THE ROLE OF BAHI SWAMP WETLAND IN ENHANCING HOUSEHOLD FOOD SECURITY AND INCOME OF ADJACENT COMMUNITIES

BY

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ABSTRACT

The study was conducted to assess the role of Bahi swamp resources in enhancing household food security and income of adjacent communities. Specifically, the study assessed the socioeconomic activities in the swamp with a potential contribution to local livelihoods, the contribution of the swamp in enhancing household food security and income and the level of local dependence on the swamp. Two villages (Makulu and Nagulo-Bahi) were involved. Data were collected through questionnaire, PRA techniques (resource mapping, key informant interviews and focused group discussions) and direct observation. Data were summarized and analysed using Microsoft Excel, SPSS and content analysis. Other data from discussions were analysed through relative ranking. The socioeconomic activities with potential contribution to food security and income of adjacent communities in order of importance included crop cultivation, fishing, livestock grazing and collection of thatching grasses. Cultivation of paddy rice contributed significantly to household food security generating 65.4% of total household food crop production compared to other crops grown in drier areas adjacent to the swamp. Fishing played a substantial contribution to household food security through household consumption of 10% of fish caught. For household income, sales of paddy rice from the swamp contributed 59.6% while fish sales contributed 36% of the total annual household income. Multiplier activities emerging during fishing season facilitate income to a wider group of communities. On average, 56.2% of the population depend on the swamp for daily socio-economic activities associated with generation of household food and income. The Bahi swamp and related products play a significant role in

enhancing local livelihoods for the adjacent communities. Planning for wise use of the swamp in respect of the dominant socioeconomic activities will likely improve its contribution to livelihoods.

DECLARATION

I, RENATUS RWEYEMAMU do hereby declare to the Senate of Sokoine University of Agriculture that, this dissertation is my own original work and that it has neither been submitted nor concurrently being submitted for a degree award in any other University

22/11/2010

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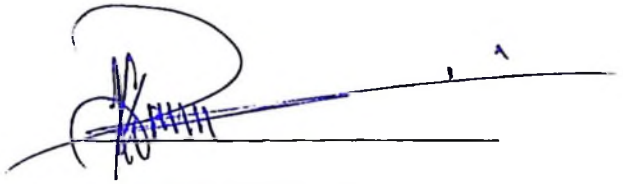
The above declaration is confirmed by



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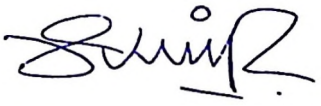

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DEDICATION

This work is dedicated to my beloved parents, Mr. Leonidas Rweyemamu and Mrs. Anna Rweyemamu who in their love initiated and inspired me to pursue my studies. To my young brother Erasmus, young sisters Angela and Agnether who remain my richest source of morale. I dedicate also to my friend Angelina Shonza for her love and encouragement during the entire time of the study.

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LIST OF SYMBOLS AND ACRONYMS

FAO	-	Food and Agriculture Organization
FGDs	-	Focused Group Discussions
IRA	-	Institute of Resource Assessment
IWMI	-	International Wetlands Management Institute
n	-	Number of respondents/interviewee
P	-	Probability level
PRA	-	Participatory Rural Appraisal
r	-	Bivariate Correlation coefficient
SPSS	-	Statistical Package for Social Science
SUA	-	Sokoine University of Agriculture
TShs	-	Tanzanian Shillings
UN	-	United Nations
US$	-	United States of American Dollar
VEOs	-	Village Executive Officers
WB	-	World Bank
ρ	-	Spearman *rho* bivariate correlation coefficient

Currency conversion

1 US Dollar = Tshs 1300

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

A wetland may be defined as an area of land in which soil is saturated with moisture either permanently or seasonally. Such areas can also be covered partially or completely by shallow pools of water. Wetlands include swamps, marshes, and bogs, among others (PBS, 2009). The presence of abundant water causes the formation of hydric soils and favours the dominance of either hydrophytic or water tolerant plants. Wetlands, particularly, tropical wetlands are of great importance to many people who live adjacent to them.

Generally, wetlands in semiarid regions support its community through three major activities: flood plain agriculture, dry season grazing and extraction of some tree products (Zoungrana and Temu, 1996). The main activities in the wetland, which supplement community livelihood, include fishing, crop production, livestock keeping, harvesting of wetland resources and trading (Kibwage *et al.*, in press). In many parts of the world particularly in developing countries, wetlands are vital resources for improving livelihoods through achieving food and water security (DFID, 2007). Wetlands provide opportunity for agricultural intensification through irrigation and livestock production. Wetland soils favour crop growing due to presence of long lasting soil moisture. Also, green pastures and water for livestock can only be obtained in wetlands during the dry season (Yanda *et al.*, 2006).

Food security is an access for all at all times to a level of food sufficiency for an active and healthy life (FAO. 2005). Food insecurity, is one of the main problems in Tanzania rural population, and about 27% of the people are food insecure (FAO. 1989). People depending on agriculture for their livelihood utilize wetlands to cope with problems of droughts and unreliable rainfall, a characteristic of the arid and semi-arid areas. As a reservoir of moisture during dry periods, wetlands are also attractive agricultural resources and many used in the past, although on a small, informal scale, to cultivate maize much earlier in the season than on the uplands (Wood, 1996). Floodplain agriculture is the most economically important use of floodplain wetlands because it supports a continuous cropping in both wet and dry seasons.

Livelihood activities in floodplain wetlands such as livestock grazing and fishing are largely integrated with surrounding activities, thereby, resulting in diversification of incomes for the rural communities, who mostly depend on natural resources for their livelihoods. Wetlands have been used in the high value crop production, sources of fodder for livestock, water for domestic purposes and many other uses (Shemdoe *et al.*, 2007). Bahi area in Dodoma supports much crop production, particularly rice. In the late 1980s, International Fund for Agricultural Development (IFAD) funded a smallholders' rain-fed irrigation project, which was established in the Bahi area by introducing the large bunds system. This bund system contributed significantly to improvement in the production of rice in wetlands (Assenga, 2001). However, rainfall unreliability remained a major problem leading to drought that affects productivity. In some areas, crop

moisture stress in the bunds has been reported, leading to low yields (Assenga, 2001). The wetlands of Bahi swamp are also famous for the production of fish, which is a major source of nutrients and income to the people. The contribution of rice production and fisheries to household livelihoods is an issue to be known and established.

1.2 Problem Statement and Justification

The semi-arid regions of Tanzania experience unreliable and low rainfall resulting in low and unpredictable production of both crops and livestock. In many instances, wetlands are key coping strategies during times of drought. Most peasants use wetlands to cope with this risk, and tend to establish their settlements around the wetlands. Minimal scientific research has focused on wetland ecosystems, (especially swamps), in spite of their increasing role in supporting livelihoods (Thenya, 2006). Generally, wetlands located in semi-arid regions support surrounding communities by enhancing flood plain agriculture, fishing, providing the dry season grazing and allowing extraction of some tree products.

Fisheries are an important source of income and proteins in the Tanzania. Many people near the shores practice a lot of fishing (Bogers, 2007). However, the contribution of the wetland fisheries to household economies is not well documented as it is characterized by seasonal variability and is mostly at the subsistence level: many people harvest fish from permanent or seasonal pools or from the littoral wetlands shortly after the floods. Catches are rarely recorded and do not appear in official catch statistics.

Due to presence of water during the dry season, combined with their natural fertility and irrigation potential, wetlands have been mostly utilised by communities around. Bahi swamp, situated in the driest parts of Tanzania is one of such wetlands. Several households to sustain their livelihoods utilize it. Communities adjacent to the swamp conduct activities such as agriculture, fishing and livestock grazing. However, the extent of contribution of this swamp to household food security and income and level of dependence by the households on it has not been established.

This study seeks to address and fill this knowledge gap. It looks at various interacting activities associated with the wetland including agriculture, livestock keeping, fishing, trading and use of other wetland related products. The information obtained is expected to inspire different stakeholders and the society's interest to devote more efforts in conservation and protection of the wetlands.

1.3 Objectives

1.3.1 Overall objective

The overall objective was to assess the role of Bahi swamp, Tanzania, in enhancing household food security and income of adjacent communities.

1.3.2 Specific objectives

The specific objectives were to

(i) assess the economic activities conducted in the swamp with a potential to contribute to household food security and income

(ii) assess the extent of contribution of the swamp to household food security and income

(iii) assess the level of dependence of adjacent communities on the swamp

1.4 Research Questions

1. Which activities are of socio-economic significance to local communities?
2. To what extent do economic activities conducted in Bahi swamp contribute to household food security and income?
3. How much do the swamp products contribute to household income and/or food security and when are they available?
4. How and to what extent do households depend on the swamp for their livelihoods?

