

# Climate Change Impacts on Fishing in Coastal Rural of Tanzania

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## Abstract

Millions of people around the world depend on fisheries and aquaculture directly or indirectly for their food security, livelihoods and poverty reduction. However, ocean's ability to meet their needs is in grave danger. Fish is a crucial source of livelihood for fishermen in the coastal rural regions of Tanzania but climate change has caused a major threat to the same. As ocean temperatures rise, many fish species are being driven into deeper waters or toward the planet's poles. The shifting conditions, meanwhile, are inviting historically anomalous breeds into new ranges with unpredictable results. The precise degree to which these phenomena are contributing to Tanzania's current plight is difficult to quantify but ample evidence suggests such changes are already affecting fisheries across the country. Climate-related impacts are occurring across regions of Tanzania and primary sectors of its economy are more vulnerable.

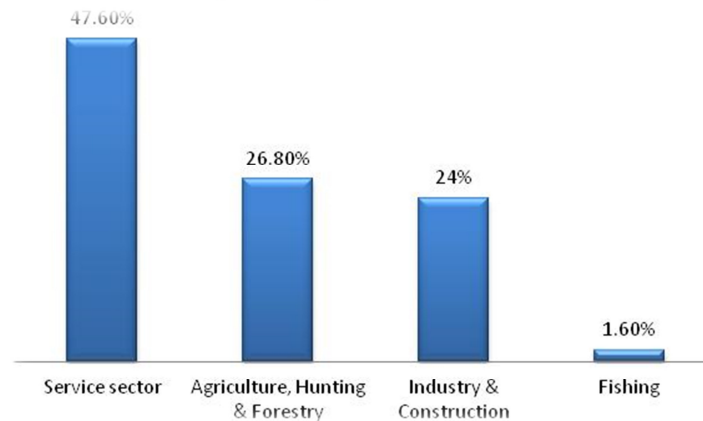
**Keywords:** Climatic Change, Fishing, Climatic Change Adaption, Tanzania.

## 1.0 Introduction

Tanzania is one of the Sub-Saharan countries projected to have more warming than the global average and the possibility of getting warmer in the future is high (IPCC 2007; Allison et al. 2009; Rajesh et al. 2014). Scientists agree that some climatic changes are inevitable because of the increase in Green House Gases (GHGs) concentration in the atmosphere resulting from increased emissions through anthropogenic activities in the world (Ngaira 2003; Team 2008). In 2003, the Initial National Communication of Tanzania (INCT) projected the increase in temperature to be between 3°C and 5°C due to doubling of Carbon dioxide (CO<sub>2</sub>) (Shardul et al. 2003). The earth's average temperature is expected to increase by 6.4°C and sea level will increase by 0.59 m at the end of 21<sup>st</sup> C (IPCC 2007) (see table 3.1). In general, the average earth's temperature has increased by 0.74°C between 1906 and 2005 (Korea Meteorological Agency 2008). Therefore, poor countries like Tanzania, which rely on primary sectors like agriculture and fisheries, are expected to be more vulnerable to climate change and variability due to limited adaptive capacity (Islam et al. 2011; Rajesh et al. 2014). However, these countries contribute little to the factors resulting in regional and global climatic changes. Climate change impacts have contributed to these countries not meeting some of the Millennium Development Goals (MDGs) (IPCC 2007; UNDP 2008).

In Tanzania, agriculture is the leading sector employing about 70% of people in rural areas (Oswald 2011). Climate change has affected the life of rural people in coastal areas particularly those that depend on fishing and subsistence farming (Mary et al. 2009; MoP 2011; Huruma 2014). Furthermore, fisheries sub sector employs more than 177,527 people as small scale fishers who work directly in the sector and approximately 4,000,000 people engaged in fisheries related activities like fish processing and marketing, trade in fishing, boat building and maintenance (MLFD 2011). Therefore, people along the coast are largely reliant on fishing as their dominant economic activity (Bene et al. 2007; Huruma 2014). In 1998, fisheries sub sector contributed about 2.7% to the National Gross Domestic Product (NGDP) after experiencing a growth of 4.3% in the same year (Fatuma 2012). However, the contribution started to fluctuate yearly with the fisheries sector NGDP contribution averaging between 1.3% to 1.6% in the period 2007 to 2012 (Planning Commission 2011; NBS 2013). The decline of the sector might be due to climate change and environmental degradation, decrease in fish catches, over participation in fishing related activities, change of species distribution and increase in population (Hazell 1984; Fatuma 2012). Therefore its contribution to the country's economy is very low compared to other sectors as stipulated in the Figure 1-1.

