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Living with climate change: avoiding conflict through adaptation in Malawi

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Abstract

In recent years, research on climate change and human security has received much attention among policy makers and academia alike. Communities in the Global South that rely on an intact resource base will especially be affected by predicted changes in temperature and precipitation. The objective of this article is to better understand under what conditions local communities can adapt to anticipated impacts of climate change and avoid conflict over the loss of resources. The empirical part of the paper answers the question to what extent local communities in the Chilwa Basin in Malawi have experienced climate change and how they are affected by it. Further, it assesses one of Malawi's adaptation projects designed to build resilience to a warmer and more variable climate, and points to some of its limitations. This research shows that not all adaptation strategies are suited to cope with a warmer and more variable climate.

1 Introduction

It is a fact that anthropogenic climate change has and is going to have severe impact on developing countries, especially those with a climate-sensitive economy (DARA, 2012). The debate on the human security implications of climate change has gained momentum in recent years. This is due to a lively policy debate as well as to several publications in prominent journals and books (Brzoska and Scheffran, 2013; Scheffran et al., 2012). While the debate on climate change and violent conflict remains inconclusive, new research on linking climate change to human security seems to be more promising (Webersik, 2010). The term human security is more encompassing, including issues pertinent to food security or public health. The term "human security" acknowledges the fact that humans are both victims and agents of change. While humans are affected by climate change impacts, they are at the same time able to mitigate the drivers of climate change as well as able to adapt to real and anticipated changes. Climate change adaptation is highly relevant for a developing country context as typ-

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ically low-income countries are least responsible for anthropogenic climate change. Yet, given their predominantly climate-sensitive economies, they are most severely affected by it. Current and future changes in temperature and precipitation variability, and changes in the intensity of natural hazards will most certainly affect food security, public health and agricultural productivity in low- and middle-income countries.

This reflects the notion that climate change is a "threat multiplier" exacerbating existing tensions, such as poverty; however, to what extent climate change will increase the likelihood of armed conflict remains questionable. This debate to date has been dominated by climate-centric research, examining potential causal links between climate (some studies use temperature, others precipitation) and armed conflict using large-n statistical studies (Buhaug, 2015; Burke et al., 2009; Hsiang et al., 2011; Miguel et al., 2004). Though the authors introduce control variables to ensure the modelling is robust, these studies are often static in terms of time and space, and remain speculative about the mechanisms through which climate drives conflict (Buhaug et al., 2014). Yet, the most recent IPCC report is supporting this claim that climate change is an important driver of war (Gleditsch and Nordås 2014).

What is missing from this analysis is to put climate change impacts and its social consequences into context. It misses the multiple strategies local communities have developed over time to adapt to a changing environment, and hence be able to avoid conflict. Even when adaptation becomes unavoidable, it needs to be sustainable. Some adaptation strategies, as demonstrated in this article, are important in the short-term to relieve some of the pressures climate change may pose but fail in the long-term in securing a sustainable livelihood.

The purpose of this article is to better understand human-environment interactions, more specifically climate change adaptation and its limitations. By taking the example of Lake Chilwa Basin in Malawi, this article demonstrates to what extent local communities are affected by climate change and how they adapt to it. Most important, this research demonstrates that not all adaptation strategies are suited to cope with

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a warmer and more variable climate. Adaptation strategies may work in the short-term but have their limitations, which need to be taken into account.

The article is divided in a theoretical and empirical part. The theoretical part evaluates linkages between climate and human security, followed by a discussion on climate change adaptation and its limitations. The empirical part draws from a field study in Malawi, more specifically the Lake Chilwa Basin. This region is home to 1.5 million people, most of them depending on its natural resources for sustaining livelihoods. This section sheds light on how climate change affects local fishing communities in the Basin and critically evaluates the long-term effectiveness and relevance of an adaptation project implemented in these communities.

2 Human security, climate change adaptation and its limitations

2.1 Climate change and human security

As the introduction illustrates, Malawi meets the dominant indicators used by typical neo-Malthusian resource scarcity-conflict studies. It is extremely poor, with a high population growth, it is highly dependent on natural resources and is vulnerable to climate change. Despite these facts, Malawi is yet to see any major armed political conflicts. Nonetheless, climate change may have severe impacts on rural poor and should therefore be considered as a real threat to the population's human security. Sustainable adaptation strategies can therefore be seen as a means to avoid conflict situations.

Much of the literature on climate change conflict has been dominated by neo-Malthusian ideas, emphasising a deterministic view of linking population pressures and resource scarcity to undesirable outcomes. This article argues that global environmental change, poverty, and society must be put into context. A region in southern Malawi was selected with great demographic and environmental challenges, fitting the neo-Malthusian discourse yet without displaying any signs of societal failure over time.