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Importance of Wetlands

Worldwide, wetlands are important for their ecological functions, which they perform, as well as for their rich flora and fauna (Kingsford, 1997). They also constitute great economic, cultural, scientific and recreational values to human life. Important ecological services derived from aquatic ecosystems include provision of habitat and nutrients for species, protection of adjacen0t lands from erosion, siltation, storm damages, floods and droughts; nutrient cycling; tourism and recreational value; carbon sinks and gas regulation. A global study has indicated that about 83 percent of the global values of ecosystem services come from marine waters, wetlands and lakes/rivers (Costanza *et al.*, 1997). Different groups of people interact with wetlands in different ways to gain diverse benefits. Overall, majority of rural and urban people, benefit directly and/or indirectly from wetlands and their products. Generally, wetland areas of semi-arid regions support surrounding communities through enhancing flood plain agriculture, providing dry season grazing and allowing extraction of some tree products.

Wetland goods and services satisfy various objectives of different users: food security and cash income (picking, fishing, hunting and agricultural production), health (drinking water, hygiene and others), recreation and culture (spiritual enrichment, cognitive development and aesthetic experience (McCartney *et al.*, 2004). Crop production, livestock husbandry, fishing, construction materials, wildlife habitat and sources of

water for irrigation and domestic use are among the general livelihood options wetlands offer.

In Cambodia, households living within the Stung Treng Ramsar Site depend for their food security and income on a varying combination of four main activities: rice cultivation, cultivation of other crops, fishing and collection of other products from the site (Allen *et al.*, 2008). The Tigris and Euphrates river basins shared by Turkey, Iraq, Syria, Iran and Jordan is of particular concern for the biologically rich wetlands as it covers Mesopotamian marshlands in Iraq, that host a myriad of important species. The Yangtze Basin in China is a rich centre for biodiversity, both terrestrial and freshwater, with about 322 species of fish and 169 species of amphibians (WRI *et al.*, 2003). The Colorado River in USA supports some agriculture but is better known for supplying water to major urban centres in Arizona and California (Channell, 1999b). The Tigris and Euphrates basin had been occupied by people for millennia and is part of the "Fertile Crescent" with its early irrigation and urban developments (Dregne, 1999b). Small-scale rainfall harvesting in deserts has been adapted to specific types of terrain, climate conditions and choice of crops (Lövenstein, 1994). Wetlands are essential throughout the tropics and Africa in particular (Bacon, 1996). Rural populations have traditionally relied on wetlands for portable water, fish, construction materials and seasonal grazing of livestock (Crissman and Streever, 1996).

The swamps and lakes of the African continent are critical for sustaining human populations. River Nile is important due to the annual flooding and deposit of nutrient-rich silts on alluvial soils as well as prevention of salt accumulations (Dregne, 1999a). Approximately about 160 million people depend on the Nile River for livelihood and about 300 million people live within the ten countries that share and depend on the Nile waters (Kameri-Mbote, 2005). The diversity of resources also explains why Lake Victoria and its catchments support over 30 million people (Bugenyi, 2001).The Hadejia-Jama'are wetlands provide a significant floodplain fishery: 4000 - 5000 tonnes per year. The Inner Niger Delta south of Timbuktoo provides support for fishing, grazing and flood recession agriculture (Kingsford, 1997).

Biodiversity and tourism

Wetlands are an important resource for a stable environment and the socio-economic development of people who have access to them. In West Africa, the floodplains of Senegal, Niger and Chad basins support over a million waterfowl, many of them migratory throughout the year (Monval *et al.*, 1987). In Uganda, at least 35 species of wetland plants are used in widely practiced traditional medicine and a collaborative relationship is developing with medical institutions for both research and utilization (Chapman *et al.*, 2001). Empirical evidence shows that some wetlands can produce up to eight times as much plant matter as an average wheat field (Maltby, 1986).

Richness of biodiversity in wetlands influences existence of various animal and plant species, some of them attractive to render the areas important tourist destinations. Potential tourist activities around most wetlands include sport fishing, bird watching and boating. The tourism potential of these areas generates revenue through charging the tourists visiting the wetland. Moreover, animals congregate close to the rivers and ponds during dry season. The most famous and one of the most important phenomenons of the Mara-Serengeti ecosystem is the herbivore migration. This migration brings large groups of herbivores in search of water and pasture to the Mara River during the dry season. These ecological changes could have an impact on the tourist arrivals and thus employment and foreign revenues in Kenya and Tanzania (Bogers, 2007). In the dry periods, the Mara River and some water pools are the only water sources in the area for domestic use and wildlife. Since this is happening during dry season, the knock-off effect could be great in associated activities such as tourism and related income generation activities.

Wetlands such as Lutembe and Mabamba in Uganda have potential for ecotourism because of their avifauna (Byaruhanga *et al.*, 2001). Elsewhere, in Murchison Falls National Park, Uganda it was demonstrated that a significant number of tourists visiting the park were interested in water birds especially the shoebills. Since the shoebills is one of the species that occurs in Mabamba (Byaruhanga *et al.*, 2001) it could form the basis of eco-tourism activities. Moreover, Sango Bay wetland is endowed with diverse and unique natural and cultural resources that are suitable for ecotourism development and

promotion. It ranks 3rd and 4th in mammal and bird species respectively when compared with Uganda's ten National Parks (Bakamwesiga, 1999).

The abundance of wildlife and biodiversity in lake Manyara basin, in Tanzania is promoting tourism development activities including hotels, tented camps, trading centers, and vegetable production (Ngana *et al.*, 2003). All these activities are dependent on water resources that are available in the basin. In Mara River, near and inside the Serengeti National Park water availability attracts animals to congregate in the area thus alarming people depending on this wildlife park for tourism related incomes (Bogers, 2007).

2.2 The Role of Wetlands in Enhancing Household Food Security and Income

2.2.1 Wetlands and food security

The definition of food security was coined by the Governments at the 1996 World Food Summit (WFS) of 1996 held in Roma, Italy. It was agreed that food security exist 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 life (FAO, 2005). The driest parts of the world are exposed to erratic rainfall and shortage of water. Such a situation exposes peasants and livestock keepers at a risk, thus food insecurity (Yanda *et al.*, 2006). Seasonal wetlands (locally called *dambos* in southern Africa) make an appreciable contribution to food security need of many rural households (Masiyandima *et al.*, 2004; McCartney and van Koppen, 2004).

The central lowlands of Tanzania receive below 500 mm of rainfall per annum. This makes rain-fed agriculture difficult due to soil water stress. Darkoh (1987) classified areas with rainfall ranging between 600 and 800 mm as semi-arid. The problem associated with this situation of limited rainfall is severe drought in such areas. For example, in Dodoma which is a semi-arid region, drought contribute to nearly 70% of all occurring famines (Ngana, 1983). In arid and semi-arid areas, wetlands enable a wider range of crops than dry-lands, and therefore, provide a variety of dietary and nutrients that are otherwise unavailable in the traditional crops grown in the uplands (Masiyandima *et al.*, 2004).

Agriculture

Agriculture has been important to people in deserts since domestication of crops began. Rain-fed agriculture is less important in deserts than in higher rainfall areas because of the scarcity and unpredictability of rain. Alternative systems began as attempts to reduce risks imposed by rainfall variation. Irrigated agriculture has evolved in different ways in different places based on different situations and crops available. Large perennial rivers running through deserts, for example, the Nile, Tigris-Euphrates, Rio Grande and Colorado rivers, have supported communities and their irrigation for a long time (Dregne, 1999b). In several parts of East Africa wetland cultivation is now a common response to land and food shortage (Olindo, 1992; Denny and Turyatunga, 1992). Cultivation of the wetlands has become increasingly common during this century. In the

1990s, approximately 25% of the wetland area in the Illubabor zone, south-west Ethiopia was cultivated (Afework, 1998).

The dependence of the majority of farmers in Sudan on rain-fed agriculture and pastures has made the economy extremely vulnerable to weather variations. As a result, failure of rains and occurrence of drought during any growing seasons lead to severe food shortages/loss of animals (El Moula, 2008). The presence of river Nile has helped farmers across the country to use irrigation for crops production. According to FAO (2008), irrigated agriculture has become more important over the past few decades because of drought, rainfall variability and uncertainty.