**Figure1-1 Economic sectors percentage share of Tanzania's GDP for the year, 2012**



Source: NBS, 2013

The service sector is leading with about 47.6% contribution to the national economy. This growth is higher than other sectors and is almost the same with overall economic growth level (Li et al. 2012). Followed by agriculture, hunting together with forestry (26.8%), then industry and construction (24%) and lastly fishing sub sector, which contributes only 1.6%. Although agriculture and fishing are considered as the backbone of the economy, they contribute less to the NGDP and are the most vulnerable sectors to climate change (Rajesh et al. 2014).

Tanzania like other low income countries is lacking financial, technological and institutional capacity to adapt effectively to the effects of climate change. In addition, rural people are aware of climate change happening in terms of increase in temperature, low rain intensity, high sun intensity, unreliability of rain and extreme drought (Deressa et al. 2008; Daninga et al. 2015). However, the main causes of climatic change is not well understood to majority of people dwelling in rural areas as most associate it with super natural powers and increase of evils in the community (Danninga et al. 2015). This has led to illegal fishing- a fast growing illegitimate practice undertaken by coastal people in many countries of the world. The practice is threatening the ecosystem and the survival fabric of many fish species (Sander, K. et al. 2014).

Therefore, this destructive impact of natural resources undermines the livelihood and economic status of poor people who are the most vulnerable to climate change (McCarthy 2001; World Bank 2013). Hence, the perspective of local people on how they think and behave on climate change together with their values and aspirations have significant role in addressing climate change (Doss et al. 2000). Local fishers are expected to be in front line in environmentally safer adaption measures. Instead, some are engaged in dynamite/ blast fishing or using unauthorised tools in fishing which endangers the sustainability of the sector. The situation might be worsened due to the fact that government officials who are responsible for mainstreaming the issues of climate change in their plans, programs, strategies and daily activities are themselves not familiar with the issues in question (Pius et al., 2013). In order to design workable policies and strategies on climate change mitigation both central and local governments should be well-informed on the issues of climate change impacts and their causes.

Climate change adversely affects mostly primary sectors such as farming, fishing, and forestry (Juana et al. 2013). It is evident that, little information is available specifically on small-scale fishers operating in coastal environment although its contributions to food security and livelihood of the communities around the coast cannot be ignored (Merle et al., 2010; Sarah et al., 2011). Therefore, the aim of this paper is to review the literatures related to climate change impacts on fishing particularly in Coastal areas. Fishing subsector plays an important role in terms of food security, wealth creation and livelihood to majority of coastal communities, hence contributing to poverty reduction (Garcia et al. 2010; Sarah et al. 2013; Michelle et al. 2013; World Bank 2013). Yet the managers and policy makers neglect to perceive its significance (Badjeck et al. 2010; Sarah et al. 2013; Michelle et al. 2013). Therefore, implementing proper measures for climatic change adaptations for economic and ecological sustainability is essential for fostering the global war against abject poverty. Hence, it is important for fishers and other stakeholders to adopt different climate change adaptation strategies.