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One explanation for Malawi's peaceful pathway is perhaps found in the ways the society copes with and adapts to environmental and social change.

2.2 Climate change adaptation

In the 1990s and early 2000s the climate change debate was mostly focused on how to mitigate climate change. In recent years growing attention has been given to adapting to climate change at local to global level (Adger et al., 2009). At the thirteenth Conference of Parties (COP 13) of the United Nations Framework Convention on Climate Change in Bali, 2007, adaptation was acknowledged as one of the four "building blocks" required to respond to climate change alongside mitigation, technology cooperation and finance (Dodman and Mitlin, 2013). At the sixteenth Conference of Parties (COP 16) in Cancun, Mexico, the parties adopted the Cancun Adaptation Framework (CAF), which affirms that adaptation must be addressed at the same level as mitigation. The framework illustrates the urgency and international commitment to prioritise adaptation and states that:

"Enhanced action and international cooperation on adaptation is urgently required to enable and support the implementation of adaptation actions aimed at reducing vulnerability and building resilience in developing country Parties, taking into account the urgent and immediate needs of those developing countries that are particularly vulnerable", (UNFCCC 2011: 4).

The literature provides a broad spectrum of understandings of the concept. Adaptation has its origin from natural science and was later adopted by anthropologists and social scientists and used in relation to human systems. When the climate change discourse evolved, the concept of climate change adaptation emerged and has gained a central position within academia and policymaking (Smit and Wandel, 2006). Climate change adaptation within social sciences mainly focuses on human systems and human-environment systems. Adger et al. (2003: 192) provides a useful definition and refers to climate change adaptation as "the adjustment of a system to moderate the

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impacts of climate change, to take advantage of new opportunities or to cope with the consequences".

Adaptation initiatives may be carried out by governments, IGOs, NGOs, CBOs or individuals and may be either anticipatory or a reactive action. The aim of adaptation is reduced vulnerability or increased resilience and it involves changing processes or practices in social and ecological systems through reducing potential damages or engaging in new opportunities (Adger et al., 2007). Climate change adaptation rarely only focuses on factors related to climate change. Adaptation may incorporate any practices or initiatives that increase resilience to elements constituting threats to communities that may aggravate through climate change, such as poverty.

According to the Fifth Assessment Report of the IPCC (Niang et al., 2014) Africa is one of the most vulnerable continents to climate change due to its high exposure and low adaptive capacity. Both the Fifth and Fourth Assessment Reports stress the need for Africa to invest in increasing its adaptive capacity as climate change is known to bring future stress into the continent's food security, eco-systems, human health and increase water stress throughout Africa (Boko et al., 2007; Niang et al., 2014). The agriculture sector is particularly threatened by climate variability and climate change, which increases the continents economic vulnerability as there is a heavy reliance on agriculture in both local livelihoods and national GDP (Boko et al., 2007). Key adaptation strategies that are recognised as beneficial for Africa by the IPCCs Fourth Assessment Report are diversification of livelihood activities, adjustment in farming operations, income generating projects, selling of labour and the move towards off-farm or non-farm livelihood incomes (Boko et al., 2007). These adaptation strategies are considered to be relevant also for Malawi.

2.3 Limitations of climate change adaptation

Not all adaptation strategies are sustainable, with limited long-term effectiveness. For instance, adapting to climate change may require human migration and resettlement. Though there is little evidence that environmental-induced migration has the potential

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to trigger armed conflict, it most certainly will create major challenges for hosting communities, especially in regions that are already densely populated, for example Malawi (Webersik, 2012). Climate related outmigration could also change the social fabric of those communities that stay behind. With shrinking populations, markets and political institutions can get distorted making it more difficult for those left behind to adapt to climate change (Barnett, 2012). In other cases, adaptation strategies that do not take into consideration the long-term impacts of climate change may prove unsustainable. Livelihood diversification is a laudable approach, however, if farming diversification activities or commercialisation of agriculture remain climate-sensitive, the long-term adaptation effect may remain limited as the following case study in the Lake Chilwa Basin in Malawi demonstrates. Other unintended social and environmental consequences of climate change adaptation can stem from large infrastructure projects, such as dam-building for hydropower and water storage, biofuel plantations, and water relocation projects, all relevant for the African context (de Sherbinin et al., 2011). For instance, the growing number of biofuel plantations bought by foreign investors has triggered a debate on land grabbing in Africa (Matondi, 2011). Most important, if people are forced to relocate due to large infrastructure projects or land-use change, their economic potential and environmental vulnerability need to be evaluated for current and future climate change impacts, as well.