The Gezira Scheme is Sudan's oldest and largest gravity irrigation system, located between the Blue Nile and the White Nile. It receives water from the Sennar Dam on the Blue Nile and is divided into some 114 000 tenancies. It has also contributed to national food security and in generating a livelihood for about 2.7 million people who now live in the command area of the scheme (FAO, 2008). Wetlands offer a wide range of livelihood options to communities in the surrounding dry lands (Ngana, 1983). The central areas of Tanzania are endowed with a number of seasonal wetlands, which have potential for agricultural development (Assenga, 2001).

Fingerponds

Fingerponds are integrated fish and crop production systems. It is an innovative, semi-intensive technology aimed at enhancing wetland products based on the wetland's natural functions (Denny, 1989). Fingerponds may be regarded as enhancement of the traditional fishery whereby local knowledge on the flood pool fishery is developed to meet the increased demand for fish proteins from the villages adjacent to natural wetlands (COFAD, 2002). They are earth ponds excavated in the fringe wetlands during the dry season: the excavated soil is spread around the ponds to create raised-bed gardens for vegetable production. The ponds resemble the natural flood pools traditionally used for wetland fish capture by local communities while the gardens are a continuation of the existing seasonal swamp margin vegetable patches. They are called "Fingerponds" because, from a bird's eye view, several of these narrow channel-like ponds appear like "fingers" penetrating the emergent macrophyte zone (Kipkemboi, 2006). The fish are trapped in the ponds during flood recession and manure and vegetable wastes from the adjacent village are used to improve pond productivity.

The advantage of this system is that it enhances diversity of produce as well as synergy between different components of the farming system. Pond water may be used to irrigate the gardens while the sludge from the pond bottom is removed during the dry season and spread over the raised beds as a fertilizer. The excess vegetables from the adjacent gardens can be chopped and used as fish food or composted and applied as green manure. However, the system is unique in that water is not regulated, relying on natural

flooding of the wetland during the rainy season to supply water and stock the ponds with fish (Kipkemboi, 2006).

Livestock farming

As dependence on moisture in wetland soils for crop growing becomes an important element of food security and household income, green pastures and water for livestock can be obtained in wetlands during the dry season thus contributing to food security. Grove (1985) reported that wetlands such as the delta of Senegal river, the Niger inland delta in Mali or Lake Chad do not only provide for rain-fed crop cultivation but extensive grasslands for relatively nutritious grazing for livestock. It is only in these areas that agriculture can continue into the dry season. Livestock farming is one of the agricultural activities that contribute significantly to the economy and livelihood of the people in semi-arid central parts of Tanzania. Wetlands therefore are major sources of water and pasture for livestock.

Fisheries

Fish provide the main source of animal protein to about one billion people globally and in coastal areas the dependence on fish is usually much higher (FAO, 2003). Inland fisheries are particularly important for the food security of poor people, as most inland fish production goes for subsistence or local consumption. Fish is nutritionally important and provides 20% or more of animal proteins to the majority of the population in sub-Sahara Africa (FAO, 2004b).

About 75% of the animal protein intake of the Cambodian households comes from fish intake, and most of it comes from freshwater fisheries (Hap, 1999). Some fish are consumed immediately within households while the surplus may be sold for income. Studies from Bangladesh indicate that the wetland fishery, especially in the floodplains, contributes significantly to the livelihoods of riparian communities (Craig *et al.*, 2004). Rice fields in countries like Cambodia, Malaysia and Thailand can yield between 50 and 300 kilograms per hectare per year (Gregory and Guttman, 2002).

2.2.2 Wetlands and household income

The wetlands contribute immensely to the livelihoods of adjacent households in many parts of the world. In Zambia for example, annual incomes from wetlands can be as high as US$ 1000 per household (90% of the total household income), with high variation across sites and households (Morardet and Koukou-Tchamba, 2004). In Kajiado district, Kenya, wetlands cover only 2% of the district's surface area but contribute up to 40% of the total income derived from local natural resources (GOK, 1996). The Yala Swamp wetland, located along the North-Western shores of Lake Victoria is one of the most extensive freshwater wetlands in Kenya. The wetlands support a large human population that derives its income directly from activities like fishing, hunting, construction material production and agricultural production (Abila, 2005).

Agriculture

Farmers cultivate in the wetlands for two main reasons namely to satisfy household food need and to sale produce for income. Umoh (2008) observed that in Akwa Ibom State, a major wetland farming state in Nigeria, one hectare of wetlands cultivated with rice alone could provide US$ 122 per farmer. In Uganda, wetland agriculture was found to be a significant source of livelihoods for resource poor communities, contributing over 60% of the household income (Kyarisiima *et al.*, 2008).

Fisheries

Fishing is one of the major economic activities in the wetlands. Fisheries in all parts of the world are symbolic of the wetland values associated with them. Fishermen are major stakeholder group which depend on the wetland fishery resources mainly to sustain their livelihoods (Kalpana *et al.*, 2007). Around 38 million people worldwide are employed in fisheries and aquaculture, 95% of them in developing countries. The majority are involved in small-scale fisheries (FAO, 2004). Related industries such as processing and marketing also provide employment for approximately 50 million people. Estimates from West and Central Africa show that the main rivers and floodplains in the region produce an annual fish catch of about 570 000 tonnes and provide employment for about 0.5 million people (Béné, 2005). Migrant fishermen may employ agricultural workers as crew, providing seasonal employment and contributing to village economies. All these involve additional people in income generating activities associated with fisheries, thus enhancing income to people.

Fisheries can provide an important contribution to household cash income. A study in Tanzania found that between 65% and 90% of fish production is sold, compared to only 15% of agricultural production in the same communities (Anderson and Ngazi, 1998). Findings by Sosovele and Mvela (2002) revealed that fishing has boosted the income of local fishermen around Mtera dam, central Tanzania significantly as an average household income from fish can rise up to Tshs 800 000/- per year but might decline during the dry seasons. This cash income gives access to other benefits such as education, health services, clothing, other foodstuffs etc. It also allows investment in other assets or enterprises such as land, livestock or fishing gear, which in turn can further reduce vulnerability to poverty. The small-scale fisheries play a very crucial role in sustaining rural livelihoods in Cambodia, as several millions of Cambodians derive their livelihood and employment from small-scale fishing activities (Hap and Bhattarai, 2006). Around Mtera dam, about 90% of residents depend on fishing activities for their livelihood (Sosovele and Mvela, 2002).

Craft making from wetland resources also provides employment and incomes to a number of residents in the wetlands. For instance, in Katonga wetlands (Uganda), 63% of women were involved in handcrafts. In Sondu-Miriu (Kenya) and Simiyu (Tanzania) wetlands, the most common craft items made using the wetland resources are mats which are made from papyrus by both men and women (Kibwage *et al.*, 2008).

2.2.3 Dependence of households on wetlands

Wetlands and people are ultimately interdependent, with local community livelihoods being highly dependent on local wetlands (Kumar, 2008). Poverty and unreliable terrestrial production have led to increased dependence on natural wetlands for livelihoods (Crissman and Streever, 1996). The dependence on wetland for both cultivated and natural wetland biomass is important to poor and middle class households while the rich family obtains significant non-farm income to meet household demands (Kipkemboi *et al.*, in press). For communities who live around natural wetlands, human life remains interwoven with wetland functions and values, and the dependence on the natural environment for their day-to-day need is inevitable (Kalpana *et al.*, 2007).

Wetlands are useful for agricultural intensification through irrigation and livestock production (Masija, 1992). Dependence on moisture in the wetland soils for crop growing becomes an important element of food security and household income in dry areas of East Africa (Yanda *et al.*, 2006). Also, green pastures and water for livestock can only be obtained in wetlands during the dry season. Therefore, communities in drier areas of Tanzania such as Dodoma and Singida regions depend much on wetlands found in their areas due to erratic climatic conditions which lead to longer dry periods which hinder other livelihood activities such as agriculture, grazing and fishing.

CHAPTER THREE

3.0 MATERIALS AND METHODOLOGY

3.1 Study Area Description

3.1.1 Location

The study was conducted in two villages, Makulu and Nagulo-Bahi that are situated adjacent to Bahi swamp. Bahi swamp is an endorheic wetland found in Bahi district, Dodoma and extends to some parts of Singida region in Tanzania. It lies between latitudes 5°51'S and 6°16'S and between longitudes 34°59'E and 35°19'E (Fig. 1), at an altitude 796 m above sea level (*www.fallingrain.com/world/TZ/Bahi*). It covers over 1500 square kilometres of an area (approximately 125 000 ha) and about 21 villages surround the swamp.

3.1.2 Climate

The area is dominated by long dry spells with cool nights and warm and sunny during the day times. Maximum and minimum temperatures are 27.5°C and 15.5°C, respectively and the rainfall ranges from 350 to 800 mm per annum (WB, 1994) which is normally a short single wet season lasting between December and March. The area has a dry Savannah type of climate characterised by a long dry season lasting between April and November. Areas around the swamp experience frequent drought associated with severe famine in some years (Mboera *et al.*, 2007).