## **2.0 Climate Change and its impacts to Fishing subsector in Tanzania**

Tanzania is among the poorest countries in the world yet with rich marine and inland fishery resources (Fatuma 2012; Hanifa et al. 2015). The total water area is estimated to be 62,000 km<sup>2</sup> and coastal line is approximately 1,424 km long containing substantial fisheries resources (Fatuma 2012). The fishing subsector plays an important role in the coastal economy because it enhances food security and income generation (Garcia et al. 2010; Merle et al. 2010; Ben et al. 2014). However, fish consumption levels and its benefits remain low in

Tanzania compared to other countries where fisheries and aquaculture are beneficial in terms of food security and income (FAO 2012). Fisheries sector contributes 27% of animal protein consumed in the country and government revenue through fishery agreements, license fees and levies associated with other related fishing activities and as a source of foreign exchange (FAO 2007). Fisher folks in Tanzania like other developing countries are characterised by poverty with limited capital and low technologies (Béné et al. 2007; Michele et al. 2013). Generally, they depend on natural resources, whose distribution and productivity are mostly affected by climate change dynamics (Allison 2005). Climate change can affect fisheries through different ways such as coral reef bleaching, changes in water temperature, wind velocity, sea level increase and wave action, which can bring ecological and biological significant change to both fresh water and marine ecosystems.

### 2.1 Coral reef Bleaching

Coral reef supports the livelihood of many people especially those engaged in activities related to marine fisheries (Cinner et al. 2008; Capili et al. 2005; Scavia et al. 2002). These fisheries dependent communities are affected by climate change, which contribute to decline in fish production. Arceo et al. (2001) identified El Nino to have caused disastrous impacts on coral reef such as bleaching. Other reef endangering factors are overfishing, coastal development and sea acidification (<http://www.globalissues.org/article/173/coral-reefs>). The reef in poor condition was estimated to be 40% in the last 20 years (Tun et al. 2004). The impacts of coral reef bleaching to fisheries have been discussed widely by different researchers (Cinner et al. 2008; Scavia et al. 2002).

In their observation, Cinner et al. (2008) focused on three dimensions of vulnerability namely sensitivity, exposure and adaptive capacity to the impact of coral bleaching to fisheries. In each dimension the researchers used different models such that in exposure dimension, the model was derived from six variables together with secondary data for coral bleaching from 216 sites collected in 1998 and 2005 with field survey of 91 sites in 2005. Social adaptive capacity index and key informants technique were used in adaptive capacity dimension. Lastly, metric of sensitivity was developed based on the level of dependency on fisheries and data from surveys of 1564 households from 29 sites was used to develop the indicator in this dimension. The results revealed the three dimension of vulnerability differ from each site. The study recommended that specific framework of policy for reducing vulnerability from climatic change should be applied in different sites. In addition, significant investment is required in the region because poverty and high illiteracy rate are key variables in people's ability to understand consequences of climate change. At the same time, overfishing and pollution were identified as key components of climate change in marine ecosystem.

On the other side, Scavia et al. (2002) summarised the coastal and marine resources by reviewing the potential impacts of coral reef on coast of the United States of America regarding ocean ecosystem. They supported argument raised by Cinner et al. (2008), that overfishing might increase the vulnerability of coral ecosystems together with climate change risk such as high temperature increase. They went further by identifying *Lethal epizootic* related diseases such as fungal, bacterial and viral as a result of coral decline, which led to high rate decline of important species of marine organisms. Some of these species not only provide livelihood to majority of people but also provide food to other fish, sea birds and other marine living organism.

Capili et al. (2005) conducted a study in Philippine coastal line, which is recognised as the longest archipelago in the world. They reviewed the climate change impact on coastal communities and recommended the adaption measures. Based on the survey conducted between 1991 and 2004, more than 50% of the reef sites have been affected because of over fishing, with the exception of the reef found in the Sulu Sea. Also they observed that, the decrease of ocean pH increases the threat to coral reef survival all over the world. The impacts of coral reef bleaching together with fish killing were witnessed in Bolinao and Silaqui islands.

### 2.2 Increase of sea level

Sea level rise was identified as among the consequence of climate change, which threatened the world, Medany (n.d). The global warming experienced during the 20<sup>th</sup> century contributed to a large extent on the sea level rise through thermal expansion of seawater together with land ice loss, Medany (n.d). Prediction models indicated an increase of 0.5 m of sea level might lead to 247 km<sup>2</sup> loss of land in coastal line (Gemma 2011). Following that analysis, Dar es Salaam region, which is among the coastal cities of Tanzania, would be at risk worth about US \$ 48 for 0.5 m sea level rise while in 1 m rise it is estimated to be US\$ 82 million (Tanzania Initial National Communication 2003). The review on the Impacts of climate variability and change on fisheries done by, Badjecka et al. (2010) revealed the rise of sea level could cause the mangrove forests to decline. Therefore, profitable species such as tiger prawns, which reside in these forests, tend to disappear, hence each year the loss is expected to be over US \$ 4 billion.