3 Explaining the context of Malawi

Malawi is one of the smaller countries in Sub-Saharan Africa, landlocked between Mozambique, Zambia and Tanzania. Nyasaland, as it was previously known, was under British rule from 1891 to 1964 when it gained its independence. After three decades of one-party rule with Hastings Banda as president, Malawi held its first multiparty elections in 1994 (CIA 2015). In contrast to the majority of the African countries, Malawi has not experienced an armed conflict after independence (Uppsala Conflict Data Programme, 2012).

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Malawi is one of the most densely populated countries in Africa with a population of approximately 15 380 000 on an area of 94 276 km^2 (EAD, 2010; UNDP, 2015). It has a high population growth of 2.80 %, according to 2008 estimates (NSO, 2015). It is one of the least-developed countries (LDCs) with a gross national income (GNI) of USD 850 purchasing power parity (PPP) per capita and ranks as 171 out of 179 on UNDP's human development index (UNDP, 2011). 74 % live on less than a dollar (PPP) a day (2004, estimate) (UNSTATS, 2012).

The country's economy is predominantly agricultural and Malawi depends on just a few cash crops. One-third of the country's gross domestic product (GDP) comes from agriculture, forestry and fishing. Table 1 presents Malawi's export commodities in which agricultural commodities such as tobacco, tea and sugar dominate. Together they constitute nearly 80 % of Malawi's exports.

The country is highly vulnerable to the effects of climate change and variability in the rainy season due to the country's dependency on natural resources. Changes such as rainfall onset, dry spells and distribution patterns can seriously jeopardise the country's economy (EAD, 2010). Such changes also threatens the country's food security and puts further pressure on Malawi's poor as most households rely on subsistence rainfed farming for their livelihood (Kalanda-Joshua et al., 2011). Climate change may therefore threaten the majority of Malawi's population, of whom approximately 90 % live in rural areas (Stringer et al., 2009).

3.1 Malawi and climate change

There have been some studies conducted on Malawi and climate change. It must be noted that there is still no consensus if the changes that Malawi is experiencing should be understood as climate change or climate variability, but studies have found some significant changes, especially in regard to temperature. UNDPs Climate Change Country Profile concludes that Malawi is experiencing an increase in mean annual temperature. From 1960 to 2006 the mean annual temperature has increased by 0.9 °C, an average rate of 0.21 °C per decade. It is predicted that the temperature will continue

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to rise by 1.1 to 3.0 °C by the 2060s and further by 1.5 to 5.0 °C by the 2090s. Observations show a significant increase in the frequency of hot days and nights throughout the year, with the highest increase during the summer months (December, January and February). The study found no statistically significant trends in precipitation. The future predictions of annual rainfall show no substantial change but it is predicted that it will fall over a shorter period causing heavier rainfall events. It is however noted that the different models predict a wide range of possible outcomes. This is due to Malawi's geographical position, located as it is between two regions of opposing climatic response to El Niño. Eastern equatorial Africa usually receives above average rainfall during El Niño while south-eastern Africa tends to experience below average rainfall. La Niña normally cause the opposite effect (McSweeney et al., 2012).

A study conducted by the Department of Climate Change and Meteorological Services (DCCMS) in Malawi, found that there are some long-term changes in precipitation and a general decrease in precipitation is documented, but regional variations are also found. Just as UNDP, they conclude that the mean temperature in the whole country is higher than it was two decades ago with warmer winters and summers (EAD, 2010).

4 Living with climate change: why climate change is relevant for Malawi

Scientific studies show evidence of a Malawi in change. While there is no consensus that the documented changes are a definite sign of climate change, they reveal a change, whether or not these are linked to climate change or climate variability. The scientific material is strengthened by testimonies from local communities in the Lake Chilwa Basin. Findings from case study of the Lake Chilwa Basin Climate Change Adaptation Programme (LCBCCAP) and its Women Fish Processing Groups (WFPGs), revealed that the women members of the groups have experienced a change in the climate in the Lake Chilwa Basin.

The study adopted a qualitative methodology and the data was collected over two months from January to March 2012. The findings are based on semi-structured in-

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terviews with 18 women who were members of the three different WFPGs located in separate locations around the lake. The objective of the WFPGs is to enhance adaptive capacity through fish processing. WFPG-project does this by (1) improving traditional methods of processing fish in order to increase quality and reduce wastage, which increases the women's income and savings, and (2) providing the WFPG members with training, such as business management, climate change, gender-issues and group dynamics.

4.1 Climate change in the Lake Chilwa Basin: local experiences

For many, climate change is something that belongs to the future. For the women in the Women Fish Processing Groups (WFPG), who rely on natural resources for their food security and livelihood every day, climate change is part of the present. The study found that for the women in the WFPG climate change is already affecting their lives. Out of the eighteen women that participated in the study, all agreed that the climate is changing.

