THE ROLE OF WETLAND PRODUCTS TO HOUSEHOLD INCOME AND FOOD SECURITY IN MVOMERO DISTRICT, TANZANIA

BY

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ABSTRACT

A comparative cross-sectional study was conducted in Mvomero district using a randomly selected sample of 112 households participating in wetland and non-wetland activities. Three villages were purposively selected in the area whereby interviews were conducted using questionnaire and PRA tools. Specific objectives were to assess the contribution of wetland products to total household cash income, assess the contribution of wetland products to household food security and to determine the socio-economic factors influencing farmers' accessibility to wetland resources. Data were analysed using descriptive and inferential statistics whereby correlation and t-test were deployed. The results indicated that the contribution of wetland products to total household cash income was 69% compared with other sources that accounted for only 31%. The study showed that the main types of foods produced in wetlands in Mvomero district were cereals such as rice and maize, sweet potatoes and yams, vegetables and fruits. Similarly, the study showed that the mean amounts of foods per household per year from wetlands was higher than that of non-wetlands. Cereals and vegetables recorded the highest amounts of 1 461.72 kg and 345.84 kg respectively in wetland while in non-wetland it was only 809.72 kg cereals and 15.31 kg for vegetables. Moreover, results revealed that majority of the farmers in the district depended on foods produced in wetlands in sustaining their livelihoods throughtout a year. Socio-economic factors that influenced farmer's accessibility to wetland resources were income and age. Respondents with relatively high income had more access to wetland resources than those with lower income. Also, the older individuals had more access than the younger. Therefore, wetlands are important contributors to household income and food security. In order to increase the productivity of the wetlands, it is recommended that local authorities in collaboration with farmers and

other stakeholders need to establish a fair means of water distribution amongst farmers particularly in the months of September and October. Formation of a water users' association may be an important approach towards achieving that goal. Further studies are recommended to examine on poor involvement of educated farmers on wetland cultivation (access) despite the fact that wetlands significantly contribute to household's income and food security.

DECLARATION

I, Obeid John Mahenya, hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work and that it has not been submitted for award of a degree to any other University.

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The above declaration confirmed

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DEDICATION

This work is dedicated to my parents the late Andagile Mahenya Mwasaga and Mesija Mulighe, who laid the foundation of my education.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATIONS AND SYMBOLS

EIA Environmental Impact Assessment

FAO	Food and Agriculture Organization of United Nations
FBD	Forestry and Beekeeping Division
FGD	Focus Group Discussion
ha	Hectares
HESLB	Higher Education Student's Loan Board
IUCN	International Union for Conservation of Nature
Ksh	Kenyan Shiling
MA	Millennium Ecosystem Assessment
MNRT	Ministry of Natural Resources and Tourism
NSGRP	National Strategy for Growth and Reduction of Poverty
NEMC	National Environment Management Council
PRA	Participatory Rural Appraisal
SPSS	Statistical Package for Social Science
URT	United Republic of Tanzania
VNRC	Village Natural Resource Committee
VPO	Vice President's Office
WWF	World Wide Fund for Nature

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Wetlands are defined as any permanently or seasonally wet land in valleys, depressions, or floodplains with open herbaceous vegetation, mainly grasses and sedges and an absence of trees (FAO, 1996). The most commonly known wetlands are open coasts, flood plains, fresh water swamps, lakes, peat lands and swamp forests (Mironga, 2005). Each one of these has a wide range of different wetland types. Irrespective of their types, sizes or locations, wetlands are of great and matchless ecological and socio-economic value (MA, 2003; Mironga, 2005). Worldwide, wetlands are known for their ability to support a large human population. A number of authors (Maltiby, 1986; Dugan, 1990; Kamukala *et al*., 1993) stress that wetlands are, and will continue to be, essential to the health, welfare and safety of people. Wetlands in their natural state provide a range of products for people (Wood, 2006).

Wetlands are found in a wide range of ecological conditions from coastal deltas to high altitude inland swamps. Wetlands, traditionally, are called *vleis*, *mbugas* or *dambos* in Eastern and Southern Africa (FAO, 1997). Tanzania is endowed with a large number of wetlands covering approximately 10% of the country's total surface. They range from substantial lake systems to river floodplains and deltaic mangrove formations such as Malagarasi, Mvoyozi, Rufiji, Lake Manyara and Lake Victoria. They are a home to multitude of aquatic flora and fauna (Bakobi, 1993; Tanzania Vice President's Office, 2001). Tanzania's wetlands are chiefly utilized for crop and livestock production and approximately 450 000 ha is under cultivation (Masija, 1993; Yanda *et al*., 2005). The

potential contribution of wetland resources to food security is vast and varied (Hailu and Abbort, 1999).

Food security means all people, at all times, having sustainable, physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (FAO, 1996). Whereas, food insecurity refers to a temporary decline in the household's access to enough food, which can result from instability of food prices, production or incomes (Reutlinger, 1987; FAO, 2007). In Tanzania, food insecurity continues to threaten large proportions of households especially in low-income families. Mkandawire *et al*. (1993) indicated that some of the causes of food insecurity include persistent drought, environmental degradation, lack of necessary tools of production by small farmers, population pressures and lack of readily available markets for agricultural commodities. Others include distorted pricing policies, lack of social and physical infrastructure in the rural economy and inappropriate agricultural and land policies pursued by the government.

1.2 Problem Statement and Justification

Wetlands, locally known as "*Vilolo*" in Mvomero District, like any other part of the country play an important role to rural communities. Wetland products are indispensable to the well-being of all people in all places (MA, 2003). Several studies (Ramsar, 2003; MA, 2003; Masiyandima *et al*., 2004) have shown that wetlands and their surrounding catchments support rural livelihoods through provision of a large range of natural resources including soils, water, plants and animals. These are used by rural households in a wide range of activities such as salt making, pottery, plant harvesting for use in food, medicine, craft, provision of fuel wood and materials for furniture and house building,

hunting and fishing. With a growing population and unpredictable climatic changes, it is important that wetlands are protected from degradation and are available as contributors of food security (Abbot and Hailu, 2001). A number of studies have been undertaken on the role of wetland common pool resources on crop production in dry areas, wetland contribution to livelihoods of Tanzanians and importance of wetlands in agriculture (Kamukala *et al*., 1993; Mkavinda and Kaswamila, 2001; Mccartney *et al*., 2004; Shemdoe *et al*., 2006). In most cases the importance of wetland products to household income and food security equals or surpasses that of other sources (i.e. non-wetland) yet their worth and potential are rarely quantified (Mondaret *et al*., 2004).

Wetlands in Mvomero district are generally, gentle sloping, wet during the rainy season and moist during the dry season which makes the sites suitable for cultivation of multiple crops based on water availability and soil fertility requirements. However, the extent to which they contribute to household income and food security is little known and documented. Therefore, this study is intended to fill in this gap by generating information that will lead to sustainable use of the wetlands. The findings will be useful for researchers, farmers, environmentalists, policy makers, planners and national and international development partners.

1.3 Objectives

1.3.1 General objective

The overall objective of the study was to assess the role of wetland products to household income and food security in Mvomero district.

1.3.2 Specific objectives

Specifically the study intended:

i. To assess the contribution of wetland products to total household cash income.
ii. To assess the contribution of wetland products to household food security.
iii. To determine the socio-economic factors influencing farmers' accessibility to wetland resources.

1.4 Hypothesis

Ho: Wetland products do not contribute a larger proportion of household income and food security than the other sources to the majority of members of the households in Mvomero district.

Hi: Wetland products contribute a larger proportion of household income and food security than other sources to the majority of members of the households in Mvomero district.

1.5 Research Questions

The study was guided by the following key questions:

i. To what extent wetland products in Mvomero district contribute to total household cash income?
ii. What are the types and amounts of different foods produced in the wetlands?
iii. How long are wetland food products used in household to alleviate food shortage?
iv. What are the socio-economic factors influencing farmer's access to wetland resources? (i.e. are wetland resources equally accessible to all members of the communities?).

1.6 Conceptual Framework

The interrelationships between the wetlands surrounding the rural communities and the state of household income and food security are represented in a conceptual framework (Figure 1). It is presumed that rural communities are exploiting these resources or products such as water, soil, wildlife and forest to improve their livelihoods in terms of income and food security.

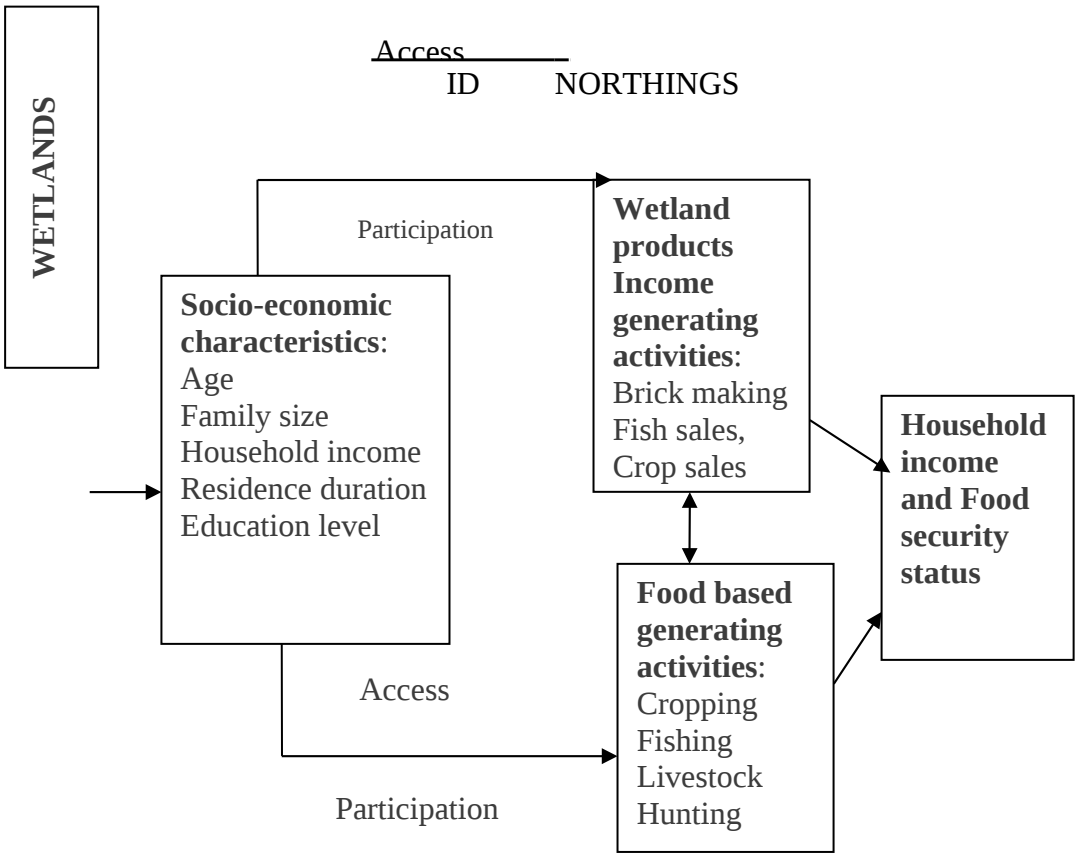

Figure 1: A conceptual framework: The role of wetland products to household income and food security

Moreover, the relationship between income-poverty and household food security is a complex one. However, it is arguable that, poor households are at risk of food insecurity due to limited resources to buy enough food. Food insecurity has deleterious effects on nutrition, health, weight, and children's psychosocial development and learning. In Tanzania for instance, the prevalence of income poverty is still high. According to the

Household Budget Survey of 2000/01, the proportion of the population below the national food poverty line is 18.7% and that below the national basic needs poverty line is 35.7% (Vice President's Office, 2005). Poverty remains overwhelmingly in rural areas where about 87% of the poor populations live. Therefore, Tanzania initiated National Strategy for Growth and Reduction of Poverty (NSGRP), also known as MKUKUTA in Swahili, which aim at reducing income poverty and food poverty by 2010. Accessing wetland resources, household income and food security status can be attained.