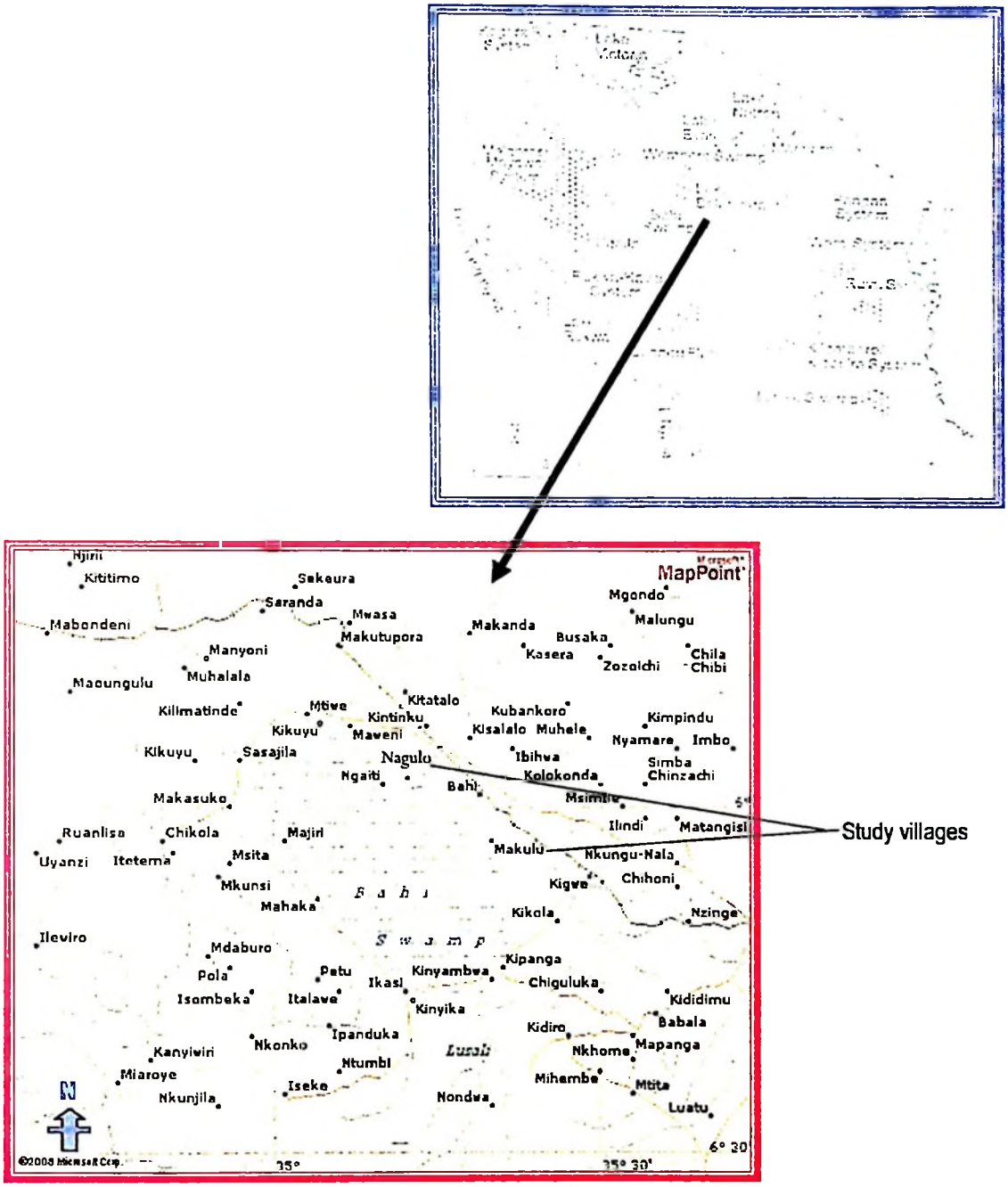

Figure 1: A map showing location of Bahi swamp and adjacent villages

Source: Microsoft Map Point Corporation (2008)

3.1.3 Vegetation

The area is characterized by mosaics of grasslands, wooded grassland and Miombo woodlands. The swamp supports salt-tolerant grasses such as *Sporobolus spicatus*. The major part of the area is covered by open forest, sedges and reeds, and grasses and is a valued grazing ground for livestock during the dry season.

3.1.4 Drainage

Drainage is internal, and because of the intense evaporation, there is much salinization of the surface layers. It is only near to the inflowing rivers (for example, the Bubu and Lusali), that annual floods have the effect of leaching the salt down into the soils and allowing crops to be grown. The swamp is characterised by shallow water tables, which control the degree of saturation of the sites. Water flows into the wetland through underground and direct rainfall (Fig 2).

Figure 2: Flooding of Bahi swamp during rain times along the Dodoma to Dar es Salaam highway (left). Children swimming in the flooded river Bubu in the swamp area (right)

3.1.5 Soil properties

The soils of Bahi swamp are sand-clay loams (vertisols). Because of high clay content. these soils are almost impossible to work during the three-month dry season when they crack deeply. Nevertheless, the soils have high water-holding capacity, sufficient for plant growth for about sixty days after surface water has disappeared (WB, 1994). Because of the high organic content of the soil, the large stored supplies of nutrients, the relatively low susceptibility to erosion, the area is extensively used for growing economically useful crops such as paddy.

3.2 Data Collection Methods

3.2.1 Research design

The cross section research design was used to enable better organization of respondents and time saving. According to Barley (1994), cross section design allows data to be collected at a single point in time without repetition. Participatory Rural Appraisal (PRA) techniques were employed to collect data. The study was carried out in two phases; preliminary and core surveys. Preliminary survey was employed to familiarise to the study area. Key issues like pre-testing of the questionnaire, group discussion, direct observation, resource mapping and relative ranking were done in this phase. The core survey involved questionnaire survey, products market survey and key informants interviews.

3.2.2 Sampling design

A multi-stage sampling was used where both purposive and random samples were drawn from the population in selected villages adjacent to the swamp. The villages were selected in collaboration with the Village Executive Officers (VEO), Village Chairmen and Street Chairmen. Selection of villages was based on accessibility and utilization of the swamp. For household surveys, selection of households was random in which 9% of total households in each village were selected for questionnaire survey, which sufficed a significant population representation. According to Boyd *et al.* (1981). significant population representation is achieved when a random sample of at least 5% is taken for study. The sampling unit of analysis in this study was the household.

3.2.3 Primary data

Participatory rural appraisal

During PRA exercises joint meetings were conducted between the researcher and a sample of ten (10) people, which comprised of Village Natural Resource Committee (VNRC), village leaders and other villagers with extensive knowledge on the swamp. An arbitrary period which could be remembered by participants (historical periods) was used to investigate the trend of utilization of the swamp and livelihood activities. In this study, PRA methods used were direct observation, focus group discussions, preference/relative ranking. In relative ranking people were asked to rank activities done around the swamp and their importance in the ranks of 1 to 5, 1 being the lowest rank and 5 the highest.

Participatory Rural Appraisal (PRA) is an essential process of learning about rural conditions based on intensive, interactive learning and shared knowledge. Duangsa (1996) acknowledges the usefulness of PRA as a flexible technique, which draws on community expertise and involvement to get action-based, timely, cost effective and reliable information that complements other research techniques.

Direct observation

Direct observations were made on various issues around the swamp, including farmlands, fishing and grazing lands. This involved also informal conversation with villagers to get more information on the Bahi swamp utilization and history of the swamp.

Resource mapping

The PRA team and village members first obtained overview of the village and the swamp, by overlooking it from the highest point. Thereafter, the village map was drawn on paper using markers by placing different signs to indicate the position of houses, farms, roads, wells, seasonal rivers, grazing and fishing areas. This exercise was done in order to understand the spatial variability of land and natural resource use in the swamp.

Focused group discussion

A checklist was used to guide focused group discussions (FGDs) (Appendices 4 and 5). This targeted key informants who had greater knowledge on the issues under discussion

related to wetlands. Different groups were gathered depending on the information required. Groups of fishermen, peasants and livestock grazers were gathered differently to get information on their utilization and dependence on the swamp. Groups of elders were gathered to obtain more information on the utilization and history of the swamp. In case of fishing and its contribution to livelihoods, a group of eight (8) fishermen were used to give statistics on fisheries on their last years experiences on the production of fish and income accrued from fishing. Another group comprised of village leaders with the purpose of getting additional information on average households crops production and income and consensus of what respondents stated during questionnaire survey.