The major concern for the WFPG members is related to changes in rainfall pattern. There are two main seasons in Malawi, one dry and one wet. The rainy season normally starts in November and ends by the end of March and throughout the period they expect daily rain. The rainy season is followed by a six months long dry season with hardly any rain (Njaya et al., 2011). Any change to the start or end date of the rainy season is regarded as a change in the rainfall pattern. In addition to the start and end date of the season, the change in rainfall pattern also has to do with the frequency of rain within the rainy season.

According to the respondents, the rainy seasons had become highly unpredictable in the past four to five years as they had been delayed, inconsistent and short. The women explained that they had experienced that the rain came as erratic, unpredictable rain and there were longer drier periods within the rain season, also known as dry spells. The rainy season of 2011–2012 is a good example of the recent trend. The women expected the rain to start in November, but instead it started in late December and

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ended in February instead of March. When the rain came, it was erratic and frequently interrupted by dry spells.

According to the scientific studies conducted on precipitation trends in Malawi there has been no significant change in annual rainfall. However, as presented in UNDPs climate change country profile on Malawi (McSweeny et al., 2012) predictions for the future is that the rain will fall over a shorter period of time and cause heavier rainfall events. This is in line with the women's experience of the rainy season of 2011–2012. Even though there is no reduction in the annual rainfall, unpredictable rainy seasons can be just as challenging for subsistence farmers as a reduction in rainfall. A study examining climate variability would be of interest in order to compare and evaluate the respondents' experiences, but as noted by Jury and Mwafulirwa (2002) very little work has been done on Malawi and climate variability.

Despite the scientific evidence of warmer annual mean temperatures and a significant increase of hot days (McSweeny et al., 2012), the women did not put much emphasis on it when asked specific experiences with climate change. In fact, only one woman spoke of warmer temperatures explaining that it had become increasingly difficult to work outside during the day due to higher temperatures. The woman however linked it to the fact that there are fewer trees than before due to over-exploitation of trees for firewood. Without the shade from the trees, the temperatures felt significantly warmer.

Malawi is a country that is prone to extreme weather events such as flood and drought and since the late 1970's the country has experienced an increase of such events (Chipotha and Mphepo, 2011). Out of eighteen women, eight had noticed an increase in droughts. Floods were not mentioned, but it should be noted that the area is not prone to floods (see Fig. 1).

4.2 Impacts of climate change: local perspectives

The study found that the climatic changes the women experienced had a significant impact on their everyday life such as their food security, subsistence farming and liveli-

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hood. In other words, climate change exacerbates some of the most important human security issues of rural poor.

4.2.1 Food security and subsistence farming

In the Lake Chilwa Basin 85 % of the population rely on rainfed subsistence farming for their food consumption (Njaya et al., 2011). Since it is impossible to cultivate without irrigation during the dry season, which the majority do not have access to, it is crucial that the rainy season is predictable and stable for the households to be able to cultivate sufficient amounts for the whole years. According to the women, the past four years have been challenging, as their garden plots have produced fewer crops. The women had tried different types of crops such as hybrid maize, groundnuts, pigeon peas and cassava, but none have produced satisfying results.

One of the main challenges for the rural poor in Malawi is to know when to plant. In Africa, farmers have usually relied on their local knowledge to make decisions regarding sowing (Kalanda-Joshua et al., 2011). According to the WFPG members, it used to be common to plant when the first rain came. Previously it was considered optimal as the rain usually continued to come consistently. Now they find that the rain is not as predictable as dry spells often occur right after the first rain. When a dry spell occurs the planted crops will fail to grow and consequently the households will have to replant. One of the women explained that she had planted maize three times this season, but every time it had withered due to lack of rain. As it is a costly affair to replant, such events push the people of Malawi further into poverty. The woman had no plans of replanting, which means that she had to purchase food throughout the year.

Several studies have similar findings (Action Aid, 2006; Nagoli, 2010; Kalanda-Joshua et al., 2011). In Action Aid's (2006) study on climate change and smallholder farmers in Malawi, farmers complained about changes in the rainfall pattern and higher temperatures, which has made it difficult to know when to plant and additionally reduced the harvest. Climate variability is therefore making local knowledge less reliable and it is threatening their main source of knowledge (Kalanda-Joshua et al., 2011).

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As a consequence of the uncertainties in the rainy season and the harvest, the women felt that they no longer could rely on subsistence farming. The majority of the women therefore cultivated less and bought bigger proportions of their food from markets. It is however viewed as a luxury that many cannot afford. The women had however been able to increase their income and savings substantially through the WFPG and were therefore capable of doing so.

4.2.2 Impacts on livelihoods

The poor rainy seasons and higher temperatures also had a negative effect on the women's business. With fish processing as their main income generating activity they were highly dependent on the fish stock in the lake.