1.7 Limitation of the Study

The main problems faced during fieldwork were lack of standard measurements. Many interviewed farmers use heaps, cups, bowls and tins, small and big plastic containers and bags of different capacities to measure quantities of different food products. The researcher had to convert the local measurements into standard units through weighing and averaging. Another major problem was lack of recorded data. Data collection depended on the respondent's memory where it was difficult to give correct amount of some categories like household's income and production data. The researcher handled this problem by probing more than once in different ways to get this information correctly, however, this had its own limitations.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Wetland Products

Wetland products refer to those benefits that people obtain from the wetland ecosystem and are divided into two broad categories: direct products such as food, water, fibre and fuel, whereas indirect products include climate regulation, nutrient cycling and soil formation (MA, 2003). The present study focuses on direct product uses. The term "product" corresponds to goods that are tangible and physical objects of biological origin such as plants, animals and their products. They sustain thousands of rural communities with a wide range of products such as drinking water, fish, shellfish, game meat (e.g. crocodiles, birds etc.), fruits, resins, timber for building, wood as a fuel, reeds for thatching and weaving, fodder for animals, fibres for textiles, medicines, dyes and tanning (Ramsar, 2003; FAO, 2005).

When wetlands are converted, usually by drainage, some benefits may be obtained. These can include an early cereal harvest, which can help improve food security by providing food during the "hungry season"; cash crops such as sugar cane which can be sold and contribute to household income. Morandet *et al*. (2004) indicated that activities related with wetland products can be important in improving people's livelihood. For instance, Lake Chilika, which is a major coastal lagoon on the east coast of India, sustains livelihoods of more than 200 000 fishermen and 800 000 agricultural farmers living in its catchments (Ramsar, 2005).

Apart from harvesting and processing of natural resources, uses of wetlands also include cultivation and livestock grazing and irrigation (WWF/IUCN, 1990; National Geographic Society, 1992; Keddy, 2000). Some of the activities such as cultivation, fishing, and harvesting wild foods are clearly economic, and are means of earning income for the household. Other uses such as water for domestic purposes, soils for decorating houses, and wild foods contribute directly to household needs (McCartney and van Koppen, 2004; Masiyandima *et al*., 2004).

2.2 Wetlands Classification in Tanzania

Wetland classification is an important component and tool in developing a bio-criteria for wetland agriculture as wetlands have biological communities that reflect climate, hydro period, habitat, and geomorphology among others. Wetland classification may be based on regions that are ecologically similar. Wetlands in the mountains, for instance, would be grouped or classified separately from wetlands in the valleys (Ramsar, 2003).

Wetlands classification in Tanzania is based on eco-regions and hydro geomorphology. They are classified broadly into six categories namely highland headwater wetlands, freshwater estuarine, internal drainage wetlands, rivers and inland floodplains, man-made, marine and coastal wetlands (Kamukala and Crafter, 1993; Munishi, 2004). Rivers and inland flood plain wetlands are usually formed in low altitudes whereby river floods seasonally during rainy seasons. These are areas where deposition takes place and layers of soil profiles are formed at various seasons and years developing very fertile soils with adequate soil moisture for reliable agriculture. These major wetland systems form the bottomland wetlands in Tanzania including those of Turiani Division. Others are those of Usangu - Ruaha - Rufiji river systems, Wami, Kilombero, Pangani, Malagarasi, Ruvu and

Katavi Rivers. Permanent and seasonal freshwater swamps, marshes and seasonal floodplains are distributed over most of the country's major river systems covering 2.7 million ha (Munishi and Halungu, 2004). The largest in this category is the Usangu - Rufiji-Ruaha River system, which has wetlands covering 695 000 ha.

2.3 The Contribution of Wetland Products to Household Cash Income and Food Security

Majority of rural households benefit directly and indirectly from wetlands and their products in the context of income and food security (Ramsar, 2005). Wetlands contribute directly to food security through the production of rice, sweet potatoes, yams, maize, and vegetables. Wetlands can take an essential part in food security, especially during the dry season or in drought years when dry land farming, which is limited to the rainfall season, cannot adequately cater for the needs of these households (Thomas and Leatherman, 1990). For instance, diverting water from river flood plains to farms is one way of raising crop production in California (Chapmann and Reiss, 2001). Large-scale irrigation is practiced in New Zealand, Eastern Asia, Northern Australia and Columbia where foods such as sweet potatoes, yams and rice are cultivated (Forde, 1997). Ruhuma basin in Sri lanka has contributed to greater agricultural productivity and better livelihood for rural people through irrigation (Nagabhatla *et al*., 2006). The main harvest from wetlands is just ready when the supply of food from the upland fields is running out for many households and the "hungry season" is just starting (Abbort and Hailu, 2000). Paddy rice is grown in swampy, riverine ecosystem in the Nile belt, Lake Victoria basin in East Africa and Indus basin in India (Revenga and Kura, 2003).

Furthermore, swamps, rivers and reservoirs play a very important role in total fish supply because of their wide distributions. Mangroves, estuaries, deltas and shallow offshore waters are vital for maintaining coastal fishes and shrimp fisheries (Semesi, 1997). The coastal people in four villages in Rufiji delta in Tanzania produced 6300 kg of honey and 902 kg of wax in 1987 from mangrove forests (Kamukala *et al.*, 1993). Frenken (2001) reported that approximately 17.5 million people worldwide are involved in fishery related activities.

FAO (1999) statistics indicated that about 8 million tons of fish were caught from freshwater ecosystems and 18 million tons of fish were produced from freshwater aquaculture. Fish production of the lower Mekong basin alone totals some 1.5 million tons annually amounting to a total retail value of US$ 1.4-1.7 billion (Dugan *et al*., 2004). Catches in Lake Victoria reached over 500 000 tons in the 1990s. The larger floodplains in Sub-saharan Africa including the inner delta of the Niger, the Sudd of the Nile and Lake Chad each produce up to 100 000 tons of fish per year and generate annual income of about US$ 20-25 million (FAO, 1999).

Cash crops such as sugar cane help farmers to earn income, which in turn is used to purchase food in the household. For example, annual incomes from wetlands in Zambia was found to be as high as US $1000 per household (or 90% of the total household income with high variation across sites and households (Morardet and Koukou-Tchamba, 2004). Another example is from Niger wetlands where, food crops provided an income of between US 200-4300 per hectare in 1993 (Brouwer, 2002). In Ethiopia, for instance, wetlands are used to secure food directly through dry season subsistence cultivation. Also, indirectly through income generation from cash crops, the production of clay pottery,

reeds and palm mats, baskets and beehives and the sale of collected items such as reeds (Abbort and Hailu, 2000).

Wetlands contribute indirectly to food security and household cash income by providing products, which people can collect and sell to provide them with cash income for purchasing food (Dugan *et al*., 2004). Some people make a living from collecting craft materials, which they either sell or use for making craft items for sale. Medicinal plants are also found in wetlands and these items contribute to the well-being of households through direct use or through sales (MA, 2003; Kambewa, 2005). In Malaysia, rural households earn up to US$80 a month by selling medicinal plants gathered from wetlands (Dugan *et al*., 2004). People living around Lake Chilwa basin (Malawi) reported to rely on wetland resources for fish (48%), grass for construction (19%), firewood (10%), reeds for construction (9%) and bird hunting (4%) (Kambewa, 2004). Other activities included brick making, livestock grazing, holding initiation and rain making ceremonies.

Wetlands are green throughout the year and thus provide fresh and nutrition forage for domestic as well as wild animals especially during dry season ensuring the survival and existence of animals (Keddy, 2000). For instance, in Tarangire National Park in Tanzania, there are Silale and Burunge swamps that provide forage for wild animals and domestic animals during dry season when other parts of the park are dry. In turn, people get milk, meat and other animal products for food and cash income.

Peasants who earn income from wetlands also practice off-farm activities as another source of their income. Off-farm income represents an important source of household livelihood (Blaehu *et al*., 2002; Dixon *et al*., 2005). Gregoire (2001) reported

diversification to be one of the ways of managing risks used by many households. Gillespie *et al*. (1994) reported two categories of enterprises which households can engage in order to generate income from off-farm activities. They included working for money, including salary, wages, or piecework and self-employment through selling commodities (agricultural and non-agricultural) produced. For instance, FAO (2007) found that although the main source of income for the households interviewed was the crops grown in the wetlands in Malawi, which accounted for nearly 34%, the sale of dry land crops was 27%, the majority of which was from tobacco (16%) and petty jobs accounted for 23% of other sources of income.

2.4 Types and Amounts of Foods Produced in Wetlands

2.4.1 Wetland agriculture

Farming activities are the major economic pursuits of people around wetlands with the cultivation of crops such as paddy, maize and various types of vegetables and fruits (Omar, 1993). The practice of growing rice and other wetland crops is increasing worldwide. For instance, farmers in Sierra Leone use the inland valley swamps for rice in the rainy season followed in the dry season by groundnuts, vegetables, potatoes and cassava (FAO, 2005). In Zambia, maize, rice, sweet potatoes, sugarcane, fruits and vegetables are grown in Barotse flood plain (ICUN, 2003). In eastern and western Uganda valley bottom wetlands are widely used for crop cultivation, livestock production and fisheries. Important wetland crops include rice, yams, Irish potatoes and sugarcane (Tindamanyire, 2002). In Kenya, Terer *et al.* (2004) found that the Tana River was mainly used for crop farming and fishing by *Pokomo* people. In Cameroon, food crops like rice, corn, groundnuts, cassava, cocoyams, beans, potatoes and vegetables (such as cabbages, leeks, tomatoes and onions) are major food crops grown in wetlands (Forpal, 2003).

In Thailand, the inland fisheries of the Mekong basin produces 2% of the world's annual total catch of all types of fish (both marine and freshwater), and 80% of the Mekongs' population get most of their protein from fish (WWF, 2006). In Nigeria, Adetola (2003) reported that coastal wetlands produced an estimated catch of 193 836 ton/ year worth $52 353 720. Jarret (1975) cited by Omari (1993) reported that Tanzania produced 160 000 t of paddy between 1974 and 1975. Therefore, the main types of foods produced in the wetlands can be summarized into cereals (rice, maize), roots and tubers (sweet potatoes, cassava), fruits, vegetables and fish. Wetlands also support extensive pastoral production. For example, the inner delta of the river Niger supports 5 million heads of cattle and small livestocks every year accounting for 10% of the country's gross national product (Dugan *et al*., 2004).

2.4.2 Wetland alleviate food shortages

Wetlands play a great role in people's lives by helping them achieve household food security. For instance, in the western highlands of Ethiopia, perennial swamp and seasonal wetlands are used to meet food security during the "hungry season" (Abort and Hailu, 2000). In Malawi, Kambewa (2005) reported that in response to droughts since the 1990s the Malawi Government with assistance from FAO and the Danish International Development Agency (DANIDA), mobilized and supported farmers to utilize wetlands, streams, and rivers for wetland cultivation. It was further observed that households who had access to wetland gardens in the dry season had enough food throughout the year. About 75% reported that they do not run out of food from January to February, a period when most Malawians do so because dry land maize is still immature (Kambewa, 2005). In Iringa (Tanzania), Kurosaki (2007) reported that wetland maize cultivation was important to the community because maize harvest came at a time of food shortages.