Questionnaire survey

A representative sample of 109 households (9%) was selected out of 1202 households based on random sampling procedures. Village registers were used as sampling frames and households were randomly picked. Data collection was done through administered questionnaires. Administered questionnaires with both open and close-ended questions were employed for interviewing heads of households (Appendix 1).

The information collected through questionnaires include socioeconomic characteristics of respondents such age, gender, occupation, composition, land holding, economic activities around the swamp like agriculture, fishing, livestock keeping, production and sales of wetland products and their role in enhancing household food security. Also, assessment of wetland products which contribute to household income, including their production, markets and sales and the level of dependence of households on the swamp

was assessed by setting questions on how and what activities are done and products from and around the swamp do people depend on.

3.2.4 Secondary data

Secondary data such as number of households in villages were collected from Village Executive Officers' records. Others were obtained from the Bahi division agricultural department office. Different sources such as books and official reports regarding previous studies conducted in Bahi swamp were used to get supplementary information on the swamp use and peoples' livelihoods.

3.3 Data Analysis

The data collected were grouped into quantitative and qualitative forms to make easy analysis. Microsoft Excel and SPSS 12 packages were used to summarize data. Quantitative data were analysed to generate descriptive information such as frequency tables and means, which enabled discussions and conclusions on the contribution of the swamp to household food security and income. Microsoft excel spreadsheets were used to compute the average production of crops and other products harvested and the revenue from their sales. Contribution of different crops to household income was presented in monetary terms in order to determine what income will be earned if the entire crop yields are sold. The percentage contribution was calculated from total annual average household crops production. This is because most of households failed to give statistics on what amount was either sold or exchanged with other products.

Qualitative data generated from discussion with groups and individuals were subjected to content analysis to generate meaningful themes and tendencies related to study objectives. Market survey analysis based on products price and revenue, was used to analyse data on wetland products traded by households (crops and fish) to enhance their income. Other data from PRA exercises (discussions) were analyzed through relative ranking.

3.6 Limitation of the Study

3.6.1 The problem of keeping records

Data related to income per household and amount of crops sold were big limitation because of the failure of respondents to keep records and recall memory. This created difficulty in determining the respondents' annual crops production and income. Data from village executive officers (VEOs) offices on average annual household crop productions and income were used to triangulate the required information.

3.6.2 Poor accessibility

Some areas were not easily accessible due to transportation, thorny shrubs and floods. A lot of time was spent in walking on foot from village to village during data collection as it was difficult to use reliable transports such as bicycle or motorcycle.

3.6.3 Willingness of respondents to be interviewed

During the study, many respondents were not ready to be interviewed without effective persuasion to them regarding the study. Some of them refused to give answers because they had not seen any outcome as far as previous researchers have passed in their areas, saying that they benefit nothing by answering questions. The problem however, was overcome by walking through with a village leader from household to household.

3.6.4 Presence of Uranium deposits

Some areas around the swamp being Uranium deposits created another limitation. Many respondents thought that the survey intended to provide information that will lead to eviction from their residence for mineral exploration. Thus, some respondents were very negative in answering questions and showing doubts, until a village or street leader accompanied the survey.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 General Socioeconomic Characteristics of Households

4.1.1 Demography

The total number of households in the studied villages was 1202. The villages were Nagulo-Bahi and Makulu with 618 and 584 households respectively. Overall, the dominant tribe in the villages was Gogo (92%), followed by Nyaturu (3%), Taturu (3%), Masai (1%) and Sukuma (1%).

4.1.2 Gender

The proportion of respondents who participated in the survey, based on gender, is shown in Table 1. Females had smaller representation (15.6%) despite the fact that, they are key players in most of the household activities. The reason behind is that the study targeted the heads of households. Therefore, except for few households, which were headed by females, majority were males (84.4%). Sometimes females had to respond on behalf of their husbands when they were not available.

4.1.3 Age

The proportion of respondents with the age ranging between 18 and 40 years was the largest followed by the age group of 41 – 60 years, which reflects permanent settlement of this age group in the villages with full engagement in different socio-economic activities. The proportion of people with age groups below 18 was relatively low

because members of the group had not yet established families, thus regarded as only household members. According to Mtenga (1999), household members are considered economically productive from the age of 16 to 64 years.

4.1.4 Land holdings

Based on the household survey, the average land owned by each household was about 2.4 hectares (about 6 acres). Most of the respondents had land holding of between 0.4 and 2.4 hectares followed by 2.4 to 4.4 hectares. Relatively low proportion had holdings of more than four hectares of land.

Table 1: General socio-economic characteristics of respondents

Socio-economic characteristics		Percentage of respondents (N=109)			
		Makulu	Nagulo-Bahi	Overall	Total
Gender	Male	41	43.4	84.4	
	Female	7.6	8	15.6	100
Age (years)	< 18	2.4	2.2	4.6	
	18 – 40	20.3	21.0	41.3	
	41 – 60	15.6	22.0	37.6	
	> 60	8.1	8.4	16.5	100
Land holding (Ha)	0.4 – 2.4	21.0	24.0	45.0	
	2.4 – 4.4	17.9	20.6	38.5	
	4.4 – 6.4	6.6	9.0	15.6	
	6.4 – 8.1	0.4	0.5	0.9	100

Non-parametric bivariate correlation analysis showed a significant positive correlation between total land owned and age of respondents ($r = 0.448$, $P < 0.01$), meaning that older people owned bigger land size compared to younger ones. Moreover, household size determined size of land owned. Bigger families owned significantly large pieces of land compared to families which were relatively small ($r = 0.625$, $P < 0.01$). Table 2 below summarizes correlation between age, household size and land size (hectares) owned by respondents.

Table 2: Non-parametric bivariate correlation (Spearman's *rho*) between age, household size and land size owned by respondents

	Age (years)	Household size	Land size (hectares)
Age (years)	1	0.428**	0.448**
Household size	0.428**	1	0.625**
Land size (hectares)	0.448**	0.625**	1

Note: ** Correlation is significant at the 0.01 level (2-tailed)

N = 109

4.2 Socio-Economic Activities and Associated Products with Potential Contribution to Household Food Security and Income in the Swamp

4.2.1 Use of the swamp

Bahi swamp is used by the adjacent communities for fishing, livestock grazing, irrigation, rice cultivation and other crops all providing people with economic benefits useful in sustaining their livelihoods. The swamp contributes, in some way, to the

livelihoods of most households in 21 villages adjacent to it. Relative ranking during focus group discussions and PRA showed that agriculture was the highest in importance among the economic activities conducted in the wetland. The secondary level of importance was attached to fetching of water for various uses. Water is a crucial service brought by the swamp to the adjacent communities because the area is semi-arid and no permanent rivers. In this context, respondents attached relatively high value on water utilization from the swamp in which water is treated as a product and service. There is an extensive system of groundwater on which people are depending on for drinking water. The people living in the affected area are mainly farmers. Fishing and livestock grazing ranked third in their importance to livelihoods. Collection of weaving and thatching grasses, collection of wild plants and firewood and tourism were the least in ranking (Fig. 3).

