
than 10kg/hr

17. If decreasing what is the reasons?

- a) illegal fishing[] b)poor rice farming practices[] c) Livestock grazing[
] d) deforestation[] e) others (specify)..... []

18. Do you think before ten years ago the wetland had more swamps for fish habitat?

a) Yes [] b) No []

19. The following socio-economic activities have adverse impact to the fish resources.

Socio-economic activities	Likert scale				
	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
Unlawful fishing practices					
Poor rice cultivation practice					
deforestation					
Livestock grazing					

20. What methods/techniques do you use in fishing among the following?

a) Bottom trawl [] b) dredging [] c) gillnetting [] d) harpooning [] e) spearfishing [] f) others.....[]

21. Do you use fishing nets?

a) Yes [] b) No []

22. If you use nets what is the minimum size of the net holes you use?

a) Less than 3cm b) 3cm to 5cm c) above 5cm []

23. In the past 5 years, how many fishing nets did you own?

a) less than 4 b) 4- 6 c) 7-10 d) more than 10 []

24. How many fishing nets do you own currently?

a) more than 10 b) 7-10 c) 4- 6 d) less than 4 []

25. Are you allowed to fish a limited quantity of fishes per year?

a) Yes [] b) No []

26. If YES, What is the quantity of this limited fishes you are allowed to fish per year? Mention
27. Is there any measures dealing with illegal fishing?
- a) Yes ☐ b) No ☐
28. What are these measures which deal with illegal fishing?
- a) Burning the nets ☐ b) fines, sanction and penalties ☐ c) suspending from fishing ☐ d) taking off the fishing tools ☐ e) other (specify)..... ☐
29. How would you rate the community implementation of measures on illegal fishing?
- a) Excellent ☐ b) Above average ☐ c) Average ☐ d) Average Below ☐ e) Very Poor ☐
30. What are some practices associated to rice farming?
- a) total river diversion ☐
- b) canalization of rivers ☐
- c) clearing of wetland vegetation ☐
- d) water pumping from swamps ☐
31. Do you think diversion of river affected the fish resources?
- a) Yes ☐ b) No ☐
32. How do you rank these impacts of rice farming practices wetland fish resources? Assign numbers from 1 on wards
- a) reduced water flow due to water extraction ☐ b) causes water pollution ☐ c) causes sedimentation ☐ e) other _____
33. Are there any plans to protect fish resource against adverse impact of rice farming?

a) ☐ Yes ☐ b) No ☐

34. What are these plans?

a) Reducing water extraction b) prohibit wetland encroachment c) canal narrowing d) other

35. What is the trend of the forest?

a) increasing b) decreasing c) constant d) not known

36. Sedimentation due to deforestation has reduced depth of fish swamps.

a) Strongly agree ☐ b) Agree ☐ c) Neither ☐ d) Disagree ☐ e) Strongly disagree ☐

37. How does the community do to combat deforestation?

a) reforestation b) punishments through bylaws c) no action

38. Are there any measures dealing with deforestation?

a) Yes ☐ b) No ☐

39. If YES, what is/are that/they? Mention a).....

b)..... c).....

40. How would you rate the community implementation of deforestation measures?

a) Excellent ☐ b) Above average ☐ c) Average d) Average Below ☐ d) Very Poor ☐

41. Is there an increase of livestock in the wetland?

a) Yes ☐ b) No ☐

42. If YES, what are the effects of grazing on fish resources?

a) Reduce water level due ☐ b) sedimentation ☐ c) phosphorus effect ☐ d) other..... ☐

43. Livestock grazing causes siltation in the wetland.

- a) Strongly agree [] b) Agree [] c) Neither [] d) Disagree [] e) Strongly disagree []

44. Are there any measure(s) dealing with livestock keeping?

- a) Yes [] b) No []

45. If YES, what is/ are that/they?

- a) Destocking [] b) prohibiting use water in dry season [] c) restricting []
d) no action other..... []

46. How would you rate the community implementation of livestock keeping measures?

- b) Excellent [] b) Above average [] c) Average d) Average Below [] d)
Very Poor []
a) Other []

47. What are the challenges of facing implementation of fishery resource in the wetland?

- a) poor financial for patrolling []
b) unwillingness of the people []
c) lack of support from the district government []
d) Lack of education

48. What do you comment on the government actions on protection of fish stock in the wetland?

- a) reduce punishment b) increase punishment c) maintain punishment d)
should not interfere []