Sarwar et al. (2005) reviewed the climate change effects on the sea level rise of the coast of Bangladesh. The study was based on secondary data sources. In their observation, they identified that coastal fisheries were affected by sea level rise through salinity, cyclone frequency increase and flooding. All the three factors cause the decline in coastal fisheries, which will affect the livelihood of the people in terms of food

nutrition and poverty reduction efforts.

Natesan et al., (2010) conducted a study in Kanyakumari District in India with the objective of quantifying and identifying the effects of sea level rise on coastal fishing villages. In their study more than 200 different species of fish, prawns and other related marine living organism were recorded. In terms of methodology, Arc GIS processed vector data and geographical information system was used to determine the first order estimate of potential losses of land due to sea level rise. The results revealed that, coastal fishing villages are highly vulnerable to the effects of sea level rise, hence proper monitoring systems, inundation zones, satellite data measurements and people awareness towards sea level rise need to be emphasized.

### 2.3 Destructive impacts of natural resources

The coastal features include mangrove swamps and forests, which provide important economic resources such as, firewood, timber for constructions of fishing boats and houses, and also provide feeding, breeding and habitat to living organisms in the ocean. Other features include woodland, coral reef, tidal marshes and mudflats. The decline of mangrove forest habitat may negatively affect fishers' livelihood due to decrease on profitable fishery species such as tiger prawns (Ellison 2008). In Tanzania majority of communities in coastal areas depend on fishing as a dominant economic activity (Huruma, 2014). Therefore the destructive impact of natural resources undermines the livelihood and economic status of poor people who are the most vulnerable to climate change (McCarthy 2001).

### 2.4 Sea Temperature increase

Understanding the impacts of global warming has become more important because it is a threat to the whole world especially African countries due to its abject poverty (Rajesh et al. 2014; Juana et al. 2013). The IPPCC (2007) predicted the temperature to rise in Africa between 0.7°C to 3.5°C by year 2050. Furthermore, it was revealed that, an average increase of about 1.5°C to 2.5°C will probably show the significant impact on ecosystems sustainability. Therefore, significant decline of fisheries yield and productivity confirms the perceptions of sea temperature increases (Juana et al. 2013). Table 2.1 indicates the projected changes in temperature and rise of sea level at the end of 21<sup>st</sup> century relative to year 20<sup>th</sup> century. Modelling advancement in climate change makes best estimates and expected ranges for projected warming for different emission scenarios.

**Table 2.1: Projected Global Temperature Average Surface Warming and Sea Level Rise at the end of the 21<sup>st</sup> Century**

Case	(Temperature change C°) (at 21 <sup>st</sup> relative to 20 <sup>th</sup> )		Sea Level rise (M)* (at 21 <sup>st</sup> relative to 20 <sup>th</sup> Century)
	Best Estimate	Expected Range	
Constant Year 2000 concentrations	0.6	0.3-0.9	NA
B1 scenario	1.8	1.1-2.9	0.18-0.38
A1T scenario	2.4	1.4-3.8	0.20-0.45
B2 scenario	2.4	1.4-3.8	0.20-0.43
A1B scenario	2.8	1.7-4.4	0.21-0.48
A2 scenario	3.4	2.0-5.4	0.23-0.51
A1FI scenario	4.0	2.4-6.4	0.26-0.59

Source: IPCC, (2007)