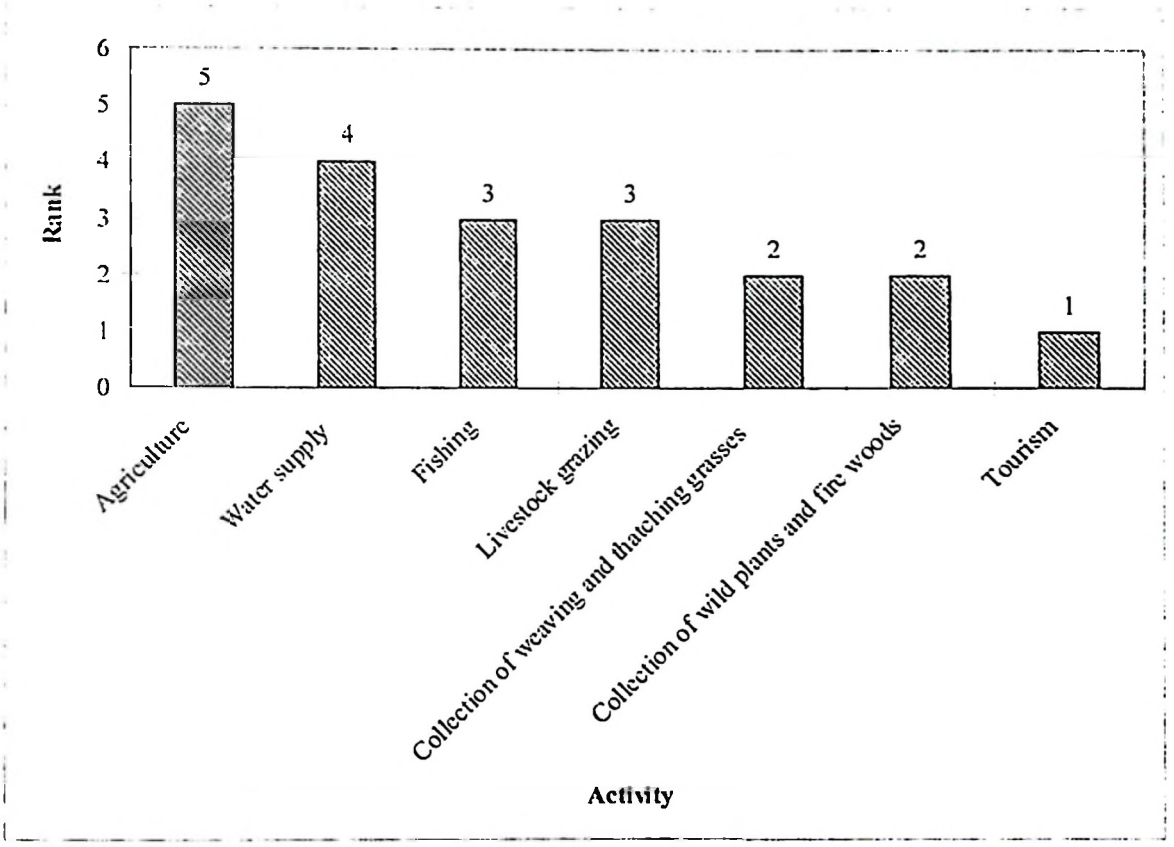

Figure 3: Ranks given to wetland related activities with economic significance

Note: 5 – was the highest score and 1- the lowest score

These results are similar to the study conducted to the communities around Kabartal wetland in India by Kalpana *et al.* (2007), where by agriculture was ranked the highest, followed by fishing while ecological functions and tourism ranked the lowest values.

In Makulu village agriculture, water supply and fishing were ranked high by majority of respondents (80%, 78% and 62% respectively), while livestock grazing was mentioned by relatively lower proportion of respondents (47%). In Nagulo-Bahi, activities such as

agriculture, fishing and water supply were mentioned by majority of respondents (82%, 76% and 72% respectively), while livestock grazing was stated by relatively lower proportion of the respondents (37%). Comparatively, Nagulo-Bahi village had more respondents on fishing and agriculture than Makulu village because of relatively more valley bottom wetlands in Nagulo-Bahi that allow accumulation of water for longer time. Tourism as an activity done around the swamp was acknowledged by the lowest (9% in Makulu and 6% in Nagulo-Bahi) (Table 3).

Table 3: Relative significance of socio-economic activities around the swamp

	Percentage of respondents (N = 109)		
Socio-economic activity	**Makulu**	**Nagulo-Bahi**	**Overall**
Agriculture	80	82	81
Water supply	78	72	75
Fishing	62	76	69
Livestock grazing	47	37	42
Tourism	9	6	8

Note: Multiple responses allowed

These findings are similar to those in the study conducted in Bhoj wetlands, India by Verma (2001), where by agriculture and fishing were stated by majority of respondents as the most important activities compared to other activities done around the wetland.

4.2.3 Wetland products

Several wetland products were listed as significant in sustaining local livelihoods for communities adjacent to the swamp. These products included crops and other species (86%), water (85%) followed by fish (70%), weaving and thatching grasses were utilized by relatively lower proportion (31%) of the population In Makulu village, much more respondents acknowledged fodder than in Nagulo-Bahi because majority of households in there are livestock keepers. Conversely, majority of respondents in Nagulo-Bahi village mentioned to obtain fish more compared to Makulu village households (Fig. 4). Furthermore, many areas close to the swamp were observed to have shallow underground water table hence shallow wells provided adequate water supply to households and their livestock after slight soil excavation, thus made many people to acknowledge water as an important product they accrue. In addition, high water holding capacity of soils observed helps cultivated crops to sustain longer dry periods without sudden wilting.

According to Kipkemboi *et al.* (in press), 92.3% of the respondents at the shores of Lake Victoria in Kenya indicated that they harvest products from wetlands. Only 29.9% of the households obtained water for household consumption from the wetland. The proportion of people obtaining water from the shores of Lake Victoria was lower than that of Bahi swamp wetland because no permanent rivers flow through the villages and from direct observation there were also few wells, thus the swamp is of great significance as water reservoir to the adjacent communities.

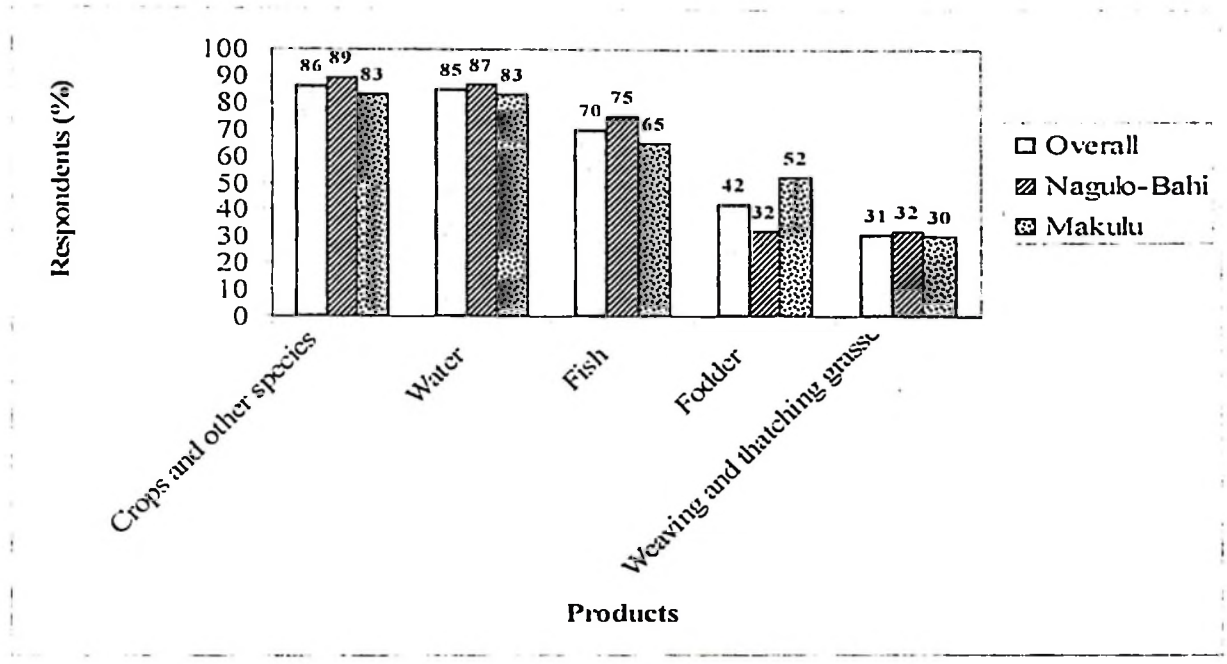

Figure 4: Major products obtained from the wetland by households

Note: Multiple responses allowed

4.3 Bahi Swamp and Household Food Security

Bahi swamp being seasonal plays a vital role in the lives of people in adjacent villages by creating an enabling environment to achieve food security during periods of food insecurity caused by weather/climatic variability. Household food security in the area is enhanced through crop production and fishing being done in the swamp.

4.3.1 Crop production

Agricultural crop production is one of the major economic activities around the swamp. There is no permanent cash crop produced, due to the nature of the swamp environment. Major crops produced are rice, groundnuts, sorghum and maize (Table 4). Crops produced in adjacent dry areas are mainly groundnut, sorghum and maize while paddy

rice (*Oryza sativa*, L.) is produced in wetter areas, where there is rich clay soils and good water retention capacity. According to respondents, much more paddy is produced in rice-beds established within the swamp than other crops. Part of the rice produced is either sold and/or exchanged with maize or sorghum from other villages for food. Therefore, households with larger rice stocks had assurance of high food security and a variety of food types as they can exchange with other crops to match their food preferences.