Lake Chilwa is a closed drainage lake, meaning that no water flows out of the lake. Thus, the water level is a direct result of the amount of rainfall that falls during the annual rainy season and the amount of water that evaporates. Because Lake Chilwa also is shallow it is prone to drying. When it dries it takes one to two years for the lake to refill and about three to four years for the fishery to recover (Njaya, 2011). One of the concerns related to climate change is that higher temperatures and a possible reduction in precipitation will cause the lake to dry up more frequently. In the past century the lake has dried nine times: 1903, 1913–1916, 1922, 1934, 1943–1949, 1967, 1973, 1975 and most recently in 1995–1996 (Chapotera, 2012).

When the water level sinks the fish stock is reduced, which increases the price of the remaining catch and reduces the women's income. If the lake dries completely the women are temporary out of business for two to four years. During the data collection the women were worried that the lake would dry within 2013. As Fig. 2 demonstrates, the lake did not dry up at the end of 2013 but lost quite some wetland areas, especially in the northern part of the lake, and as a consequence, decreased in size. In, 1993 and 1994 the region had similar records that caused the lake to dry the following year (Ngozo, 2012).

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The changing climate is having a significant impact on the rural poor's human security. It is pushing the people living in the Lake Chilwa Basin further into poverty by affecting the natural resources they depend on. Unpredictable rainy seasons have made subsistence farming challenging and there is a concern that Lake Chilwa will dry up more frequently. It is questionable whether or not the changes are a result of climate change and hence a long-term trend or if it is a result of climate variability and therefore a short-term trend. Nevertheless, the WFPG members express that the changes are serious threats to the livelihood and food security of the whole Lake Chilwa Basin (see Fig. 3). The study therefore indicates that climate change may have devastating effects on the most fundamental needs for the rural poor. Such issues may further exacerbate into health issues such as malnutrition, starvation and diseases.

5 Climate change adaptation and its limitations in Malawi

Climate variability and climate change will have serious implications for rural poor in Malawi that depend on natural resources for their livelihood and food security. Adaptation programmes are developed in order to reduce the vulnerability of the poor to present and future events of environmental hazards. LCBCCAP is such a programme. While there are undoubtedly positive outcomes from the WFPG-project, there are also certain limitations that are important to recognise as these may have a significant affect on the members' ability to adapt to climate change.

The case study found that the members of the WFPG were satisfied with their involvement in the LCBCCAP programme. Their income and savings had increased[1], they were no longer dependent on their own harvest for food consumption as they had

[1]Data on income and savings was only available from two WFPG as the Kachulu group had not been up and running long enough for the data from their group to be relevant. It should be noted that the data on income and savings is drawn from the women's memory and thus its reliability is questionable since several of the women note that they had little knowledge of how to manage their income prior to training from the project. The information provided by the

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enough money to purchase food, they enjoyed working in a group instead of individually and were pleased with the different training LCBCCAP offered them (see Table 2 and Fig. 4). The programme had also managed to increase the fish value chain in the lake. Because of the new strategies that the women were using there was less waste and the women were able to produce a product with higher quality and better taste, hence they could also increase the price of the fish product. These are all positive outcomes and the LCBCCAP has in many ways contributed towards enhancing the women's financial and social position, but there are some concerns.[2]

It is problematic that the women's livelihood is dependent on Lake Chilwa. In the last century the lake has dried up nine times and it is considered normal that it happens every ten to twenty years (Chapotera, 2012; Njaya et al., 2009). It is therefore not a question whether the lake will dry again, but when. Further, a concern is that climate change, with higher temperatures and more unpredictable precipitation, will cause the lake to dry even more frequently. Previous experiences have proven that when the lake dries completely the whole fish sector collapses. However, according to Njaya et al. (2011) the people who depend on the lake are well adapted to the cycles of change. When the lake dries there are large-scale shifts from fishing to farming, pastoralism and other occupations. Migration is also common. However, migration may be problematic as it puts extra constrain on the natural resources in the area where people migrate and conflicts may arise between the locals and the migrants. This is a concern that also Chiotha is worried about in the Lake Chilwa district (Ngozo, 2012).

Nine out of eighteen WFPG members remember the last time the lake dried in 1995/96 well. Looking back at how communities and individuals were able to cope

women is nonetheless a reflection of the positive impact the project has had on the their income and savings.

[2]It should be noted that during the time of data collection in January 2012 the WFPG were still in the start-up face as the groups had only been active for six to eight months and the LCBCCAP is still developing their projects as they are learning from the their experience and from the feedback given by the WFPG members.