\*Model-based range excluding future rapid dynamic changes in ice flow

Variations of sea currents and waves due to sea surface temperature in both tropical and subtropical coastal zones, and increase in frequency and severity of coral reef bleaching is an example of climate change risk to fishers and the community at large (Mc William 2005). Furthermore, the sector is characterised by traditional methods of fishing such as gillnets, hooks and seines fishing. It is also dominated by illegal fishing both in artisanal and deep sea fishing, which have impacts on livelihoods and economy at large. Article 1, Protocol on Fisheries of Southern African Development Community (SADC) define illegal fishing as “any fishing or related activity carried out in contravention of the laws of a state Party or the measures of an international fisheries management organisation accepted by a State party and subject to the jurisdiction of that State”. Since East African countries, Tanzania included are among the most food insecure in the world due to climate change and variability (Devereux et al. 2004), fishery management is therefore important in order to protect fishery resources for sustainable utilization (Fatuma 2012). Thus, fishing sector is experiencing an adverse effect due to the climate change especially in coastal marine, which include decrease of fish yield, unreliable heavy rainfall and wind which is dangerous for fishers to work thus increasing the number of unemployed people who were directly or indirectly engaged in it. In particular, the risk of climate change on primary sectors is evident (Case 2006; Rajesh et al. 2014; Daninga et al. 2015). However, none of the studies

reviewed above identified the adaptation measures to climatic risk taken by the fishers leading into a conclusion that there is inadequate attention paid towards the sector (Badjeck et al. 2010). FAO (2009) advises that, if no proper measure is taken to adapt to climatic change impacts, the African region will constantly continue to be vulnerable.

### **3.0 Risk of Climate Change with Respect to Gender on Coastal Rural Livelihoods**

With respect to gender, the sector has been dominated for many years by men while women are marginalised (Sarah et al. 2013; Huruma 2014). This might be due to the nature of the livelihood activities involved. Badjeck et al. (2010) recognised the sector to be an important source of livelihood for women in both rural and urban. However, Sarah et al. (2013) argued that, traditional perspective of men and women within the community have influenced the notion that women participate less in fisheries economies. This perception probably influences the climate change adaptation options practised in most African countries to be biased towards men. This is because most of them do not tackle the women's interest in the community such as decision making, access and control of the assets etc (González et al. 2011). In recent years, a number of women have been involved in fishing by buying the fish from the fishers and selling as food back to the fishers and to other community members around them while leaving some for home consumption (FAO, 1997; Sarah et al. 2013; Huruma, 2014). Therefore, the effect of climate change will have negative impacts to the coastal community, especially to women who have less access to most resources around them (Apata *et al.*, 2010). However, through engaging in fishing subsector, women fill the gap of the household's food security and income (Melissa et al. 2013; Sarah 2013). The gender gap need to be narrowed, otherwise if the role of women is ignored, efforts of governments in developing countries against rural poverty might not be achieved.

### **4.0 Summary of Empirical Studies on Farmers' Adaptation Measures to Climate Change**

This paper does not intend to compare the adaptation measures in climate change between farming and fishing subsectors. Rather, it highlights some different measures and barriers identified by farmers as observed by different authors. The farming subsector is getting more involved on climate change adaptation strategies as compared to fishing sub sector (Sarah et al. 2013; Michelle et al. 2013). This might be substantiated by the fact that most of international agreements concerning food security give first priority to agriculture, specifically farming sub sector (Merle et al. 2010).

Juana et al. (2013) reviewed a number of studies related to farmers' perception and adaptations to climate change in different countries of Sub-Saharan Africa. The general observations from these studies justify the assumption that farming gets more attention on climatic risks than other primary sectors. Acquah – de Graft et al. (2011) as cited by Juana et al. (2013) revealed that, out of 185 farmers who were included in the study in western part of Ghana, 60% adopted adaptation measures while 40% did not adopt any. The identified adaptation measures were switching to other crops, water and soil conservation strategies, usage of different crop varieties, changing planting dates, engaging to nonfarm activities and increase in irrigation systems. On the other side barriers that were observed for farmers not to adopt climate change strategies included lack of information related to climate change, lack of access to financial resources, low education level, insecure property rights, lack of access to farm implements, shortage of land and labour. Table 4-1 shows the summary of empirical studies on farmers' adaptation measures to climate change in some Sub Saharan countries.