Appendix 2: Checklist for key informants (District fishery Officer)

1. What is the trend of fish resource in Wembere wetland from 2006 to 2016?
2. Do you think rice cultivation is affecting the level of water in the swamps?
How do you deal with to protect adverse impact to fish resources?
3. How do you deal with deforestation and its adverse impact to the wetland?
4. What fishing methods do the fishers use and how these methods are lawful to fishing activities?
5. How do you manage the problem of illegal fishing gears if it exists?
6. What size of fishes is allowable to be fished?
7. How is the revenue collected from fishery used to manage fish resource in the wetland?
8. How do you manage this resource?
9. Is there any educational programme for the wise use of fish resources in these swamps?
10. What initiatives do the district council put to protect the decline of fish resource in the swamps?

***** Trend of fish resources on wetland from 2006 to 2016.

Appendix 3: Checklist for key informants (District Forestry officer)

1. What is the trend of forest in riparian area from 2006 to 2016?
2. What assistance do you give to the riparian villages in order to combat deforestation in riparian?
3. What does the district government do to combat the problem of deforestation in wet lands riparian?
4. Is there any bylaw and if yes how this bylaw is implemented?
5. What are the challenges facing forestry in this area?

Appendix 4: Checklist for key informants (Village Executive officer)

1. What is the current trend of fish availability in the village compared to 10 years ago?
2. Do you have any programme to enhance fishermen in the wetland?
3. What size of fish is allowed for fishing?
4. How do you control adverse impact from rice farming on water level?
5. What challenges do you face to control these adverse impact?
6. How does the community deal with the problem of deforestation?
7. What challenges face the village in combating the problem of deforestation?
8. What is the trend of the number of livestock in this area?
9. What are the impacts of livestock on wetland fish resources?
10. What are the challenges the village faces to combat the problem?
11. Is there any community based management plan on fish resources in the wetland?
12. What challenges do you get in managing the fish resources in the wetland?
13. What support does the community village get from district experts in pursuing fish stock/resources in the wetland/swamps?

****Trend of livestock in the village from 2006 to 2016

Appendix 5: Checklist for key informants (Ward Agriculture Extension Officer)

1. What is the trend of rice farm-fields in the ward from 2006 to 2016?
2. What techniques do farmers use to extract water from the river?
3. How these techniques affect the water in the swamps?
4. What measures do you take to make sure that rice farming does not affect the fish resources?
5. What are the challenges of controlling the adverse impact of rice farming on fish resources?

Appendix 6: Checklist for Field site Visit

- Water extraction techniques by rice farmers
- Fishing sites
- Fishing equipments: e.g. fishing nets, boats

Appendix 7: Checklist for group discussion

1. Trend of fish availability
2. The socio-economic activities and fish resources
3. Interventions and challenges facing fish resources

Appendix 8: Research permission letter from the University

 **THE UNIVERSITY OF DODOMA**
DEPUTY VICE CHANCELLOR ACADEMIC, RESEARCH & CONSULTANCY
OFFICE OF GRADUATE STUDIES AND CONTINUING EDUCATION
P.O. BOX 259, DODOMA, TANZANIA.
Tel: +255 26 23 10173; Fax: +255 26 23 10005; Email: graduate@udom.ac.tz; website: www.udom.ac.tz

REF: UDOM/GRF/13/63 Friday, 05 May 2017

To Whom It May Concern:

RE: INTRODUCING MR.ROBERT YOHANA.

The above named candidate is enrolled at the University of Dodoma for the degree of Master of Science in Natural Resources Management (MSc NRM) with registration number HD/UDOM/344/T.2015

As an essential requirement of the study programme, each candidate is required to submit a dissertation report on a research undertaken within an industry and supervised by a member of the University's academic staff. Where possible the research should relate to a practical situation in an organisation or firm selected by the candidate. Candidates are expected to use their own initiative to identify a possible research and negotiate access with a local firm or organization.

The above named candidate has developed the proposal titled **"THE INFLUENCE OF SOCIO ECONOMIC ACTIVITIES ON WEMBERE WETLAND FISH RESOURCES: A CASE OF TABORA REGION"** which has been approved for data collection. The work may take the form of a survey, ethnography, case studies, etc. Where the research may contain confidential information and its publication could be harmful to the organization, confidentiality is assured by the University. Such reports will be seen only by the Supervisor and Examiner for examination purposes.

I would be grateful if you would provide the candidate with this opportunity to facilitate his Studies while at the same time gaining some useful inputs for your own organization through the results of the research report.