2.5 Wetland Degradation

A number of authors have reported wetland deterioration worldwide (Maltby, 1986; Dugan, 1990; NEMC/WWF/IUCN, 1990). For example, Halls (1997) and IUCN (2002) reported that globally, 160 600 km^2 of wetlands had been drained by 1995 primarily for agriculture and food production. Furthermore, it has been estimated that about 90% of New Zealand's former wetlands have been absorbed by arable, pastoral and horticultural developments (Mironga, 2005). In Brazil, the "*varzea*" or floodplain of the Amazon River is the most important ecosystem both ecologically and economically. The intensification of fisheries, commercial logging and expansion of extensive cattle and waterbuffalo are reported to be the leading to the depletion of the "*varzea*" natural resources (Ramsar, 2005). In Uganda, an estimated 1620ha (16.2 km^2) of swamp had been reclaimed through drainage (Tindamanyire, 2002).

Wetland degradation in Kenya is caused by land reclamation, overgrazing eutrophication of inland waters and agricultural pollution (Mironga, 2005). In Tanzania, both human activities and natural threats such as sea level rise, drought, storms and erosion contribute to wetland degradation (Bakobi, 1993). Human activities in the wetlands have resulted into beach erosion along the coast, loss of Lake Haubi in Kondoa, drastic reduction of waterlilies in Kagera River, silting of the little and Great Ruaha River complex, drying of the lower streams on Mt Kilimanjaro and vigorous growth of water hyacinth in Lake Victoria and the Pangani River (Bakobi, 1993). Thus, the continuing loss of wetlands through human development must have significant impacts whose repercussions at present are not clearly understood.

2.6 Sustainable Use of Wetlands in Tanzania

In the past, wetlands were considered as wastelands although they were potentially suitable for agriculture due to the availability of water and high soil fertility (Masija, 1993). At present, some wetlands are used for agriculture and support other activities such as wildlife, tourism and forestry (Bakobi, 1993). Nevertheless, interventions are necessary to protect wetlands against environmental degradation and pollution. In this response for instance, The United Republic of Tanzania officially ratified the Convention on Wetlands (Ramsar, 1971) in August 2000, thereby demonstrating its vision and commitment towards sustainable wetland management. The Convention emphasises the need for wise use of all wetlands. The contracting parties define the wise use of the "sustainable utilisation to the benefit of people in a way compatible with the maintenance of the natural properties of the ecosystem" (MNRT, 2004). Natural properties of the ecosystem are defined by MNRT (2004) as those physical, biological or chemical components, such as soil, water, plants, animals and nutrients, and the interactions between them. Sustainable utilisation has been defined as "human use of wetlands so that it may yield the greatest continuous benefit to the present generations while maintaining its potential to meet the needs and aspirations of future generations" (MNRT, 2004).

Generally, problems and issues in wetland management for sustainable production are environmental, socio-economic and institutional with each category having its own drivers, pressures and impacts on wetlands (Munishi *et al.*, 2003). For instance, agriculturalists see moist, fertile soils with great potential of growing rice, maize, sorghum and cotton. Fishery managers find a potential for fish production; hydrologists calculate water supply and demand for various projects; foresters are interested in the mangroves and riverine forests; game wardens view wetlands as sanctuaries for wildlife and

ecologists are interested in the intricacies of the ecosystem. Unsustainable agricultural practices are one of the major environmental issues that call for attention in wetland sustainability (Bakobi, 1993).

2.7 Wetland Institutions

2.7.1 Meaning of an institution

An institution may mean different things to different people. It may be formal or informal. Institutions are defined as the rules of the game in a society or, more formally, as the humanly devised constraints that shape human interaction (North, 1990). In consequence they structure incentives in human exchange, whether political, social or economic (North, 1990). Ostrom (1992) defined institutions as set of rules actually used by the set of individuals to organize repetitive activities that produce outcomes affecting those individuals and potentially affecting others. Ruttan (1989) defined institutions as rules of society or organizations that facilitate coordination among people by helping them form expectations, which each person can reasonably hold in dealing with others. They reflect the conventions that have evolved in different societies regarding the behaviour of individuals and groups relative to their own behaviour and the behaviour of others.

It can be concluded that an institution is a set of principles, which govern the behavioural relations among individuals or groups. For instance, a formal organization such as village conservation committee is an institution because it provides sets of rules governing the relationships between members and non-members. Cultural rules and codes of conduct are also labelled institutions as far as they can constrain the relationships between different individuals and /or groups.

2.7.2 The role of institutions in wetland management

Institutions are critical at all levels of human interaction. This is in part because in the world of limited and uncertain information, individuals must make guesses as to the likelihood of behaviour being sanctioned or rewarded (Ostrom, 1996). Those guesses are complicated by how widely problem and policy areas vary in scale, cost, input, technology and the numbers of other people involved. Under such uncertainty, political institutions and effective leadership, which help translate problems into policies, are essential (Wunsch, 2000). Institutions are necessary to guide political decision-making along procedures regarded as just and fair, to define certain outcome sets as acceptable and unacceptable, to clarify just who has the right to participate in which decisions, to assure and re-assure people that future decisions will be made predictably and not randomly and to specify what sort of citizen obligations might and might not be incurred. Institutions have a mechanism to structure politics along productive lines (avoiding prisoner's dilemma games) and to ground politics in norms (Ostrom, 1986a; 1986b).

Pretty (1995) indicated that all good cases of environmental regeneration are invariably those cases where voluntary agencies have set up an effective institution at the village level. The author contends that it is the creation of the village level institutions which brings people together, spurs them into action and ensures the protection and development of wetland resource base.

Institutions are commonly formed to take charge of new activities and / or manage a new resource, such as water users associations for irrigation, water point committees to manage pumps or farmers of common micro-catchments to control soil erosion. However, such

local groups adopt and change their roles and responsibilities as internal and external conditions change (Ostram, 1986).

2.7.3 Local institutions

The term “local” or “indigenous” and “traditional” can be differentiated although many writers do not make this distinction. Kajembe (1994) defined traditional institutions based on order and code of practice accepted from the past, and local or indigenous as something originating, developing, or produced naturally in a particular place (land), region, or environment. Therefore, something traditional is not necessarily indigenous. Most of these institutions lost their authority and legitimacy during the colonial era. The subordination of customary authorities such as chiefs and headmen to repressive state apparatuses has undermined the legitimacy of these institutions (Chanley, 1994). Natural resources (such as wetlands) were taken from the hands of the local people and became state lands. This act undermined the sense of local responsibility for resource management, a legacy that has proved increasingly problematic (Sarin, 1993). Prior to colonization, societies in the then Tanganyika had a system of governance that protected community biological and other natural resources whereby the collection and utilization of natural resources was foreseen by tribal rules and regulations.

Tribal rules and regulations regulated land uses and enforced cultivation regulations (Chamberlain *et al*., 1998). Examples of such rules included those, which enhance productivity of protection of trees and shrubs against abusive harvesting and browsing. Kajembe (1994) described those rules as “fairness ethics” and do not require formal enforcement since they were embodied in the moral cultures of the people. Ovieno (2000) argues that some of these rules were so fundamental that they appeared to be taken for

granted as inviolable and were widely respected by all people. Their violation when it did occur was generally resolved by social controls (Kajembe, 1994). Informal procedures are part of the social fabric of local societies in the tropics, where kinship system and the rules and obligations set up by the culture provided the stabilizing force. Although rules and regulations exist in a society, they are rarely explicit and need to be interpreted to fit each situation. For instance, Dixon (2007) reported that farmers in southwest Ethiopia have extensive knowledge of the role and behaviour of water in their local wetlands (known as hydrological processes) thus agreed to leave the uncultivated plots to restore water naturally (known as fallow plots). Another example can be drawn among the *Sukuma* in Tanzania, where there are general rules limiting access to certain wetland pastures (O'kting'ati and Kajembe, 1991, cited by Kajembe, 1994) but there is a constant argument about where and when to apply them. In most cases, there are verbal persuasions involving elaborate rhetorical arguments in order to influence communal agreement.

2.8 Food Security

Various scholars have variously defined the term food security. Cohen *et al*. (1989) defined food security as the ability of a country to provide adequate amount of food for its population. Mkandawire *et al*. (1993) argues that food production and food security as both concepts and processes are inextricably intertwined. In that sense food production refers to agricultural processes, whereby the primary pre-occupation of farmers is production of food either for self-provision or income generation or both, while food security means always having food to eat for active and healthier life.

People meet food security by having land and other resources to or having employment that pays enough to buy food. Steven *et al.* (1999) defined food security as a condition in

which all people have access at all times to nutritionally adequate food through normal food channels. FAO (1996) states that food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy lifestyle. The key elements (indicators) that determine food security at any point in time are availability of enough food for an active and healthy life, the access to it and the guarantee that one has the access to it at any given time (Maxwell *et al*., 1992). The performance of these indicators will therefore, determine whether a certain area or population is food secure or insecure. Food insecurity is a situation in which individuals have neither physical nor economic access to the nourishment they need (Reutlinger, 1987). A household is said to be food insecure when its consumption falls to less than 80% of the Recommended Daily Allowance (RDA) of caloric intake for an individual to be active and healthy (Reutlinger, 1987).

Based on temporal dimension, two types of household's food insecurity can be distinguished namely chronic and transitory. Chronic (permanent) food insecurity refers to a continuously inadequate diet resulting from lack of resources to produce or acquire food (Reutlinger, 1985). World Bank (2001) argued that chronic food insecurity at the household level is mainly a problem of poor households in most parts of the world. For instance, FAO (2003) reports that around 852 million men, women and children are chronically hungry due to extreme poverty world-wide, while up to 2 billion people lack food security intermittently due to varying degrees of poverty.

Transitory food insecurity refers to a temporary decline in the household's access to enough food. It results from instability of food prices, production or incomes (FAO,

2002). In Africa, particularly in Sub-Saharan Africa, food insecurity is projected to accelerate to almost quadruple from 11% in 1969/71 to 39% in 2010 (FAO, 1996). About 40% of the total African population, largely children and women, face mounting problems of poverty and malnutrition (FAO, 1996).

Causes of food insecurity facing farm households in various developing regions of Africa, Latin America and Asia have been reported in literature. Much of the Sub-Sahara African population, particularly in rural areas, experiences some degree of hunger over the rainy, or "hungry" season, when food stocks dwindle and roads become muddy and impassable (Bonnard, 1999). Migration of male labour is also recognized as a cause of seasonal hunger. A study conducted in Lesotho at one of the villages found that women and children suffered from lack of food and poor hygiene because women were too exhausted to cook and clean at times of peak agricultural work (Huss-Ashmore, 1984). FAO (2002) observed that growing cash crops at the expense of subsistence crops has largely contributed to food deficit among the *Gernieri* in Gambia. FAO (2002) observes that illness of adults at critical times in the production process adversely affects labour efficiency and productivity, which in turn contributes to food shortage. Likewise, a study by Ashimogo and Hella (2000) in Iringa Tanzania reveals that the transition to commercial agriculture has had negative influence on food security.

FAO (2006) reported that 98% of Tanzania’s agriculture depends on rains and in every 3-5 years (on average) there has been crop failure (in some parts of the country) due to drought or floods or both. Severe droughts were experienced in 1961/62, 1970/71 and 1973-75, followed by floods in 1978/79 and poor rains in 1979/80 and 1980/81; then moderately satisfactory rains from 1981/82 to 1984/85, followed by floods in three ‘grain

basket' regions (Morogoro, Mbeya, Rukwa) in 1988/89 and in Kilimanjaro (Moshi and Rombo Districts) and Mtwara Regions during 1990/91 (FAO, 2006). Droughts and floods affected large parts of the country in 1992/93. In addition, farming technology is low and about 85% of cultivation is still done by hand hoe, and only 10% by oxen, and 5% by tractors. Farm inputs (fertilizers, hybrid seed, insecticides, herbicides, etc) are fast becoming inaccessible to the smallholder farmers due to rising prices and removal of state subsidies (FAO, 2006).