**Table: 4-1 Summary of Empirical Studies on Farmers Adaptation measures to Climate Change in some Sub Saharan Countries**

No.	Author(s) and Region/Country of Study conducted	Adaptations Measures Observed
1.	Kurukulasuriya et al. (2006) - Burkina Faso, Ghana, Cameroon, Senegal, Niger, Ethiopia, Egypt, South Africa, Zimbabwe, Zambia & Kenya.	<ul style="list-style-type: none"> <li>• Farmers were switching to other crops.</li> <li>• Farmers select goats and sheep in warmer temperature instead of cow and chicken.</li> </ul>
2.	Maddison (2006) - Africa	<ul style="list-style-type: none"> <li>• Farmers had opportunity of free extension services and markets.</li> </ul>
3.	De Wit (2006) – Cameroon, Burkina Faso, Ehiopia, Ghana, Egypt, Kenya, Niger, South Africa, Senegal & Zambia.	<ul style="list-style-type: none"> <li>• Water &amp; soil conservation strategies.</li> <li>• Adopt different crops varieties.</li> <li>• Changing planting dates.</li> </ul>
4.	Nhemachena et al. (2007) - Zambia, South Africa & Zimbabwe.	<ul style="list-style-type: none"> <li>• Farmers use different crop varieties.</li> <li>• Diversifications of crops.</li> <li>• Changing planting dates.</li> <li>• Engaging to non-farm activities.</li> <li>• Increase in irrigation systems.</li> <li>• Water &amp; soil conservation techniques.</li> </ul>
5.	Deressa et al. (2008) - Ethiopia.	<ul style="list-style-type: none"> <li>• Changing planting dates.</li> <li>• Farmers use different crop varieties.</li> <li>• Planting trees.</li> <li>• Increase in irrigation systems.</li> <li>• Soil conservation techniques.</li> </ul>
6.	Yesuf et al. (2008) – Ethiopia.	<ul style="list-style-type: none"> <li>• Planting trees.</li> <li>• Engaging in nonfarm activities.</li> </ul>
7.	Gbetibouo (2009) - South Africa.	<ul style="list-style-type: none"> <li>• The use of extension services.</li> <li>• Access to information about climate &amp; weather.</li> </ul>
8.	Apata et al. (2009) – Nigeria.	<ul style="list-style-type: none"> <li>• Farming experience &amp; access to education.</li> <li>• Mixed crops &amp; livestock systems.</li> </ul>
9.	Akponikple et al. (2010) – Burkina Faso, Benin, Ghana, Togo & Niger.	<ul style="list-style-type: none"> <li>• Water &amp; soil conservation strategies.</li> <li>• Delay planting seasons.</li> </ul>
10.	ACCA (2010) – Ethiopia.	<ul style="list-style-type: none"> <li>• Water &amp; soil conservation strategies.</li> <li>• Adopt different crops varieties.</li> <li>• Changing planting dates.</li> <li>• Use of external fertilizers.</li> <li>• Adopt short duration's crops.</li> <li>• Access to extension services to both livestock and crops farmers.</li> <li>• Access of information on climate change.</li> </ul>
11.	Fosu- Mensah et al. (2010) - Ghana	<ul style="list-style-type: none"> <li>• Changing planting dates.</li> <li>• Crops diversifications.</li> </ul>
12.	Acquah- de et al. (2011) - Ghana.	<ul style="list-style-type: none"> <li>• Changing planting dates.</li> <li>• Crops diversifications.</li> <li>• Planting trees.</li> <li>• Soil conservation &amp; water harvesting techniques.</li> </ul>
13.	Nyanga et al. (2011) - Zambia.	<ul style="list-style-type: none"> <li>• Crops &amp; livestock diversifications.</li> <li>• Conservation agriculture and gardening.</li> <li>• Pastoral farmers seek support from veterinary officers.</li> </ul>
14.	Sofoluwe et al. (2011) – Nigeria.	<ul style="list-style-type: none"> <li>• Delay planting season.</li> <li>• Irrigations.</li> <li>• Soil conservations.</li> <li>• Adopt different crops varieties.</li> </ul>
15.	Mandleni et al. (2011) – South Africa.	<ul style="list-style-type: none"> <li>• Farmers attend extension services training.</li> </ul>
16.	Daninga et al. (2014) - Tanzania	<ul style="list-style-type: none"> <li>• Farmers engaged in off farm activities.</li> </ul>