Sincerely,

Waziri, A.
For: Director, Graduate Studies and Continuing Education

C.c: Director, GS&CE



Appendix 9: Research permission letter from regional administrative officer

**OFISI YA RAIS
TAWALA ZA MIKOA NA SERIKALI ZA MITAA**

Telegrams: MKUU WA MKOA
Telephone: (026) 2604058/2604116
Fax: (026) 260 4274
Email: Ras.tabora@tamisemi.go.tz.



Ofisi ya Mkuu wa Mkoa,
S.L.P. 25,
TABORA.

Unapojibu Tafadhali Taja:

Kumb. Na.DA.39/70/03/51

10 Machi, 2017

Katibu Tawala wa Wilaya,
S.L.P 5,
IGUNGA.

YAH: KIBALI CHA KUFANYA UTAFITI.

Tafadhali husika na somo hilo hapo juu.

Hapa namtambulisha kwako Ndugu Robert Yohanna mwanafunzi wa Chuo Kikuu cha Dodoma wa Shahada ya Uzamili. Ameomba kukubaliwa na chuo kikuu hicho kufanya utafiti wa "**The Influence of Socio – Economic Activities on Wembere Wetland Fish Resources in Tabora Region**".

Kwa barua hii aruhusiwe kufanya utafiti huo.

Stephen A. Bushiri
Kny: KATIBU TAWALA MKOA
TABORA.
K.M.Y KATIBU TAWALA MKOA

Nakala: Deputy vice Chancellor, **TABORA**
Academic, Research and Consultancy,
P.O.Box 259,
DODOMA.

" ✓ Ndugu Robert Yohanna,
Safarini Tabora.

Appendix 10: Research permission letter from Executive Director

HALMASHAURI YA WILAYA YA IGUNGA
(Barua zote zitumwe kwa Mkurugenzi Mtendaji (W))

Tel: 026-2650019 (G/L)
026-2650021 (D/L)
Fax: 026-2650242



S.L.P. 19,
IGUNGA.

Kumb. Na. HWIG/E.4/2 Vol.II/83

21 Machi, 2017

KWA YEYOTE ANAYEHUSIKA,
WILAYA YA IGUNGA.

Yah: KIBALI CHA KUFANYA UTAFITI
MWANACHUO ROBERT YOHANNA

Somo tajwa hapo juu lahusika.

Ofisi imepokea barua yenye Kumb. Na. AB.208/232/01/89 ya tarehe
20 Machi, 2017 kutoka kwa Katibu Tawala wa Wilaya ikimtambulisha mtajwa
hapo juu.

Kwa barua hii, kibali kinatolewa kwa mtajwa hapo juu kwa ajili ya utafiti juu ya
*"The Influence of Socio – Economic Activities on Wembere wet land Fish
Resources in Tabora Region".*

Kwa barua hii Wadau wote watakaohusika wanaombwa kutoa ushirikiano wa
karibu kwa Mtafiti huyu.

Nashukuru kwa ushirikiano.


Twalipo S. Twalipo
Kny: MKURUGENZI MTENDAJI
HALMASHAURI YA WILAYA
IGUNGA

Nakala: Mkuu wa Wilaya, **HALMASHAURI YA WILAYA**
S.L.P. 5, **IGUNGA**
IGUNGA. – Rejea barua yako Kumb. Na. AB.208/232/01/89 ya
tarehe 20 Machi, 2017

Mwanachuo Robert Yohanna (Mtafiti).

Appendix 11: External Examiner Corrections

S/N	Title	External Comments	Type of errors	Response From Candidate
1.	Background to problem	-	Shorten the subsection on background to problem to four pages utmost	Corrected as external examiner advised
2.	Empirical evidences	Whole content	The present current empirical evidence to enhance the need of the study	Corrected as external examiner advised
3	Conceptual framework	Pg 34	Variable needed detailed explanation to show the causes effect relation	Corrected as external examiner advised
4	Section 3.7.2	Pg 42	To indicate the model which was used	Corrected as external examiner advised
5	Discussion	-	Discussion in relation to other studies	Discussed as external examiner advised
6	Section 4.2.2 in Chapter Four	Pg 74	Needed to indicate the trend by secondary data	Corrected as external examiner advised
7	References	-	To adhere to referencing principles	Corrected as external examiner advised
8	Incorporation	-	To incorporate other comments given in the text	Corrected as external examiner advised