Table 4: Crop types and yield by households in the Bahi swamp wetlands

Crop type	Annual yield (kg) per household	Percentage of the total production
Paddy rice	1636	65.0
Groundnuts	536	21.0
Sorghum	225	9.0
Maize	146	6.0
Total production	**2543**	**100**

Key informant interviews with village executive officers (VEOs) showed that average annual household crops production was 2500 kg equivalent to 2.5 tonnes. Thus, from the survey, rice produced in wetter areas has higher yield of 1636 kg when compared to other crops that are cultivated in adjacent drier areas with lower yields of 536 225 and 146 kilograms for groundnuts, sorghum and maize respectively. Paddy rice showed the highest yield of all crops with significant contribution to household food security, contributing more than 60% of the total annual households' food crop production.

Hence, the swamp crop products especially paddy rice appeared to play an important role in the food security of the local population.

These results are similar to observations by Yanda *et al.* (2006) in Ngaiti village which is also adjacent to the Bahi swamp who revealed an average annual yield of paddy rice grown in wetlands to be 10.27 bags per household, while other crops grown in adjacent dry lands showed the lowest yields. High yield in paddy rice was enhanced by presence of water in rice-beds thus allowing it to grow healthier and generating high yields.

4.3.2 Fishing

Fishing plays a substantial role in enhancing household food security. Fish is the cheapest source of protein and during fishing season, this source of protein becomes available to households more cheaply. Although the swamp is seasonal, it becomes suitable breeding site for fish after heavy rains and flooding. Focus group discussion with fishermen showed that areas such as Nondwa and Surungai experience intensive flooding and hence form important fishing grounds. Fish species available in Bahi swamp include *Oreochromis urolepsis* (perege) and *Clarias spp* (kambare).

It was observed that a fisherman can conduct 24 catches per year, which gives an average 2866 fishes caught annually. Households consume about 10% percent of this (286 fishes) as food, thus making a notable contribution to household food security. Because of unreliable storage techniques for fish caught at household level, relatively

small amount is left for household consumption. The study by Abila and Othina (2005) along Yala swamp in Kenya, observed that only 7% of respondents utilized fish caught for household consumption and the rest is used for trade due to similar reasons.

4.4 Bahi Swamp and Household Income

There are several sources of income for communities adjacent to the swamp. Among the sources include sales of crops (87.5%) followed by other business (52%) and livestock sales (44.2%). The swamp supports livestock grazing during both dry and wet seasons thus enabling people to have healthier livestock that can yield high incomes through sales. Sale of fish was mentioned by few respondents (41.8%) because of the nature of fishing activity in the area being seasonal after heavy rains and flooding of the swamp. This may imply that low proportion of the population practise fishing but it contributes substantially to household income (Fig. 5).

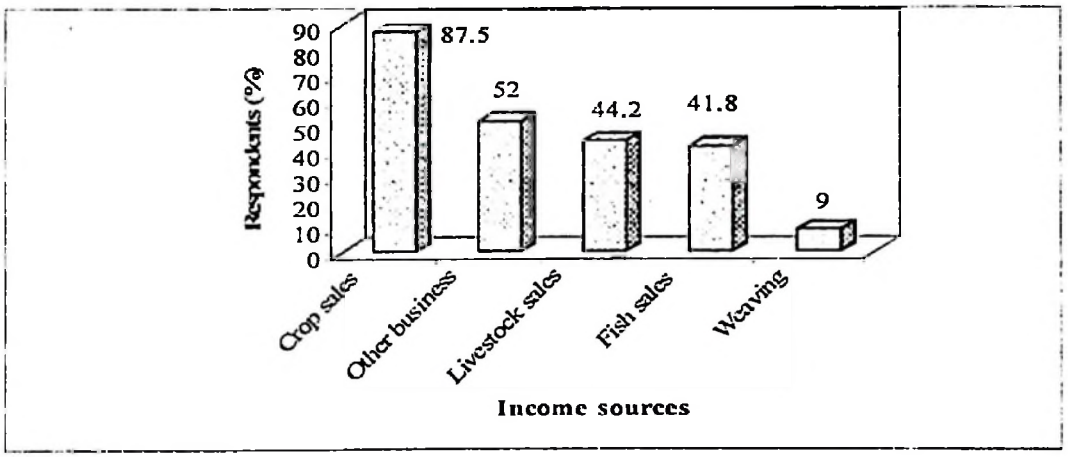

Figure 5: Sources of income for communities living adjacent to the Bahi swamp

Note: Multiple responses allowed

4.4.1 Crop sales

Sale of agriculture crops is the major source of income to the households. This is because agriculture is the major economic activity in the area and especially crop production from wetland, as the swamp supports a variety of crops cultivation leading to remarkable higher crops yields than other areas situated away from Bahi swamp. Key informant interviews with VEOs showed that average annual household income was about Tshs 800 000/- with rice production contributing the highest income, about 60% of the total annual household income (Table 5). According to the World Bank (2009) database on world's economic indicator, per capita income of Tanzanians for year 2008 was US$ 430 (equivalent to Tshs 559 000/-). Thus income from sales of the entire amount of paddy rice produced contributes more than eighty percent of national per capita income in the area annually.

Table 5: Average annual contribution of different crops to total household income among communities living adjacent to the swamp

Crop type	Annual income from crop sales (Tshs)	Percentage contribution by crops
Paddy rice	477 169.80	60.0
Groundnuts	138 042.45	17.0
Sorghum	45 198.10	6.0
Maize	5377.40	1.0
Total	**665 787.75**	**84**

According to Kasthala *et al.* (2008), agricultural production along the Mtanza wetland in the Rufiji basin generated annual cash income of Tshs 695 689/-. This income is almost similar to that for Bahi swamp though a bit higher because of higher variety of crops grown along Mtanza wetland like sesame, cowpeas and vegetables. Shabaan *et al.* (2004) observed that crops grown in the Bumbwisudi wetland in Zanzibar typically provide from six to twenty percent of the total household income generated. These contributions is lower than that of Bahi swamp because people around Bumbwisudi wetland consume most of crops harvested and sell smaller amounts, as there are other additional income generating activities around the wetland such as fishing and crafts making.

4.4.2 Fishing and fish sales

Fishing also contributes in enhancing the income of the households around the swamp. It was found that a fisherman can obtain between 50 to 200 pieces of fish per catch depending on the condition of the area and amount of water. For the amount caught, about 90% are sold. Each fish can be sold at a price of 100/- to 200/- Tshs depending on size, generating an annual income of Tshs 12 794/- per catch. A fisherman can make about 8 catches per month which becomes equivalent to 24 catches for 3 peak months per year, which make an annual income of Tshs 288 000/-. This amount is substantially high for a single economic activity considering the rural economy in Tanzania. This income contributes about 36% of the total annual household income. According to the World Bank (2009) database on world's economic indicator, per capita income of

Tanzanians for year 2008 was US$ 430 (equivalent to Tshs 559 000/-). Thus, fish sales contribute about fifty percent of the national per capita income of the area annually. Therefore, fisheries although of small scale, provide an important contribution to fishermen's household cash income at Bahi swamp.

Kasthala *et al.* (2008) observed that fishing contributes an average of TShs 353 612/- per household annually along Rufiji River catchments in Mtanza-Msona wetland. Meanwhile, in Stung Treng Ramsar Site, Cambodia fishing generated US$ 425 per household annually from fishing (Allen *et al.*, 2008). These figures are higher than that of Bahi swamp due to difference in fishing seasons and amount of fish per catch. Fishing season in Bahi swamp is shorter than in Mtanza-Msona wetland or Stung Treng Ramsar Site.

The cash income obtained from fishing has a multiplier effect in terms of other benefits to the community including education, health services, clothing and other food as well as investment in other assets or enterprises such as land, livestock or fishing gear, which in turn can further reduce vulnerability to poverty. Fishing at the swamp also has multiplier effects on the economy of different groups including multiple temporary employments such as suppliers of firewood to fishermen, scrapping fish scales, preparing fish and frying them for sale and cleaning of nets, boats and assistance in fishing. This is a multiplier effect to a wider segment of the community, which would not have been there if it were not for the swamp.

4.5 Extent of Household Dependence on the Swamp

It was observed that the population was highly dependent on the swamp due to different products and services offered by the wetland. About 82% of the population depend on the swamp in their daily socio-economic activities. This shows that the swamp and adjacent communities are ultimately interdependent, with local community livelihood being highly dependent on the wetland. Similar findings were observed by Schuyt (2005) who indicated a high dependence of local riparian communities on natural wetlands in Yala swamp in Kenya. Moreover, Kalpana *et al.* (2007) found that 67% of people around Kabartal wetland in India depend on the wetland for different types of subsistence and commercial goods provided by the wetland.