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at that time gives valuable insight into people's ability to adapt to present and future climate changes. The women were asked about what they remember it and how they responded to the incident. They mentioned that the fish sector collapsed and people started migrating to other areas to find work and food. They got involved with causal day labour, known as *ganyu* or utilised the empty land of the lake to cultivate vegetables. Others started processing maize flour instead of processing fish and the women were forced to walk further to fetch water.

The findings indicate that the communities struggled when Lake Chilwa dried in 1995/96. In order to survive people engaged in alternative income generating activities or migrated to find employment and food. During a new incident, the women will most likely have to take the same measures as their source of income will vanish. While it indicates that they are able to cope, it does not indicate that LCBCCAP has significantly increased their adaptive capacity as their reliance on the fish and farming sector still makes them highly vulnerable to future events. It can therefore be argued that LCBCCAP should bear this in mind and design adaptation strategies that are not solely dependent on a sector and a resource that is threatened by climate change like the WFPG-project is.

Livelihood diversification is recognised as an effective strategy for rural poor to decrease their vulnerability towards environmental and economic shocks, and hence climate change (Simtowe, 2010). Nelson et al. (2009) explains that there is a correlation between the diversity of livelihood strategies and adaptive capacity due to the possibility to substitute between alternative livelihood strategies. By having more than one source of income it is possible to spread the risk in case there is a poor season within one sector. A study conducted on fishermen in the basin from the 1970s identified that the wealthiest fishermen in the basin were the ones who had diversified their income (Njaya et al., 2011). LCBCCAP also view diversification as an effective adaptation strategy as they state that: "It is recognized that resilience to climate change involves household's diversifying their livelihood strategies to have options for managing drought, floods, and temperature increases. Thus, in communities throughout the

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Basin, the project will work to identify ways in which to diversify and enhance their livelihoods, increase productivity of ecosystems and rural incomes, and reduce vulnerability to economic and environmental shocks", (LEAD et al., 2009: 15).

The majority of the women however, were not diversifying their livelihood strategies. Out of eighteen women only two reported that they had another income generating activity and only one women were planning on introducing a new strategy. The two women were involved in beer brewing and boat construction and the third woman wanted to start cultivating rice. The rest were relying on fish processing as their source of income. Eight out of the women did however mention that they were involved with *ganyu* when facing economic difficulties. *Ganyu* refers to casual daily wage labour. It is often unskilled agricultural labour and is a common livelihood strategy in Malawi (Simtowe, 2010). While it serves as a backup strategy for poor seasons, it is not a reliable source of income. Further, out of the ten women who were married, eight of the husbands were working either in the fish sector or as farmers, hence also their income was dependent on natural resources. This is problematic because the lake dries due to low precipitation over more than one year, which will also have a negative effect on the agriculture sector. Overall the study found that the WFPG members and their household had a weak income base that is highly vulnerable to climate change due to their dependence on natural resources and their low livelihood diversification (see Table 3).

The case study of the LCBCCAP and WFPG illustrates the importance of designing climate change adaptation strategies that take into consideration future environmental events and how the strategies will affect the beneficiaries' adaptive capacity during the event. Enhanced capacities within the fish sector will be of little value when the lake actually dries. Without an income the WFPG will be pushed further into poverty.

In order for LCBCCAP to improve the WFPG-project and further reduce the women's vulnerability towards climate variability and climate change, diversification may be a step in the right direction However, for diversification to be an effective adaptation strategy for the WFPG members it is necessary that the additional income sources

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do not react similar to a change in the climate as the fish sector. Finding a source of income that is not dependent on a natural resource may very well be the best option.

6 Conclusion and lessons learned

Climate change poses a significant threat to human security in Africa, much due to the population's dependency on climate-sensitive resources for their livelihood, high poverty rates and thus limited adaptive capacity. This study presents empirical evidence of fishing communities' experiences with changing climate patterns around the Lake Chilwa Basin in Malawi and how these threaten their livelihood and subsistence farming and thus exacerbating poverty and food insecurity in the region.

The study of Women Fish Processing Groups in the Lake Chilwa Basin in Malawi demonstrates that local communities vulnerable to climate change can at least to some extent adapt to climate change impacts using low-cost strategies based on local practices. Adaptation is key, and if functioning well, it can perhaps help to avoid tensions and conflict over the loss of a natural resource base.

However, if adaptation strategies fail and local communities are forced to resettle (for instance in case Lake Chilwa is to dry up), social conflicts in receiving areas are likely to arise. Yet, whether this has occurred in the past when the lake dried up requires further investigation.