Deterioration in the ecological conditions of production has also been seen as a cause of seasonal hunger in several African nations. Closely associated with this, Messer (1989) noted insufficient farmland, low yields on farms and high storage losses of staples to be the principal causes of seasonal food shortage in Nigeria. Findings in central Malawi (Nurse, 1975) are contrary to the findings in Lesotho (Huss-Ashmore, 1984), because in the former men normally do not work in local subsistence production.

Generally, in most parts of the world, rural communities suffer from seasonal variations in food supply and the "hungry season" is a key feature of life for many millions of people. This food shortage is often addressed by the drainage of wetlands or the use of areas with seepage water or a high water table to produce food crops in the dry season. Such crops can make a dramatic impact upon the availability of food in the hungry season, even though the production is small, its value is great (Mironga, 2005; Wood *et al*., 2006).

2.8.1 Food security at different levels

Food security can be monitored at many levels; national, regional, household and individual levels. At National or Regional level, food security can be monitored in terms

of indicators of production, supply, trade, stocks and market prices (Valdes and Konandres, 1981 cited by Nyange, 2000). However, at National level, food supply or aggregate availability represents only a proxy for consumption or "disappearance" as opposed to quantitative food intake measures taken directly at household or individual level (Thomson and Metz, 1997). Different regions may experience varying degrees of food security as a result of natural resource endowments, differences in purchasing power, logistic and infrastructure, access to markets, trade and imports (FAO, 1990).

At the household level, food security refers to ability of the household to secure, either from own production or through purchases, adequate food for meeting the dietary needs of its members. Ensuring food security is a necessary condition for improving the nutrition status of each member in the household, but by itself is not sufficient because of other problems related to distribution of food among members of the household. Food requirements among members in the household vary with age, sex, occupation, and physiological changes of the body such as pregnancy and sickness (Nyange, 2000).

2.8.2 Dimensions of food security

Thomson and Metz (1997) identified three dimensions of food security namely; availability, stability and accessibility. Firstly, food availability is necessary to ensure sufficient food supply both at national and local levels. The market has a great role of linking food surplus and food deficit areas. Secondly, food stability refers to variations and the risk of shortfalls in food production, supplies and/or demand over time. In food stability, concerns are income distribution, effective markets and various public and informal support and safety nets. A society can be said to enjoy food security if it has developed an internal structure that will sustain the food norm in the face of crises

threatening to lower the achieved level of food consumption. Thirdly, food accessibility, which is perhaps the most critical dimension, ensures that each household or member has physical and economic access to food that it needs. Physical access to food is related to the adequacy of supply and to efficiency of the distribution system involving storage, processing, preservation, transport and marketing.

Economic access to food refers to the ability of groups of people to establish entitlement over a requisite amount of food, the ability to generate income, whether in cash or in kind and the proportion of income that is readily available for consumption purposes (Thompson and Metz, 1997). For instance, Sahley *et al.* (2005) reported that most families in Malawi were consuming what they produce or by purchasing food in the growing season from income earned from their harvest time sales or from off-farm work. FAO (1996) argues that access to food is concerned with the demand for food, which is a function of several variables namely the price of the food item in question, the prices of complementary and substitutable items, income, demographic variables and tastes or preferences. To ensure food security (access), FAO (1996) emphasized that a food system should be characterized by:

- the capacity to produce, store and import sufficient food to meet basic needs for all population groups
- maximum autonomy and self-determination (without implying self-sufficiency), which reduces vulnerability to international market fluctuations and political pressures
- reliability, such that seasonal, cyclical and other variations in access to food are minimal
- sustainability, such that the ecological system is protected and improved over time

- Equity, which is dependable access to adequate food for all social groups.

It is therefore worth noting that a secure food system must be able to deliver inputs and outputs (both those produced and consumed domestically and those traded internationally) where and when they are required.

2.8.3 Household food security

A household is food secure when it has access to the food needed for a healthy life for all its members (adequate in terms of quality, quantity, safety and culturally acceptable), and when it is not at undue risk of losing such access (Mosha, 1990; FAO, 2004,). World Food Summit (2000) defined household food security as availability of adequate food in terms of quantity and quality that should be safe, nutritious and acceptable to all household members. It should be accessible and sustainable to all members at all times throughout the year. Hence, there should be enough food to meet daily requirements of all members of the household. Food insecurity continues to threaten large proportions of households particularly in low-income families (FAO, 2004).

In Tanzania most rural communities depend on their own food production for consumption (Keenja, 2001). Mlambiti *et al.* (1999) argued that about 37% of Tanzanian population is undernourished because they have inadequate access to food, essentially too poor or otherwise disadvantaged to exert effective access to several resources. Apart from climatic conditions being the cause of household food insecurity, local brewing, overselling of food crops for family income, low household income, traditional ceremonies and funerals also contribute to household food insecurity (Makundi, 1996; Ishengoma, 1998). Other factors reported by URT (2003) which hinder efforts to produce

enough food are land degradation and rural poverty. However, Kavishe (1990) pointed out that in aggregate terms Tanzania has no food shortage, although, some parts of the country are facing food shortage due to prolonged drought, floods, market and infrastructural constraints that hinder smooth transfer of food from surplus areas to deficit ones. A survey by Liwenga (1995) in Kondoa revealed that there were 92% of the respondents who had food shortage and these food problems occurred just before crop harvest. The reason for the deficit was failure of crop production and excessive crop selling.

2.8.4 Indicators used for measuring household food security

Maxwell *et al*. (1992) described two types of household food security indicators namely process indicators that reflect both food supply and food access and outcome indicators, which serve as proxies for food consumption. Outcome indicators are mainly used to evaluate the food security status before and after an intervention. In general, outcome indicators are grouped into direct and indirect indicators. Direct indicators of food consumption include those indicators which are closest to actual food consumption rather than to marketing channel information, while indirect indicators are generally used when the direct indicators are either unavailable or too costly (in terms of time and money) to collect the information required.

One of the major problems associated with household food security is that many of the proxies that are appropriate for one area may not be appropriate for another, therefore this call for process indicators which are at local level better-understood (Maxwell *et al*., 1992). Process indicators are used to measure the changing status of food security. They are divided into two categories namely supply and access indicators. Supply indicators

measure the availability of food, assessment of food security which include famine early warning systems focusing on food supply at national and regional levels including meteorological data (rainfall), information on natural resources, agriculture production data, food balance sheet, information on pest management, information on markets and institutional support structures and regional conflicts and their consequences (Nyborg and Haug, 1994).

Access indicators are used to measure people's access and entitlement to food, either through own production, purchase or transfer/gifts. They reflect to a large extent people's responses to worsening conditions. These types of indicators are termed as coping ability (Borton and Shoham, 1991). Some of the examples include risk-minimizing strategies (adjustment during and before a production season) including land use practices and diversification of livestock, loss management strategies, farmers response to lower production which include dietary change, change in food source, diversification of income sources and access to loans /credit, livestock sales, seasonal migration, sale of production assets and distress migration (FAO, 2001). Consequently, this study uses process indicators in measuring the household food security which include agriculture production (quantity of foods produced) data and food adequate information (in terms of months, year).

2.9 Socio-economic Factors Influencing Farmer's Accessibility to Wetland Resources

2.9.1 Wetland ownership and accessibility

The ownership and access to wetlands is a complex phenomenon and is variously interpreted by different stakeholders depending on their particular interests. Some wetlands are believed to be individually owned, some are communally owned, some are

under ‘assumed ownership’ and others are leased (Bakema and Lyango, 2005). For instance, Chinnack (2005) reported that the oxbow lake and flood plain vegetation’s resources are held to be common property in Thailand. Community members hold that as long as one does not destroy resources or violate specific communal rights where anyone has the right to use the resources of the wetlands. In other words, resource access rights come from the rights for basic livelihood, and include a duty for resource co-management within a framework of community rights.

In India, Barik *et al.* (1996) noted that floodplain wetlands of Indo-Gangetic basin have remained as open access resource with no ownership over it. Kambewa (2005) reported that in the Lake Chilwa in Malawi wetland gardens are accessed through permission from village headmen, group village headmen and traditional authorities and through inheritance from family members. Although accessibility resulting from swamps ownership has little bearing on resource use in Uganda, the extent to which swamps are utilised is dependent on accessibility constraints such as the distance the household members have to travel to obtain these resources (Maclean, 2003). In Tanzania if a wetland is within a national park or game reserve, then its management falls under the control of the Director of Wildlife (Chabwela, 1991). Hydropower dams are controlled by the Tanzanian Electricity Company (TANESCO). In some areas, for example, the Bahi Swamps, the wildlife is under the control of the Director of Wildlife but the wetland is managed by the villagers.

Wood (2000) indicated some specific factors that determine access to wetlands and their resources to include perceptions of value, availability of household resources which are needed to gain particular benefits from wetlands and demands from household resources,

which require certain benefits to be obtained from wetlands. Others are skills and their distribution in society (especially for medicinal plant collection, but also fishing and wildlife hunting), political regulations/processes and how they impact upon different groups in society and societal rules, which determine activity and norms.

2.9.2 Education

Education is an important element for accessing wetland resources and development. Mallaise (1998) argued that, given everything else, educated rural households are more productive in agriculture and are likely to have access to wetland resources opportunities than the non-educated. Rodgers (1989) asserted that education is one of the strongest means of access to economic resources (wetland) as reflected in household income and welfare.

Education enables the farmer to perceive and understand the rules of the game of wetland access and perceive the relevance in the context of his/her wetland situation. It is an important modernization factor, which influences people's behaviour, their perceptions and lifestyle (Kangarawe, 1995). However, Mbonile (1995) in contrary argued that the educated people consider themselves as suitable for white-collar jobs and so are likely to move from rural to urban areas in search of better opportunities hence denying access to wetland resources. It is generally acknowledged that education is perceived as being among the factors that influence an individual's perception to access to resources. Education is therefore taken as the key to better opportunities for development, accessibility, information and services.

2.9.3 Duration of stay

The longer time an individual stays in a village, the more he/ she will be trusted by the surrounding community thus easy access to community resources. For instance, in Uganda in Lake Bunyonyi, Maclean *et al*. (2003) reported that the increased pressure on swamp resources resulted in a greater reluctance to trust strangers. Moreover, experience and knowledge on issues pertaining to rules and regulations of wetland resources accessibility is enhanced as a person stays long time in the area.

2.9.4 Household income

Abbot and Hailu (2000) observed that it was mainly the relatively wealthy members in Ethiopia that had access to wetland resources for crop cultivation. They performed most of the cultivation not only as a result of their ownership of wetland holdings but also due to their ability to deploy adequate labour both for cultivation and crop guarding. Similarly, Mulugeta (2004) reported that wealthier farmers in Ethiopia tended to access wetlands rather than the economically less fortunate ones. In Malawi, Kambewa (2004) reported that about 10% of farmers accessed wetland gardens by renting/ borrowing during dry season and 90% cultivated on their own wetland gardens. In Singida, Tanzania, which is a semi-arid region, Yanda *et al*. (2005) asserted that the *Wagoli* households have economic powers (income) to occupy both dry lands and wetlands. They also occupy large farm sizes more than 5 hectares because they can manage them by employing labour. Food security depends greatly on income. For instance, Nord (2003) reported that in US, in 2001, food insecurity was five times more prevalent in households with annual incomes below the poverty line ($17 960 for a family of two adults and two children) than in households with incomes above that range.

2.9.5 Household size

The size of the household reflects to a certain extent the availability of labour, which is the most important input in many wetland farming and access. Smaller household size would thus mean limited household labour availability for various activities (Kangarawe, 1995). FAO (2007) reported that relatively larger families in Malawi had more access to wetland particularly where physical works are necessary to control water flow, planting and weeding of crops that are often labour intensive. However, Lorri and Kavishe (1990) reported that large family size was one of the factors contributing to food insecurity and low income to many rural households.