Source: Adopted and modified from Juana (2013)

### 5.0 Measures taken by the Government of Tanzania on Climatic Change Adaptation

Tanzania Fisheries policy promotes conservation and sustainable development of the sector to the current and future generation. Fishing sub sector is getting less involved on climate change mitigation strategies compared to farming subsector (Sarah et al. 2013; Michelle et al. 2013). While small-scale farmers adopt different strategies

to climate risk as explained above, in West Africa, fishers tend to adopt alternative means of survival by engaging on bush hunting (Badjeck et al. 2010). Fish consumption levels and its benefits remain low in Tanzania compared to other countries where fisheries and aquaculture are beneficial in terms of food security and income (FAO 2012). For example, survey on fishery potentials in the country was done in 2010 only in Lake Victoria, while that of territorial sea was done in 1970's. The deep sea is unknown while Lake Tanganyika and Nyasa surveys were carried out in the 1990's. Table 5-1 shows the water body surface area in km<sup>2</sup>, fishery potential and the year of survey.

**Table 5-1: Tanzania Fishery Potential**

No.	Water body	Surface area in KM <sup>2</sup>	Fishery potentials	Year of survey
1	Territorial sea	64,000	100,000	1970's
2	Deep sea	223,000	Unknown	NA
3	Lake Victoria	35,088	1,027,338	2010
4	Lake Tanganyika	13,489	295,000	1998
5	Lake Nyasa	5,760	168,000	1994
6	Other inland water bodies	5,000	30,000	1970's
	<b>Total</b>	<b>346,337</b>	<b>1,620,338</b>	

Source: Adopted from Fatuma 2012

Tanzania signed the United Nations Framework Convention on Climate Change (UNFCCC) and Kyoto Protocol in 1996 and 2002 respectively. The country tried to ensure climate change impacts are addressed at the national level. The main objective of UNFCCC was to stabilize GHGs concentrations in the atmosphere to minimize the negative effects caused by anthropogenic interference with climate change. Therefore, in order to meet the objectives of UNFCCC, the Kyoto Protocol was adopted to provide legal binding emission reductions commitments (URT 2012). Furthermore, in 2007, Tanzania developed a National adaptation programme of action (NAPA) to fulfil the requirements of UNFCCC (Gemma et al. 2011). In 2006, the country also signed the Joint Assistance Strategy for Tanzania with 19 donors to provide medium term framework for managing country level cooperation with development partners.

In Tanzania, climate change policy for adaptation and mitigation is planned at the National level while implementation is done at Local Government Authority level (Riziki 2015). Local governments are directly involved with communities within their jurisdictions both at urban and rural context, although the designated climate changes policy in country is not yet implemented (Shemdoe 2013). However, coping with climatic impacts like drought and flooding is left to local communities or individuals at local government level (Herslund et al. 2012).

## 6.0 Financing of Climatic Change Adaptation Measures in Tanzania

It is a challenge for both local and international community on accessing, managing and spending effectively and efficiently finance related to climate change (Pius et al. 2013). Currently the country receives about US \$ 1.0 billion annually of Official Development Assistance (ODA) (Shardul et al. 2003). But it seems it is a challenge to identify the climatic related actions which may lead to uncertainty or sometimes over estimates of spending (Pius et al. 2013). Proper adaptation measures can reduce the effects of climate change. However significant amount of funds are needed to address the existing and future climatic change impacts because the costs keep on increasing (Global climate Adaptation Partnership 2011). For instance, by 2030 the cost is estimated to be 1.0 billion US\$ per year. It was estimated by DFID as cited by Gemma et al. (2011) that in order for the country to build resilience and adaptive capacity to climatic change impact, about US\$ 100 to 150 million is needed per year. Tanzania's budget of activities related to climate change has increased by 57% from US \$244.88 million in financial year 2009/10 to US \$559.72 in 2012/13. The increment is directly proportional to the percentage share of the total budget. Donors have contributed to the increased budgetary allocation on activities related to climate change. Table 6-1 shows the public expenditure on climatic change related activities while the Table 6-2 illustrates the climate change related programs by the ministries, though the two ministries (Ministry of Agriculture, food security and cooperatives; Ministry of Livestock development and Fisheries) which are mostly affected by climate change are not included in the programmes.