The example of Lake Chilwa and the likely increase in frequency of drying illustrates that for adaptation strategies to decrease the rural poor's vulnerability to the long-term as well as the short-term impacts of climate change, it is essential that they take into account the affect of climate change on the natural resources that the communities rely on. Adapting existing income-generation activities may prove to be insufficient. Strategies that focus on reducing the overall dependency on climate-sensitive natural resources by diversifying livelihoods will arguably increase the communities capacity to adapt to and cope with adverse effects of climate change to a greater extent. In sum, limitations and unintended consequences of climate change adaptation strate-

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gies need to be taken seriously to ensure effective and lasting adaptation. On parallel, policy makers need to acknowledge and to strengthen existing coping mechanisms local communities have developed over time to adapt to environmental change.

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Table 1. Export commodities 2010.

Export commodities	Value (K'mn)	Percentage
Tea	12 078.6	8.6 %
Tobacco	87 490.4	62.2 %
Cotton	1751.5	1.2 %
Sugar	10 324.3	7.3 %
Uranium	17 093.2	12.2 %
Pulses	2304.3	1.6 %
Rice	133.2	0.1 %
Coffee	3111.3	2.2 %
Nuts	1073.8	0.8 %
Spices	319.1	0.2 %
Beverages, Spirits and Vinegar	1083.4	0.8 %
Natural Rubber	1432.6	1.0 %
Wood Saw and Plied	1666.3	1.2 %
Live Trees	26.3	0.0 %
Cotton Fabrics	89.7	0.1 %
Skin and Hides	97.7	0.1 %
Woven Fabrics of Staple Fibres	142.2	0.1 %
Apparel Clothing Knitted	364.2	0.3 %

Source: (GoM 2010:79).

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Table 2. Respondents' income before and after joining a WFPG.

Respondent	Present Income (MKWA)	Previous Income (MKWA)	Difference	Increase in income
S7	3000	1000	2000	200 %
S8	5000	1250	3750	300 %
S9	2000	1500	500	33 %
S10	600	300	300	100 %
S11	2000	1000	1000	100 %
S12	2500	600	1900	317 %
T13	3000	1000	2000	200 %
T14	3000	1000	2000	200 %
T15	4000	1500	2500	167 %
T16	5000	1000	4000	400 %
T17	2000	1000	1000	100 %
T18	5000	500	4500	900 %
Mean	3091	971	2120	218 %

Source: Author's research, 2012.

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Table 3. Livelihood diversification.

	Wife		Husband
	Main source of income	Other sources of income	Main source of income
K1	Fish processing	Ganyu	Fish sector
K2	Fish processing	Ganyu	Farmer
K3	Fish processing		Fish sector
K4 (separated)	Fish processing	Ganyu, beer brewing	N/A
K5	Fish processing	Building boats	Fish sector
K6 (widow)	Fish processing	Ganyu	N/A
S7	Fish processing		Farmer
S8	Fish processing	Ganyu	Fish sector
S9	Fish processing		Non-NR based
S10 (widow)	Fish processing		N/A
S11	Fish processing		Fish sector
S12	Fish processing		Non-NR based
T13 (divorced)	Fish processing		N/A
T14	Fish processing		Farmer
T15 (widow)	Fish processing	Ganyu	N/A
T16 (separated)	Fish processing		N/A
T17 (widow)	Fish processing	Ganyu	N/A
T18 (separated)	Fish processing	Ganyu	N/A

Source: Author's research, 2012.

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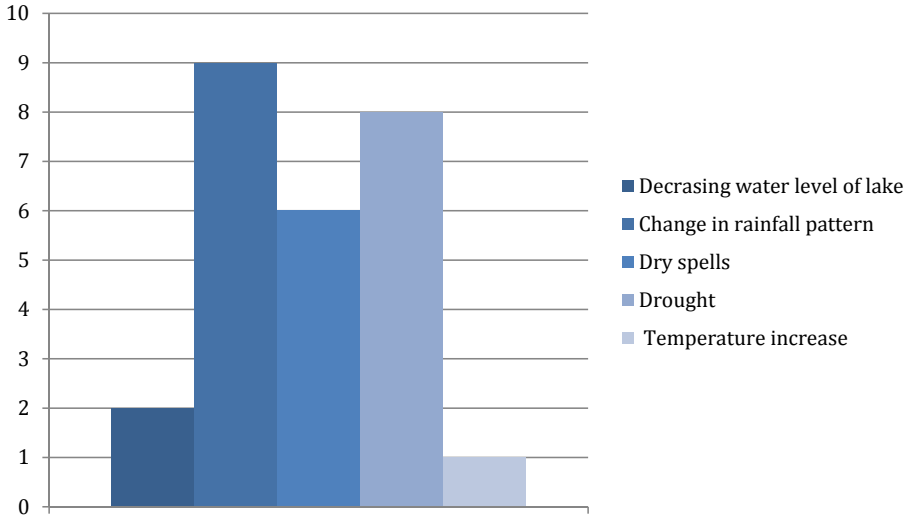

Figure 1. The respondents experience with climate change (source: Author's research, 2012).