2.9.6 Age

Several studies (Warren, 1991; Adams, 1993; Kajembe, 1994) indicated that indigenous knowledge accumulates with age. Aged people are considered to be key informants since they know much of the information based on the traditional wetland use for food production and other wetland uses. Yang (1999) argues that age connotes experience and perhaps an accumulation of wealth. Therefore, aged people are likely to access wetland resources than their counterparts (the young). For instance, Kambewa (2004) reported in Malawi that 61% of households with wetland gardens had inherited them from their family members, while 39% were allocated the gardens by the chiefs.

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Study Site Description

3.1.1 Geographical location

The study was carried out in Turiani Division, Mvomero District in Morogoro Region. Turiani is one of the five divisions of Mvomero District, which lies within 37º - 38° East of Greenwich and 5º - 7° South of the equator (Lyimo *et al*., 2003). The study was conducted in three villages of Komtonga, Digoma and Dihinda (Figure 2).

3.1.2 Climate

The climate in the study area is a sub-humid tropical climate with humidity varying from minimum of 70% to maximum of 98%. Total mean annual rainfall is about 2000-3100mm. It rains during the months of March to May and October to December, the former constitute “Masika" rains or long rains while the latter constitute “Vuli" rains or short rains (Lyimo *et al*., 2003). Temperatures normally vary from 20-30° C (District Planning Report, 2003).

3.1.3 Vegetation

The vegetation in the study area is characterized by a wide range of forest type from lowland to submontane, montane and upper montane on the wetter eastern side. Woodlands occur in the drier areas in the foothills and on western side from 380 – 600 m above sea level. Woodland species include *Annona senegalensis, Brachystegia boehmii, B. microphylla, B. spiciformis, Diplorhynchus condilocarpon, Julbernardia globiflora* among others. Lowland forest species include *Afrosersalisia cerasifera, Antiaris*

toxicaria, Bequaeritiodendron natalense, Cola greenwayii, Cola stelecantha, Milicia excelsa, Parinari excelsa. Submontane forest species include but are not limited to *Allanblackia stuhlmannii, Leptonychia usambarensis, Myrianthus holstii, Macaranga capensis, Newtonia buchanani and Parinari excelsa*. Montane forest species include *Agauria salicifolia, Aphloia theiformis, Cryptocaria liebertiana, Ilex mitis, Maesa lanceolata and Myrica salicifolia* (Forestry and Beekeeping Division, 2005). Mtui *et al*. (2006) and Bracebridge (2006) reported that Turiani division (Mvomero district) is characterized by lowlands, small hills and low undulating mountains. Important vegetation includes small forests with light grasslands dominated by *Panicum* species, mostly intermingled with shrub and leguminous trees.

3.1.4 Edaphic and ecological characteristics

The study area has six main groups of soils namely dry; slightly clay soils; red soils with friable clay; undifferentiated black soils; alluvial soils and partially overlaid with alluvium (Senkondo, 1992). A study conducted by Senkondo and Temu (1990) indicated that soils in the district may show remarkable differences within a few kilometers. The land is plain surrounded by the Nguru Mountains and the uncultivated lowlands are covered with grassland (Lyimo *et al*., 2004).

3.1.5 Socio-economic profile

Mvomero District has a population of 263 920 people of whom 131 256 were males and 129 269 females (District Planning Report, 2003). The population growth is relatively high at a rate of 2.6% per annum. The estimated per capita income of the people of Mvomero in 2001 was about US $ 196 (Tsh. 182 500). More than 85% of the population engages in agriculture producing maize, beans, cassava, sorghum, paddy, fruits,

cardamom, coffee, cotton, sunflower, sisal and sugarcane (URT, 2005). The livestock raised include; cattle, goats, sheep, pigs, chicken and ducks. The main tribes include; the *Luguru*, *Zigua*, *Kwere*, *Maasai*, and *Sukuma* (URT, 2005).

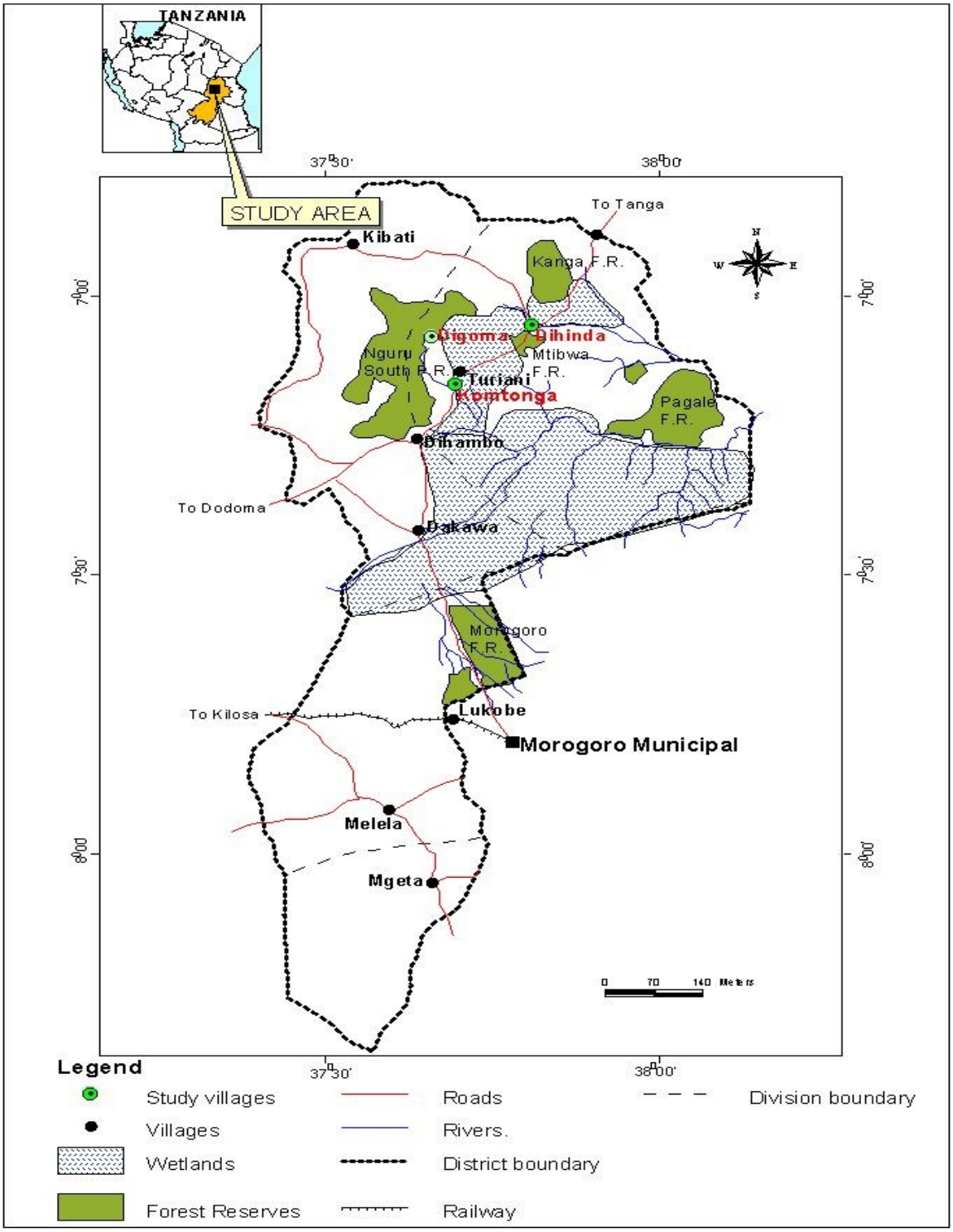

Figure 2: A map of Mvomero District showing the study villages of Komtonga, Digoma and Dihinda

3.2 Research Design

The research design for this study was a cross-sectional, where data was collected at a single point in time without repetitions. This design was chosen because it is more flexible and less costly (Babie, 1990; Bailey, 1994). Unlike the longitudinal design which involves trend studies and the limited time justifies the use of the selected design (Casley and Kumar, 1988).

3.3 Key Variables in the Study

The overall objective of this study was to assess the role of wetland products to household's income and food security. Dependent variables in the study included household food security and income levels. With regard to food security, indicators that were used included quantity of foods produced (Kg) and time length (number of months) faced with food shortage. Income level was measured by cash income obtained from wetland and non-wetland produces and other sources (off-farm activities such as employment, remittances and casual labouring). Moreover, in this context, the correlation test was applied in order to identify which socio-economic variables (independent) were significant in farmer's accessibility to wetland resources. This included age, education level, family size, household income, farm size and duration of residence in the area.

3.4 Sampling Procedure

A purposive sampling was employed in which three wards out of the five were selected from Turiani Division. Based on the information from the District office and proximity to wetland resources, three villages were picked from the selected wards. The selected villages were Komtonga, Digoma and Dihinda which together have 2,227 households. Afterwards a systematic random sampling of households from each village's up-dated

register was done, whereby a total number of households in a selected village were divided by sample size, this was done in order to select a systematic interval from one household to another for interview. The sample size was selected following Boyd and Stach (1988) formula that 5-15% of total population is sufficient for a social survey. The sampling fraction n/N was equal to 5%, where n is the size of the sampled households and N is the total population of households in the village. Out of 2227 households 112 were selected from the study villages. The household was taken as a unit of analysis because primarily it is where all decisions about food production, investment and consumption are taken (Makundi, 1996). Table 1 presents the distribution of sampled households from the surveyed villages.

Table 1: Sampling of households in the study area

Villages	Total number of households	Number of sampled households
Komtonga	471	24
Digoma	840	42
Dihinda	916	46
Total		112

3.5 Data Collection

Two types of data collected. These were primary and secondary data. Primary data were collected directly from sampled households and secondary data were obtained from relevant reports (both published and unpublished) available in the Internet, Sokoine National Agriculture Library (SNAL) and other reports from the Regional/ District agricultural and natural resources offices. Primary data were collected through a variety of survey methods including questionnaires (face-to-face interviews), Participatory Rural Appraisal (PRA) tools namely focused group discussion, key informants and personal observation. The process of data collection involved several steps namely reconnaissance

survey, questionnaire survey, focus group discussion, key informant interviews and participant observation.

(a) Reconnaissance survey

This was conducted in order to obtain a general picture of the research area. It also included visiting farms, selection of sampling units and pre-testing questionnaires. During this survey, four households from each of the identified villages were randomly selected and interviewed to pre-test the questionnaire so as to check reliability and validity of the questions. Slight corrections were made to meet the needs.

(b) Questionnaire survey

This was done through structured and semi-structured questionnaires (Appendix 1). The interview was face-to-face where the researcher had to reach the respondents at their homes. The questionnaire was made to solicit information from heads of households regarding the role of wetland products to household's income and food security. The questionnaire was formulated in English and translated into Swahili to facilitate easy communication in data collection. The information included among others household characteristics, wetland and non-wetland products based activities such as crop farming, fishing, livestock keeping (grazing) and brick making; total size of the wetland farm and cash money earned from wetland based activities and that of non-wetland activities. Types and amounts of different foods produced or harvested was measured using units familiar to local people such as "*debe*", "*kopo*", "*tengas*" etc. and later were converted into standard units (kgs).

(c) Key informants

A checklist was designed to guide the interviews with key informants who are knowledgeable on wetland and non-wetland issues (Appendix 2). These included District Agriculture Officer, District Natural Resources Officer and District Planning Officer. The information sought included common period of food shortage as well as food availability, general characteristics of well-to-do households in the district in terms of source of income, food, occupation, general characteristics of poor households and wetland threats in the area.

(d) Participant observation

Direct observations were made on selected household farms regarding the general conditions of crop farming, size of the wetland farms and types of food crops grown in the wetlands and non-wetlands. This method was useful because respondents were made to provide more important answers to questions and not hide important information from the study (Kajembe and Luoga, 1996). Much of the information was obtained by observing different activities performed or which have been performed by the communities. While observing, the researcher had an opportunity to compare what had been told with what was really taking place.