In many circumstances, wetlands are regarded as economic strongholds for communities living at their verge (Adams, 1993; Turner *et al.*, 2000). The dependence of the local communities is based on the products and services offered by the swamp and it differs slightly in the two villages because of variation in the available products or services. In Nagulo-Bahi village, high dependence was on fertile soils for crop production (89%), water (76%) and fish (61%). Thatching and weaving materials were the least important. While in Makulu village, high dependence on the swamp was observed in fertile soils for crop production (82%), water (78%) and fish (51%) and dependence on fodder (44%). Thatching and weaving materials were also the least important (Table 6). A high percentage of people in Nagulo-Bahi depend on the swamp for fishing because of their proximity to the fishing ground compared to the Makulu villagers. Most of Makulu

villagers are livestock keepers, meaning that their dependence on the swamp for grazing is higher than Nagulo-Bahi villagers are.

Table 6: Percentage of population depending on the Bahi swamp wetlands for various products and services

Item of dependence	Percentage (N = 109)		
	Nagulo-Bahi	Makulu	Overall
Fertile soils for crop production	89	82	86
Water for irrigation and home use	76	78	77
Fish for sale and home use	61	51	56
Fodder for livestock	39	44	42
Thatching and weaving grass materials	19	21	20

Note: Multiple responses allowed

Valuable products influence dependence on wetlands or services offered to the adjacent communities and their accessibility, thus differential dependence in the two villages emerged. According to Kipkemboi *et al.* (in press), over 90 % of households around Lake Victoria in Kenya depend on natural plant biomass (mainly papyrus harvesting) and 60 % on seasonal cultivated crops along the shores of the lake.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

There are variety of socio-economic activities undertaken in Bahi swamp and related products/services which make significant contributions to food security and income of adjacent communities. The swamp contributes substantially to household food security through crop production and fishing. In crop cultivation, much contribution comes from paddy rice cultivated in wet areas. Fishing also contributes substantially to household food security through domestic utilization of fish caught. Moreover, the swamp supports livestock grazing throughout the year thus enhancing households to have additional meat supply and income through livestock sales.

Bahi swamp also contribute significantly to household income through sale of crops especially paddy rice and fish. Moreover, variety of socioeconomic activities emerging during fishing season are done by other groups associated with fishermen facilitate an income generated to a wider group. Dependence on the swamp is due to valuable products or services offered to the adjacent communities.

5.2 Recommendations

From the results and discussions of this study, the following seem to be pertinent recommendations:

(i) In order to improve and maintain rural income using resources from the swamp while adhering to conservation, planning and development of wetland friendly investments is essential.

(ii) Introduction of more sustainable livelihood activities which can be done in the swamp such as fingerponds so as to expose communities around on benefits of the swamp.

(iii) Planning for wise use of the swamp in respect of the dominant socioeconomic activities will likely improve its contribution to livelihoods.

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APPENDICES

Appendix 1: Questionnaire for Household Survey

District.....Division.....

Ward..... Village.....

A) SOCIOECONOMIC CHARACTERISTICS OF HOUSEHOLD

1. Respondent status; (a) Head of household (b) member of household ( )

Gender	Age (years)	Marital status	Education level	Number of dependants
1=Male 2=Female	1=Below 18 2=18-40 3=41-60 4=Above 60	1=Single 2=Married 3=Separated 4=Widowed	1= Primary 2=Secondary 3=College 4=University 5=Informal	1= None 2= 1-5 3= More than 5

2. Tribe.....
3. Total land owned by household in acres.....
4. Can you tell me which wetland related activities influenced by this Bahi swamp do you depend on and benefit you?
5. Can you tell me wetland related products influenced by the swamp which are available and benefit you?

B) ACTIVITIES FOR LIVELIHOOD

A: Agriculture

1. What was the production in the last crop season/year?

Crop types	Area cultivated (acres)	Production (bags/sacs)	Bags/sacs sold	Price per bag or sac	Total income per year

2. In your agricultural activities, do you depend on the swamp? YES..... NO.....
3. If yes, how and why.....
4. For how long have you been conducting agriculture around the swamp?
5. Do you conduct agriculture throughout the year? YES..... NO.....

B: Livestock

1. Do you own livestock?
2. Where do you depend much in obtaining fodder for your livestock?
3. Do you face difficulties in getting grazing areas for your grazing livestock?

C: Fishing

1. Do you practice fishing in the swamp valley? YES.....NO.....
2. If no, why.....
3. If yes, please fill the table below

Fish type	No. caught/day	No. sold/ day	Price /each	Income/day

4. For how long have you been conducting your activity?
5. How do you use the fish and/or its products?

(a) Food (household consumption) (b) Selling (c) Both .....

6. Before deciding either to sell fish caught or consuming in the household what do you consider? (a) catch level (b)availability of buyers (c) domestic need for fish (d) Others (specify).....

(B) FOOD SECURITY AND INCOME

1. Please mention any of your income generating activities.....
2. What are the major source of your income?.....
3. What is your average annual income in Tshs?
4. Which livelihood activity brings you the most money?
5. Can you tell me, which livelihood activity enhances you with food security and through what products?
6. Are you able to meet your food preferences frequently? (a)YES (b) NO
7. What is the main source of your food?
   - Own produce
   - Purchase from market ( )
   - Gathering
8. What are main foods types eaten/consumed in your household?

Food type	**Obtained from**

9. Have you ever experienced hunger periods? YES..... NO.....
10. If YES, How frequent does these periods occur?
    (a) Often (b) Sometimes ( )
11. If YES, What type of food is available or did you use during hunger periods?

12. Can you suggest some strategies on how the swamp can be conserved sustainably so that it continues to benefit you?

(C) DEPENDENCE ON THE SWAMP

1. Do you depend on the swamp for your livelihood?
2. Can you tell me the reason why do you depend on the swamp?
3. For which services or products provided by the swamp do you depend on?

Appendix 2: Checklist for District Natural Resource/Agricultural Officer

Name.....

Title.....

District.....

1. For how long have you been in the district?
2. How many villages exist in this district?
3. Which products do people obtain/collect from the swamp or due to the swamp?
4. What can you say on the contribution of the swamp to the household food security and income?
5. What could be the reasons for them to depend on the swamp for their livelihood?
6. Is the area/swamp reserved or an open access?
7. Which season do people depend on the swamp and which product do they obtain.

8. Can you suggest some strategies on how the swamp can be conserved sustainably so that it continues to benefit you?

Appendix 3: Checklist for the village executive officers

Name.....

Title.....

Village.....

1. For how long have you been in the area?
2. What is the total population (or household number) in this village?
3. What are wetland related activities done by people around the swamp?
4. Which products do people obtain/collect from the swamp or due to the swamp?
5. What could be the reasons for them to depend on the swamp for their livelihood?
6. Is the area/swamp reserved or an open access?
7. What can you say on the contribution of the swamp to the household food security and income?
8. Which season do people depend on the swamp and which product do they obtain?
9. Can you suggest some strategies on how the swamp can be conserved sustainably so that it continues to benefit you?

Appendix 4: Checklist to the fishermen

Village..... Date.....

1. Name of fisherman.....
2. Gender .....
3. Do you practice fishing the whole season, or sometimes (which months)?
4. After fishing, how do you make use of fish caught?
   (a) Household consumption (b) Trade (c) Both ....
5. Before deciding either to sell fish caught or consuming in the household what do you consider? (a) catch level (b)availability of buyers (c) domestic need for fish (d) Others (specify).....
6. Please tell me the following

Fish type	No. caught/day	No. sold/ day	Price /each	Income/day

7. Can you suggest some strategies on how the swamp can be conserved sustainably so that it continues to benefit you?

Appendix 5: Checklist for focused group discussion

a) Which use value do you accrue from wetland? Rank those use values on a scale of 1 to 5 in order of increasing precedence.
b) Which products do people obtain/collect from the swamp or due to the swamp?
c) Which economic activities are carried out around the swamp for the whole season, and which ones are not?

d) What could be the reasons for them to depend on the swamp for their livelihood?

e) What can you say on the contribution of the swamp to the household food security and income?

f) Can you help me to know situation, factors or conditions which increase dependence on the swamp by household?

g) Which season do people depend on the swamp and which product do they obtain?

h) Can you suggest some strategies on how the swamp can be conserved sustainably so that it continues to benefit you?

Appendix 6: Fishing and catching amount by fishermen per catch

S/N	Amount caught	Amount sold	Price/fish(Tshs)	Income (Tshs)
1	100	90	150	13500
2	180	160	100	16000
3	110	98	150	14700
4	145	130	100	13000
5	60	55	150	8250
6	190	175	100	17500
7	50	42	200	8400
8	120	110	100	11000
	Average caught	**Average sold**		**Average Income**
	119.4	**107.5**		**12793.75**