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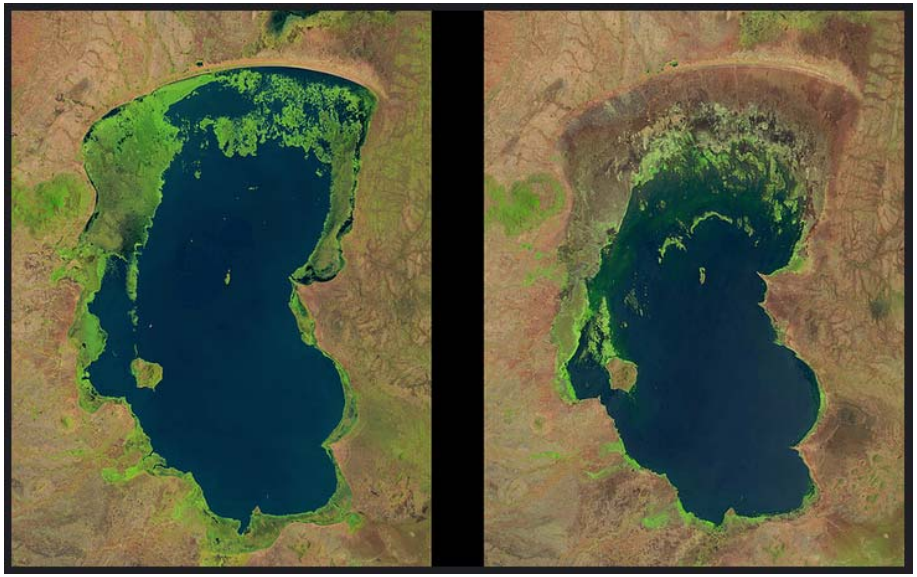

Figure 2. The Landsat images show the size of Lake Chilwa in October 1990 and November 2013 and the changes in the internationally recognised wetland areas (in bright green) surrounding the lake (source: USGS, 2014.).

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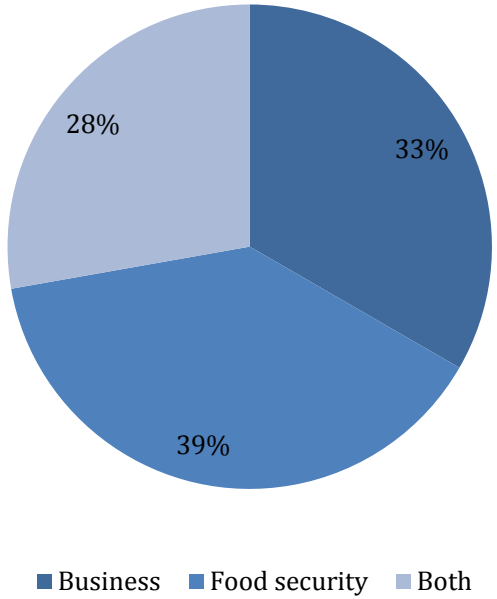

Figure 3. The respondents' perception of how climate change affects them (source: Author's research, 2012).

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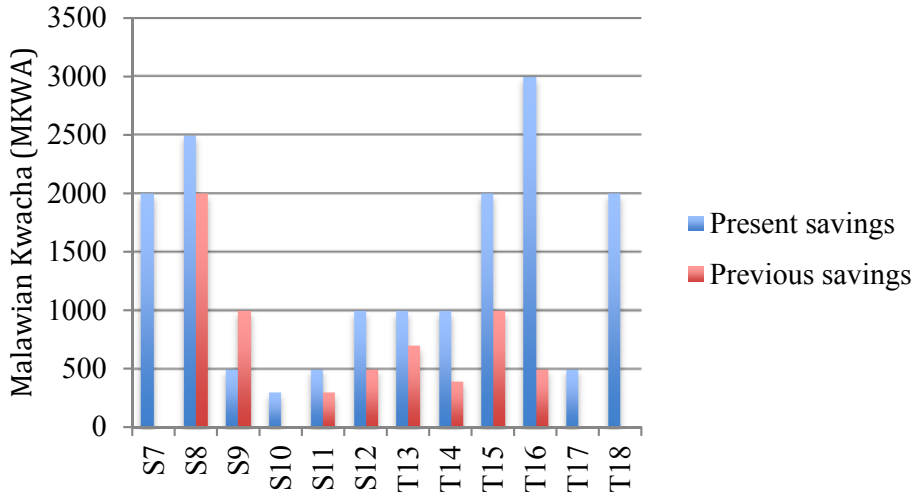

Figure 4. Respondent's savings before and after joining a WFPG (source: Author's research, 2012).

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