(e) Focus group discussion

Focus group discussion was selected because it is a powerful tool, which provides valuable spontaneous information in a short period at relatively low cost. This method involved the use of a checklist (appendix 3) to facilitate the discussion. Focus groups were comprised of men and women, elders, middle aged, youth and village government leaders. Ten participants in each village under investigation were

included. The method sought diverse information about the contribution of wetlands in the study area. The information discussed included; types of food crops grown in wetlands, wetland accessibility, factors affecting wetland crop production, crop calendar for crops grown or cultivated in wetland against those in non-wetland and types of food crops grown in the wetlands and non-wetlands. Others were common period of food shortage as well as food availability, general characteristics of well-to-do households in the area in terms of source of income, food, occupation, general characteristics of poor households and threats to wetland in the area.

3.6 Data Analysis

3.6.1 Content analysis

The PRA data such as participant observation was analysed by content analysis. In this regard, the recorded dialogues were broken down into meaningful themes and inferences were made. Data from focus group discussions and key informants were analysed with assistance of people in the field. The focus group discussion and key informants data were presented in deceptive form.

3.6.2 Questionnaire data

Data from the questionnaire survey were verified, compiled, coded, summarized and analyzed using Statistical Package for Social Sciences (SPSS) computer program. Descriptive statistics such as mean, percentages and frequencies were done for quantitative information. The t-test was carried out in order to compare both mean values of household cash income and amounts of foods obtained from wetland and non-wetland produces. The comparison provided a way for evaluating whether the difference between

two means was statistically significant. Moreover, a correlation test was used to test the socio-economic factors that influenced farmer’s accessibility to wetland resources.

CHAPTER FOUR

4.0 RESULTS AND DISSCUSSION

This chapter includes socio-economic characteristics of the sampled respondents and contributions of wetland, non-wetland agriculture produce and off-farm activities to total household cash income. Others are contributions of wetland products to household food security, alleviation of food shortage in the households by wetland produces and socio-economic factors influencing peoples' accessibility to wetland resources.

4.1 Socio-economic Characteristics of the Sampled Respondents

The main socio-economic characteristics that were taken into consideration were age, education, marital status, main occupation, household size, wetland farm size and duration of residence. Results are presented in Table 2.

4.1.1 Age

Majority (50.0%) of the respondents were in the age group of 30-45 years, followed by the age group of between 46 and 60 years (29.5%). The domination of the 30-45 years age category indicates that the community comprised of higher percentages of energetic people who can contribute to household income and food production. A study conducted by Yanda *et al*. (2005) in Singida reported that 70% of the respondents were in the age between 31-50 years, which reflected energetic people with full engagement in socio-economic activities. In addition, age affects experience, wealth, and decision-making, all of which contribute to income and food security. The respondents aged over 60 years rarely participate in production activities especially in agriculture probably because they are considered as economically not active (Ishengoma, 1998).

Table 2: Distribution of respondents according to their socio-economic characteristics at Komtonga, Digoma and Dihinda villages in Turiani division (n=112)

Attributes	Alternatives	Frequency	Percentage
Age	Below 30 years	14	12.5
	Between 30 and 45 years	56	50.0
	Between 46 and 60 years	24	29.5
	Over 60 years	9	8.0
Education	Non formal education	13	11.6
	Primary school education	97	86.6
	Secondary school education	2	1.8
Marital status	Single	3	2.7
	Married	94	83.9
	Separated	3	2.7
	Widowed	5	4.5
	Divorced	7	6.3
Main occupation	Trading	2	1.8
	Formal employment	1	0.9
	Crop farming only	99	88.4
	Crop farming and livestock only	10	8.9
Household size	1-3 people in the household	24	21.4
	4-6 people in the household	55	49.1
	≥7 people in the household	33	29.5
Wetland farm size	< 1hectare	76	67.9
	≥ 1 hectares	36	32.1
Residence duration	< 10 years of residence	11	9.8
	10-30 years of residence	35	31.3
	≥30 years of residence	66	58.9

4.1.2 Education levels

Results in Table 2 indicate that large percentages of the respondents (86.6%) have attended primary school education and only a small percentage (1.8%) had attended secondary school education. There were also respondents who had not gone to school (11.6%). Many studies have revealed that educated heads of households are likely to use production information more efficiently and therefore improve their incomes and food security (Phillips, 1994; Wang *et al*., 1996; World Bank, 1996 and Yang, 1997). Mbwilo

(2002) reported that actions and attitudes concerning use of available natural resources reflect the level of education. People go to school to enhance their income and food producing abilities and to develop understanding and appreciation of how the physical world and human societies operate. Kajembe and Luoga (1996) pointed out that education tends to create awareness, positive attitudes, values and motivation. Education tends to stimulate self-confidence and self-reliance. Therefore, if all other factors are constant, the level of education would contribute positively to household income and food security since farmers may use the acquired education on working in the wetlands.

4.1.3 Marital status

Results in Table 2 show that many of the respondents (83.9%) in the study area were married people, only few of them were single (2.7%), separated (2.7%), and widowed (4.5%). This is an indication of the African belief that four hands can produce better than two hands (Zinjama, 1986). Married couples are likely to be more productive than single persons due to labour supply, hence household wellbeing (Muywanga, 2004).

4.1.4 Main occupation

The main occupation of the respondents was farming and livestock keeping (Table 2). The majority were doing crop farming (88.4%) followed by livestock keeping together with crop cultivation (8.9%). Only 1.8% of the respondents were traders and 0.9% had formal employment. Similar findings were reported by Makwaia (2003) in Arusha region whereby the main occupation of the majority of the respondents (63%) were crop farmers. The major food crops that were observed in the current study area were rice, maize, cassava, yams, banana, sweet potatoes, and vegetables (such as cabbage and *mchicha*) and fruits. Cash crops mainly sugar cane was also observed in relatively large farms. Other

cash crops included cardamon, sorghum and finger millet. The main livestock kept were cattle, goats, and sheep. Interviews and participant observations revealed that crop production was supplemented by other small businesses including selling of agricultural produces (such as maize, rice, yams, sweet potatoes and vegetables) and non-agricultural activities including running small shops, bicycle repair, tailoring, shoe repair and to a lesser extent formal employment.

4.1.5 Household size

The results in Table 2 indicate that 49.1% of the households had an average of 4-6 persons, followed by the category of above seven persons (29.5%). The average size for the study area was 5.3 individuals, which is slightly larger than the national average of five people reported by NBS (2002) and URT (2003). Family size is an important factor for determining the extent to which labour is available in food production and income. Yanda *et al*. (2005) reported that wetland productivity is based on available labour. One of the limiting factors in rural productivity is lack of labour force. Hence, family size is important for household income and food security. However, Lorri and Kavishe (1990) argue that big family size is one of the factors contributing to food insecurity in Tanzania.

4.1.6 Wetland farm sizes

Results from Table 2 show that majority of the households interviewed (67.9%) owned less than one hectare (2.5 acres) of wetland farm and only few (32.1%) owned more than one hectare. The mean of wetland farm size was calculated to be 1.03 ha (2.6 acres). However, the majority still depended on wetland farm plots for earning their living because of its fertility and the ability to produce more yields hence more income and food in comparison with dry lands. In a survey conducted by Yanda *et al*. (2005) in Singida,

households owned average land of 6.94 acres but used much of their time in rice production because they were sure of high yields due to the fertility of soils and water availability. Makundi (1996) asserted that households having adequate land area for cultivation are in a better position with regard to food security and income.

During focus group discussions, the group members had the opinion that one hectare of wetland farm could produce up to 20 000 kilogram of rice. This preposition is supported by a report issued by TARP II-SUA (2002) which indicated that one hectare of wetland farm produced up to 35 000 kilogram of rice in Usangu in Mbeya region.

4.1.7 Residence duration

About 58.9% of the respondents had stayed in the villages for a period of more than 30 years, whereas 31.3% have stayed for 10 to 30 years and 9.8% for less than 10 years (Table 2). The implication is that having stayed in a village for long time, the respondent could have gained enough knowledge and experience of the wetland activities. Makawia (2003) noted that age and experience of an individual may play an important role in indigenous knowledge and practices. Long stayed farmers are probably more knowledgeable and experienced in issues relating to weather conditions, type of wetland crops, crop calendar and market situations. All of this information (knowledge) are important for crop production and productivity.

4.2 Contribution of Wetland Products to Total Household Cash Income

The contributions of wetland, non-wetland products and off-farm activities to the total household cash income are broad, but with reference to this study, the results are based on those products that earn direct revenue to the household and which are possible to estimate

their values based on market prices. People in the study area were engaged in various activities in order to earn income to sustain their households. The activities included those done in wetland as well as in the non-wetland (uplands). They included crop farming (98.2%), livestock keeping (25.7%), vegetable production (75.9%) and fishing (3.4%) (Table 4). Similar situation has also been reported in Barotse floodplains in Zambia where the population depended on wetland crop farming, livestock keeping, fishing and natural resource exploitation (IUCN, 2003).

Table 3 presents the results of mean income comparisons of wetland and non-wetland. The results indicate that mean incomes per household per year earned from crop and vegetable productions in wetlands were higher than those from non-wetland. T-test analyses show that the differences were statistically significant at $P \leq 0.001$. These results imply that wetland contribution to household cash income was superior to non-wetland. Possible reason attributing to such a difference could be explained by the fact that most respondents invest more in wetlands than non-wetland areas since wetlands are more fertile and the availability of water is more reliable. This proposition is in concurrent with the study carried out in Sri Lanka by Nagabhatla *et al*. (2006) which indicated that farmers prefer to use wetlands due to fertile agricultural land and ability to control the water (moisture). Another study conducted by Yanda *et al*. (2005) in Singida reported similar reason that farmers utilize wetlands for rice cultivation because of high yields and high soil fertility, which in turn contributed substantially to household cash income. Findings reported by Morandet and Tchamba (2000) indicated that average annual household income from wetland crops in Limpopo river basin (Zambia) was as high as $ 1000 making up to 90% of the total household income. Brouwer (2002) reported similar findings from Niger wetlands.

Table 3: Comparisons of average total cash income earned from wetland and non-wetland agricultural products at Komtonga, Digoma and Dihinda villages in Turiani division

Attribute	Mean values in TShs		Test statistics	
	Wetland	Non-wetland	t-value	Significance
Crops	730 514.67	14 692.73	4.428	0.000***
Livestock	11 290.91	40 500.00	3.683	0.004 **
Vegetables	42 359.50	5 286.76	3.575	0.001***
Fish	26 857.14		-	

Key:

*** = Significant at P≤0.001, ** P≤0.01

Table 4: Wetland and Non-wetland agricultural activities at Komtoga, Digoma and Dihinda villages in Turiani division

Activity*	Frequency	Percentage
Crop farming	111	98.2
Vegetable production	66	75.9
Livestock keeping	9	25.7
Fishing	3	3.4

*Multiple responses

Only the mean income per household from livestock production in non-wetland was higher than that of wetland (Table 3), which was statistically significant at P≤0.01. This was attributed by the fact that much of the wetland in the study area is used mainly for crop cultivation whereby livestock are grazed in upland areas to avoid conflicts with crop farmers. These findings appear to disagree with those of Mironga (2005) in Kisii wetlands (Kenya) who noted that livestock incomes from wetlands were higher (Ksh 70 000) than those from non-wetlands (Ksh 30 000).

Figure 3 indicates that wetland products contributed the highest (69%) to the total household cash income followed by off-farm activities (18%) and non-wetland (13%). The reason is that wetlands inherently have higher productivity because of the presence of fertile soils hence higher returns than non-wetland areas (dry land). Mironga (2005) and

Nagabhala *et al.* (2006) reported that the importance of wetlands lies mainly in their remarkably higher productivity in relation to most non-wetland areas. Majule and Mwalyosi (2005) pointed out that declining soil fertility in dry lands was one of the factors for expanding farming in valley bottoms.