**Table 6-1: Public Expenditure on Climatic Change Related Activities from 2009/10 to 2012/13**

Year	2009/10	2010/11	2011/12	2012/13
Total amount (US \$ in millions*)	244.88	320.46	506.62	559.72
% share of the total Budget	4.2	4.8	6.4	6.5

Source: Adopted from Pius et al. 2013

\*exchange rate used is Annual average exchange rate

**Table 6-2: Ministries' Climatic Change Related Programs**

Ministry	Development Projects	Project Objectives
Office of Vice President	Climate Change Impacts, Adaptation and Mitigation (CCIAM) Programme.	To promote afforestation, natural forest conservation, reforestation and better agricultural practices for improved livelihoods.
Office of Vice President	Mainstreaming Environment and climate change.	Guidance provision on how to mainstream responses to climatic change within economic development.
Office of Prime Minister	Strengthening National Disaster Preparedness.	Enhancing national capacity to reduce vulnerability and mitigate disasters.
Office of Prime Minister, Regional Administration and Local Government (RALG)	Dar er Salaam Rapid Transport Programme (DART).	Provision of mass transport program which will help to improve the mobility of the city and reduce emissions.
Office of Prime Minister, Regional Administration and Local Government (RALG)	Mainstreaming of Sustainable Forest Management.	Supporting key Ministries, Departments and Agencies together with Local Government Authorities to integrate climate change adaptation and mitigation into their plans and strategies.
Ministry of Energy and Minerals	Rural photovoltaic (Pv) - Market Barrier Removal.	Reducing Tanzania's energy-related carbon dioxide emissions by introducing photovoltaic as a substitute for fossil fuel utilized in for lighting in rural areas.
Ministry of Energy and Minerals	Rural Electrification.	Avoiding climate change, deforestation, air pollution and land degradation.
Ministry of Energy and Minerals	Climate Change Adaptation and Mitigation.	Supporting climate change adaptation and mitigation.
Ministry of Education and Vocational Training	Climate Change Adaptation and Mitigation.	Enhancing national capacity to reduce vulnerability and mitigate disasters.

Source: Adopted from Pius et al., 2013

It can be highlighted that, Tanzania is not adequately adapted to the current climatic risk especially on primary sectors despite the fact that they are highly affected by the climatic change. Therefore, urgent action is needed to fill the gap of existing adaptation deficit. This can include the involvement of most vulnerable sectors, ministries and other stakeholders in identifying climate change adaptation and mitigation programmes and then implementing, monitoring and evaluating of those projects.

## 7.0 Conclusion

Oceans are facing a diverse pressure resulting from human activities while at the same time impact from climate change is growing. Although a number of efforts have been undertaken to create awareness on climatic changes at local and global levels, still majority of people do not have sufficient knowledge and information on the causes, impacts and adaptive measures for climate change. Lack of data on impact of climate change on fishing contributes to negligence of the fishing subsector in proper policy making particularly in developing economies like Tanzania. This indicates that appropriate adaption measures are required such as National Climate Policy and strategies to ensure ecological sustainability. Fishers and their organisations should be involved in policy and strategy formulation in mitigation of climate change impacts, because these are among the groups most vulnerable to the effects caused by climate change. In that the same vein, the climate change agenda needs to be mainstreamed to all government levels otherwise human, economic and physical negative impacts will be observed. More effort is needed to enhance mind set change on causes of climate change to all stakeholders including rural communities, because they are the most vulnerable groups to the climatic change risks.

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