Off-farm activities carried out in the study area included petty trading, employment, casual labouring and bicycle repair. Gregoire (2001) argued that households engage in off-farm activities as one way of managing risks through diversification. This is attributed to the fact that off-farm activities are very important for both allowing households to operate at a level beyond immediate subsistence production and provide additional incomes to households.

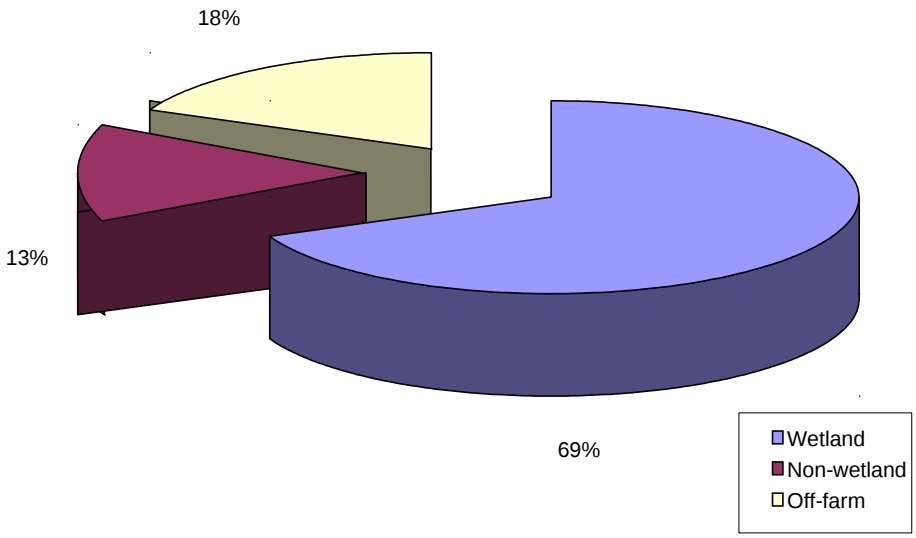

Figure 3: Contribution of wetland, non-wetland agriculture produce and off-farm activities to total household cash income at Komtonga, Digoma and Dihinda villages in Turiani division

Figure 3 also shows that the contribution of non-wetland agriculture activities to total household income was 13%. The possible reason is that in dry land (non-wetland) large capital (inputs) in terms of fertilizers and time are required to be invested so as to realize income while in wetland agricultural activities less capital is required in order to accrue incomes. Observations made by Kurosaki (2007) show that the cultivation of tomatoes in the dry season from wetland provided "*hela ya haraka*" (daily earning) without special capital, in contrast to large sum of money derived from coffee sales which is referred to "*hela ya msimu*" (seasonal earning). The latter demands large capital, which very few farmers can afford. Observations indicated that the main cash crops that generated the household income in the three villages included sugarcane together with other food crops such as rice, maize and vegetables.

4.3 Contribution of Wetland Products to Household Food Security

4.3.1 Types and amounts of foods produced

Most farmers in Mvomero district depend on cereals (maize and rice), legumes (beans and cowpeas), and root and tuber crops (yams, sweet potatoes and cassava). Comparison of mean values of each food category was done for wetland and non-wetland (Table 5). The mean amounts of foods per household per year from wetlands was higher than that of non-wetlands. Cereals and vegetables recorded highest production levels.

Furthermore, the t-test analyses results in Table 5 revealed that mean production levels of root and tuber crops, fruits and vegetables were statistically significant higher in the wetland than non-wetland. There were no significant difference in production of cereals between wetland and non-wetland. These findings are however, inconsistent with those reported by Abort and Hailu (2000), which indicated that 80% of cereals was produced in

wetland areas in Illubabor Ethiopia. It is obvious that wetlands contribute a significant variety of foods as mentioned in Table 5. Nagabhatla *et al.* (2006) asserted that Ruhuma basin in Sri Lanka contributed a greater agricultural productivity and better livelihood for rural people through irrigation.

During focus group discussions, it was reported that wetland crop productivity among others was constrained by water use competition between farmers themselves particularly during September and October when the flow of water from rivers is low due to dryness, water pollution and increasing occurrence of diseases and pests. These findings are in line with those reported by Majule and Mwalyosi (2005) that excessive uses of agrochemicals are the main cause of water pollution in the basin.

Table 5: Comparisons of household average amounts of food from wetland and non-wetland produces at Komtonga, Digoma and Dihinda villages in Turiani division

Type of food	Mean values in kg		Test statistics	
	Wetland	Non-wetland	t-value	Significance
Cereals	1461.72	809.72	1.946	0.054 ns
Root crops	90.09	6.07	3.638	0.000***
Fruits	178.71	35.16	1.991	0.049*
Vegetables	345.84	15.31	2.006	0.047*
Fish	0.84	-		

Key:

*** Significant at = P≤0.001
* Significant at = P≤0.05
ns = Not significant at P≤0.05

Through focus group discussions, it was further observed that fishing in the study area was largely undertaken in March and April when there was enough water in the wetlands. The main rivers whereby small-scale fishing is done include Divue, Msegere, Mbulumi, Mjonga and Mvaji. Although fishing in the study area (Table 5) had low yield, it was

important for providing animal-source protein in the diet contributing to household nutrition well-being and hence food security. Reasons for low yield of fish in Mvomero district are many but the main one include poor equipment used in fishing. These findings are in line with those reported by Kambewa (2005) that fishing in Chilwa basin is mainly done by poor fishing tools such as arrows and spears. Also, Ogutu and Balirwa (2004) reported that poor fishing crafts, inefficient traditional fishing gear and limited markets were some of the major problems facing fishing in Lake Victoria (Uganda).

The main types of fruits that were observed included mangoes, banana, pineapples and watermelon. Mbwambo (2004) noted that fruits contribute significantly to household food and cash economies for many households during seasonal food shortages. It was further observed that, people in the study area depended largely on maize and rice as their main staple foods. Sugar cane is also grown as one of the commercial crops and that the money obtained from sugar cane sales help farmers to purchase food for their households.

4.3.2 Alleviation of food shortage in the households by wetland produce

The aim was to see how long foods from wetland could sustain the households with regard to number of months. The findings are summarized in Table 6. The majority of the households (52.7%) depended on wetland foods throughout year while 17.0% reported to sustain for less than four months. The reason presumably was that farmers harvest wetland products almost throughout the year. The same arguments were given by Kambewa (2005) who reported that harvesting in the Lake Chilwa basin was done all year round with rice as the main crop.

Table 6: Alleviation of food shortages by wetland produces at Komtonga, Digoma and Dihinda villages in Turiani division

Time length category	Frequency	Percent
< 4 months	19	17.0
4 – 8 months	34	30.4
12 months (a year)	59	52.7
Total	112	100.0

During focus group discussions, it was reported that a wetland crop such as rice is cultivated or grown twice or sometimes thrice in a favourable year, unlike in the non-wetland areas where rice is hardly grown. Usually, rice is cultivated in January to February and August to October. Rice varieties grown in the area included hybrids such as "*kilombero*", "*rangi mbili"* and "*super Mbeya*". Other crops like vegetables, yams, and banana are grown and harvested throughout the year and therefore the possibility for alleviating food shortage during the dry season is quite high. It was observed in Digoma village that farmers had much yams sold in the village market, which helped them to get cash to purchase other household requirements. Maize in wetland is mainly cultivated during dry season, which is locally known as "*langata*" meaning dry season. By this time, the wetland is still moist and therefore able to support the growth of maize.

In the focus group discussions, it was reported that fresh maize was often harvested and sold to businessmen to sell them in towns like Morogoro and Dar es Salaam. Maize is harvested between August and September when most families have started running out of food. Majule and Mwalyosi (2005) argued that fresh maize produced from wetlands during dry season are popular items in urban areas particularly in Dar es Salaam. It was also noted that sometimes farmers were restricted by local authorities from selling fresh cob-maize, hence limiting their households' earnings.

During focus group discussions and key informants interviews, months of food shortages were noted to be mostly December, January and February. It is during these months food crops like yams and sweet potatoes are harvested from wetlands, which supplement the household's food basket. These findings concur with Kurosaki (2007) who reported that although the yields from wetlands were not much compared to uplands, the harvest was important because it came at the time of food shortage. Most households in the study area were food secure throughout the year by harvesting wetland products such as fruits and by engaging in wetland agricultural activities like crop cultivation.

4.4 Socio-economic Factors Influencing Peoples' Accessibility to Wetland Resources

Table 7 presents the results of the correlation relationship of selected independent variables and wetland farm size (dependent variable). For the sake of analysis in this study, wetland farm size possessed by a household was taken to be a measure of accessibility to wetland for that particular household. The independent variables included age, household income, household size, years of residence and education level (number of years in school). It was revealed that age of the head of the household and income were significantly correlated positively with the size of the wetland that a household owned or cultivated. Other socio-economic factors such as household size, duration of residence and education level were not significantly correlated with size of land indicating that these variables were probably not influencing the accessibility to wetland resources.

Table 7: Results of correlation tests between household wetland farm size and socio-economic variables at Komtonga, Digoma and Dihinda villages in Turiani division

Variable	Correlation coefficient(r)	Significance
Age of the farmer/head of the household	0.239	0.014*
Household income	0.317	0.001***
Household size	0.180	0.057 ns
Residence duration	0.0236	0.790 ns
Education levels	-0.016	0.873 ns

Key:

*** = Significant at p ≤0.001, * = Significant at p ≤0.05, ns = Not significant

4.4.1 Age

There was a significant positive relationship (Table 7) between age and wetland farm size (r = 0.239). This indicated that the older the farmer, the more access to wetland resources he/she has and vice versa. The reason is that aged people are probably more responsible and committed to family needs as they have to look for more land resources to meet the family needs. These findings concur with that of Makwaia (2003) who reported that age and experience of individual play important role in involvement in various activities for more resources to meet family needs. In addition, Adams (1993) argued that indigenous knowledge accumulates with age, thus aged people know much of the information related to traditional wetland use for food production.

4.4.2 Household income

The correlation coefficient of household income (r = 0.317) showed a positive influence on farmers accessibility to wetland resources at p≤0.001 (Table 7). This implies that when income of a farmer increases, the increase of wetland farm size (acres) is possible and vice versa. The implication is that farmers with high income are more likely to access more land than farmers with low income. Increasing income to farmers increases the farmer's ability to hire and meet costs associated with technology requiring increased demand for

labour or other inputs (Ryoba, 1996) cited by Lugendo (2003). Normally, households with relatively high income are likely to purchase more land and invest in agricultural production. A study of wetland use (access) in Kemise in Ethiopia conducted by Mulugeta (2004) indicated that it is the wealthier farmers who tend to cultivate wetlands rather than the economically less fortunate ones. It was observed that majority of farmers in Turiani who were economically well to do were the ones who owned large (more than one hectare) wetland farms in which they cultivated mainly sugar cane and rice. The cultivation of sugar cane and rice was mainly done for earning cash income. It was further observed that farmers particularly from Kilimanjaro Region had managed to acquire large tracts of wetland farms because of their high incomes, which enabled them to purchase wetland farms from other farmers who had relatively lower incomes.

4.4.3 Household size, residence duration and education level

It was noted that, the correlation relationships (Table 7) between farmer's household size, residence duration and education level with the wetland farm size, were statistically insignificant at $p \leq 0.05$. This observation concur with the study conducted by Terer and Ndiritu (2004) who reported that the *Pokomo* community in Kenya use different traditional systems in cultivating and managing resources that they need for their livelihood. Similarly, Dixon (2007) reported that rural communities in Illubabor, Ethiopia have built up a considerable local knowledge, which was used for wetland cultivation. This indigenous or local knowledge included variations in vegetation, soils, geomorphology and hydrology.

The study expected that education level of the respondent would likely increase the access to wetlands since education level eliminates ignorance and raises awareness on the

importance and benefits of wetlands (Rodgers, 1989; Kinyashi and Argyraki, 2003; Mwakubo *et al*., 2004). However, the study has indicated that education level of the respondent has no relationship with access to wetland resources. Therefore, the actual reason is not clearly established.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

i. The results from this study indicated that the contribution of wetland products to total household cash income was 69% compared with other sources that accounted for only 31%. Households are likely to raise their incomes and produce enough food from wetlands and other related agricultural sectors, if the government would improve infrastructures particularly in building a bridge, which will connect Digoma village with Turiani Division, this will ease the transportation of crops to the market and the supply of farm inputs into this village and its neighbours, consequently encouraging farmers to intensify their agricultural activities.

ii. The main types of foods produced in wetlands in Mvomero district included rice and maize (cereals), rice being dominant cereal, sweet potatoes and yams (root crops), vegetables and fruits. It is urged that introduction of improved seeds or crops varieties could give more yield in the wetlands.

iii. Similarly, the study has shown that the mean amount of foods per household per year from wetlands was higher than that from non-wetlands. Cereals and vegetables recorded the highest (1 461.72 kg and 345.84 kg respectively in wetlands), while in non-wetlands was 809.72 kg for cereals and 15.31 kg for vegetables.

iv. The results revealed that the majority of the households (52.7%) in the study area depended on wetland foods in sustaining their households throughout a year. Households in the study area need to adopt extensively wetland conservation practices such as avoiding misuse of agricultural chemicals, pesticides and insecticides that can endanger the future of wetlands. Formal and local institutions should be fully involved in the conservation of wetlands and catchment areas by making and enforcing rules and regulations that govern environment conservation. This approach will ensure the sustainability of household food security as well as income.

v. The socio-economic factors that influenced farmers' accessibility to wetland resources were age of the farmer and income levels. Farmers with relatively higher incomes had more access to wetland resources than those with lower incomes. Also, age showed positive influence on the accessibility to wetland resources whereby older farmers had more access. Household size, duration of stay in the area and education levels were found to have no influence.

5.2 Recommendations

The following recommendations are made on the basis of the current study:

i. In order to reduce water competition among farmers, it is recommended that local authorities should collaborate with farmers (stakeholders) to establish a fair means of water distribution particularly during the dry seasons (September – October and January - February). This could be facilitated through establishment of water user's association.

ii. To improve food security for both within and outside wetlands, there is a need to adopt an integrated water resource management approach in the catchments. This will ensure a balance between water for agriculture and water for other uses.

iii. In order to mitigate water pollution emanating from intensive use of agrochemicals and increase crop (cereals) productivity in wetlands people should be educated on sound agricultural practices and proper use of wetlands for conservation purposes.

iv. Since the study has shown that wetlands have larger contribution on sustaining rural households in food security, it is recommended that people should be encouraged to invest more in wetlands.

v. Lastly, it is recommended that further studies be conducted to investigate on influence of education and duration of stay in the area on wetland cultivation (access).

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APPENDICES

Appendix 1: Questionnaire for household's survey

These questionnaires for households are aimed at seeking information on the role played by wetland products to household income and food security. The information provided will help to identify some strategies to promote the wise use of wetland products in a sustainable manner. This information is strictly confidential and will only be used for academic purposes.

Division: …….
Ward: ……..
Village …….
Household identification number ……..…

Part A: Background information

1. Name of the head of the household …….
2. Sex ……
3. Age……years
4. Tribe……..
5. Religion ……0.1 Muslim 0.2 Christian 0.3 Traditional 0.4 Other (Specify)
6. Marital status
   - 0.1 Single ( )
   - 0.2 Married ( )
     - i) Polygamous
     - ii) Monogamous
   - 0.3 Separated ( )
   - 0.4 Widowed ( )
   - 0.5 Divorced ( )
   - 0.6 Cohabiting ( )

7 What is your education level? / number of years at school
- 0.1 Non formal education ( )
- 0.2 Adult education only ( )
- 0.3 Primary education
  - i) Completed ( )
  - ii) Attended only few years ( )
- 0.4 Secondary education
  - i) Form IV only ( )
  - ii) Form V1 only ( )
- 0.5 College
  - i) Form IV with Training ( )
  - ii) Form VI with Training ( )
- 0.6 Others (specify) ……..

8. Give the total number of household members……..

Age group (years)	Only Family members		Others in the Household	
	Male	Female	Male	Female
0 – 5				
6 – 18				
19 – 50				
Over 50				

9. What is your main occupation?

1.0 Trading ( )
1.1Formal employment ( )
1.2 Crop farming only ( )
1.3 Livestock keeping only ( )
1.4 Crop farming and livestock keeping ( )
1.5 Combination of the above ( )
1.3 Other (specify)……

10. How long have you lived in this village?.....

11. What is the total size of your farm? (Acres) ……

12. How much of that belongs to the wetland?.....…….

13. How did acquire your wetland farm?

0.1Inherited
0.2 Purchased
0.3 borrowed/hired
0.4 Allocated by Government Village
0.5 Other (Specify)……

14. What is your total household income per annum……..
15. What kind of wetland products based activities are you engaging with? (You can select more than one)

0.1. Crop cultivation
0.2. vegetable farming Yes No
0.3. livestock keeping Yes No
0.4. fishing Yes No
0.5. Brick making Yes No
0.6. fish farming(Aquaculture) Yes No
0.7. Handcraft Yes No
0.8. Thatching and weaving Yes No
0.9. Hunting Yes No
0.10. Lumbering Yes No
0.11 Fruit collection Yes No
0.12 Fuel wood collection Yes No

Part B: Income Situation

16. How much cash money do you earn per month from various activities that you are engaged in?

Activity	**Cash Income**
Wetland activities	
Brick making	
Firewood collection	
Livestock Keeping	
Herbal activities (Traditional Medicine)	
Beekeeping	
Hunting	
Fruits collection	
Fishing	
Thatching grass	
Weaving materials	
Handcraft	
Wetland Crop farming	
Rice	
Maize	
Sugar cane	
Vegetables	
Yams	
Tomatoes	
Others (Specify	
Non-Wetland activities	
Stone Crushing	
Business	
Employed	
Non-wetland crop farming	
Rice	
Maize	
Sugar cane	
Vegetables	
Yams	
Tomatoes	
Others (Specify	
Total	

17. What are other sources of income apart from wetland products based activities?

0.1 Employed ( )
0.2 Engage in casual labour ( )
0.3 Remittances from relatives ( )
0.4 Businesses ( )
0.5 Stone Crushing ( )
0.6 Other (Specify)……

18. When do you normally earn from these?/ other sources of income (Please indicate the months of the year for each)

Activity	Time of the year
Brick making	
Casual labour	
Business Remittances from relatives Other (Specify……..	

19. What are the main sources of income in your household?

0.1 From wetland farm produce ( )
0.2 Remittance from relatives ( )
0.3 Salary/wages ( )
0.4 Investment/business ( )
0.5 Credits/microfinance ( )
0.6 Other (Specify…….

Part C: food security situation

20. What foods do you commonly consume in your household?

Foods	**Main Source**	**Wetland or Non-wetland**
Staples Maize Rice Cassava yams **Relishes** Vegetables Fish Meat Beans Game meat Others (Specify)……	0.1 own produce 0.2 purchase from market 0.3 both own produce and purchase 0.4 other (Specify)	

21. What are the types of wetland crops do you produce?

Crops	**Main purpose**	
	Household consumption	Cash
0.1Rice		
0.2 Sugar cane		
0.3 Vegetables		
0.4 Fruits		
0.5 Yams		
0.6 Others (Specify)……		

22. What are the amounts of foods produced? (Fill in the blanks below)

	Common Units		**Amount in Kg**				
Type of food	Wetland	Non-wetland	Wetland	Non-wetland	Total	Unit price	Cash value
Rice							
Fish							
Cassava							
Sweet potatoes							
Vegetables:							
Spinach							
Mchicha							
Cabbage							
Chinese							
Others							
Beans							
Fruits							
Maize							
Tomatoes							
Pumkins							
Onions							
Watermelon							
Cowpeas							
Others (Specify)…….							

23. When do you normally experience food shortage in your Household? (Which months of the year?)……

24. What do you normally do to cope?

Coping Strategy	**Yes**	**No**
Sell assets and buy food		
Support from the Government		
Support from relatives		
Skipping meals		
Borrowing/taking a loan		
Reduce expenditure on non food needs		
Reduce size of the family by sending members to live and work elsewhere.		
Reduce food consumption.		
Changing diet.		
Sell labour		
Eating less preferred food		
Other (Specify)……		

25. How long do you rely on the foods from wetland?

0.1 One month ( )
0.2 Three months ( )
0.3 Six months ( )
0.4 A year ( )

Appendix 2: Checklist- key informants: District Natural Resources Officer/District Planning Officer and District Agricultural Officer

1. Name: ……..…….Date…….
2. District……

3What are the common wetland foods do people eat? (Mention them)

iii) ……
iv) …….
v) …….
vi) …….

6. What is the main wetland food products used in this area?

vii) …….
viii) …….
ix) …….

7. What are the general characteristics of well-to-do households in this area? In terms of:

0.1 Sources of income ( )
0.2 Food ( )
0.3 Occupation ( )
0.4 Ethnicity ( )
0.5 Ownership of wetland plots…..

8. What are the characteristics of poor households?.....
9. What is the total annual average income per household?.....……
10.Can people afford enough food for every meal? ……..
11.Have you experienced shortage of food in this area……..
12.If yes, what are the coping strategies used by people?.....
13How often do they use wetland products?.....
14.Are these wetlands valued by people of this area?

0.1 Yes ( )
0.1 No ( )

15. What are your opinions.....
16. What is the average size of Wetland a household can possess in terms of acres or number of plots?.....

17. Please indicate the common wetlands products found in the District?
……..

18. Are these wetlands reserved or open access?
1. Reserved
2. Open access

19. What are the main wetland products based activities people engage with?

0.1 Fishing ( )
0.2 Crop Cultivation ( )
0.3 Hunting ( )
0.4 Animal keeping ( )
0.5 Lumbering ( )
0.6 Other specify …….

20. What other activities people engage with apart from wetland products based activities?

0.1 businesses ( )
0.2 employed ( )
0. other specify……

25. What are threats to wetland in this area…….

Appendix 3: Checklist: Focus Group Discussion

A: 1. Are all members of communities (households) accessible to wetland resources?

0.1 Yes
0.2 No

2. If no, what are the reasons?
0.1 Inheritance/land tenure
0.2 healthy risks
0.3 limited wetland for farming
0.4 Other occupations
0.5 Other (Specify)……..

3. What are the factors affecting wetland crop productivity?
0.1 Lack of capital
0.2 lack of appropriate water management
0.3 Water logging
0.4 Prolonged drought
0.5 other (specify)……

4. What are the types of food crops grown in the wetlands?……..

B: 5. Crops Calendar for crops grown in wetland against those in non wetland crops (please indicate months in the table below, use tick √ where relevant)

Months	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Wetland crops												
1.Rice												
2.Sugarcane												
3.Coconut												
4.Yams												
5. vegetables												
6.Banana												
7.maize												
8. Other (Specify)												
Non wetland crops												
1.Maize												
2.Cassava												
3.Beans												
4.Other (Specify)												

6. Food availability Calendar in the year; please identify the most common period (months) of food shortage, use tick √ where appropriate.

Month	J	F	M	A	M	J	J	A	S	O	N	D
Check (√)												

7. What are the general characteristics of well-to- do households in this area?

Criteria	**Characteristics**
1.Source of Income 2.Food 3. Occupation 4.Ethinicity 5.Ownership of wetland plots/acres 6. Other (specify)……	

8. What are the general characteristics of poor Households?.....