

1 Vulnerability to climate change and adaptation strategies of local communities in  
2 Malawi: Experiences of women fish processing groups in the Lake Chilwa Basin  
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## 5 **Abstract:**

6 In recent years, research on climate change and human security has received much  
7 attention among policy makers and academia alike. Communities in the Global South  
8 that rely on an intact resource base and struggle with poverty, existing inequalities and  
9 historical injustices will especially be affected by predicted changes in temperature and  
10 precipitation. The objective of this article is to better understand under what conditions  
11 local communities can adapt to anticipated impacts of climate change. The empirical  
12 part of the paper answers the question to what extent local women engaged in fish  
13 processing in the Chilwa Basin in Malawi have experienced climate change and how  
14 they are affected by it. The article assesses an adaptation project designed to make fish  
15 processing women more resilient to a warmer and more variable climate. The research  
16 results shows that improving fish processing and marketing as strategies to adapt to  
17 climate change have their limitations. The study concludes that livelihood  
18 diversification can be a more effective strategy for Malawian women to adapt to a more  
19 variable and unpredictable climate rather than exclusively relying on a resource base  
20 that is threatened by climate change.

21

22 **Keywords:** climate change, Malawi, climate change adaptation, human security

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27

## 28 **1 Introduction**

29 It is a fact that anthropogenic climate change has and is going to have severe impact on  
30 developing countries, especially those with a climate-sensitive economy (DARA, 2012).  
31 Moreover, countries in the Global South struggle with poverty, horizontal inequalities,  
32 armed conflict, poor governance, and historical injustices, some of the additional  
33 compounding factors that make them vulnerable (O'Brien et al. 2000). Therefore,  
34 framing climate change impacts as a human security concern fits with the discussion on  
35 differential vulnerability, given the array of social, political, and economic factors that  
36 make people vulnerable in the first place (McDowell et al. 2016). The debate on the  
37 human security implications of climate change has gained momentum in recent years.  
38 This is due to a lively policy debate as well as to several publications in journals and  
39 books (Brzoska and Scheffran 2013; Scheffran et al. 2012, Webersik 2010). Yet, climate  
40 change impacts and their causal linkages with human security are complex and  
41 multifaceted, and research needs to address “the limits of our capacity to understand  
42 complexity” (Nicholson 2013: 158). Keeping this in mind, this research aims at  
43 contextualising climate change adaptation and its limitations in southern Malawi.

44 Human security is adequate in the context of climate change impacts as it includes  
45 issues pertinent to food security, public health, or any type of loss in key livelihood  
46 assets as opposed to the term security defined as freedom from physical force (Redclift  
47 and Grasso 2013). Human security acknowledges the fact that humans are both victims  
48 and agents of change. While humans are affected by climate change impacts, they are at  
49 the same time able to mitigate the drivers of climate change as well as able to adapt to  
50 real and anticipated changes (Adger et al. 2009). Countries of the Global South are  
51 typically low-income countries and are least responsible for anthropogenic climate  
52 change. Most important, given their predominantly rain-fed agriculture, a large  
53 percentage of the population economically dependent on agriculture, their low financial  
54 and institutional capacity to cope with and to withstand natural hazards, countries in  
55 the Global South are most severely affected by climate change impacts (Boko et al. 2007;  
56 Niang et al. 2014). In sum, current and future changes in temperature and precipitation

57 variability, and changes in the intensity of natural hazards will most certainly affect  
58 food security, public health and agricultural productivity in low-income countries.  
59 This reflects the notion that climate change is often seen as a 'threat multiplier'  
60 exacerbating existing tensions, such as poverty or inequalities (Hegre et al. 2016;  
61 Johnstone and Mazo 2011). Even when climate change adaptation becomes unavoidable,  
62 it needs to be sustainable. Some adaptation strategies, such as agricultural innovation in  
63 the fisheries sector as demonstrated in this article, are important in the short-term to  
64 relieve some of the pressures climate change may pose but may fail in the long-term in  
65 securing a sustainable livelihood.

66 The purpose of this article is to better understand human-environment interactions,  
67 bearing in mind their complexity, more specifically climate change adaptation and its  
68 limitations. By taking the example of Lake Chilwa Basin in Malawi, this article asks the  
69 following research questions: To what extent have women in Lake Chilwa Basin  
70 perceived changes in the climate, what have they experienced and how have they been  
71 affected by it? To what extent do local climate change adaptation projects increase the  
72 women's adaptive capacity? Evidence is drawn from a case study of the Lake Chilwa  
73 Basin Climate Change Adaptation Programme (LCBCCAP) and its Women Fish  
74 Processing Groups (WFPGs). Most important, this article demonstrates that some  
75 adaptation strategies have limitations and are not suited to cope with a warmer and  
76 more variable climate. Research on limitations of climate change adaptation is in its  
77 infancy, and this study contributes to this body of research with presenting novel  
78 empirical material on southern Malawi, a region that is very poor, densely populated,  
79 and prone to climate variability threatening local livelihoods. The study concludes that  
80 income diversification can build resilience to climate change.

81 The article is divided into a theoretical and empirical part. The theoretical part  
82 evaluates the role of climate change for human security, followed by a discussion on  
83 climate change adaptation and its limitations. The empirical part draws from a field  
84 study in Malawi, more specifically the Lake Chilwa Basin. This region is home to 1.5  
85 million people, most of them depending on its natural resources for sustaining  
86 livelihoods. Climate variability is a perceived human security challenge among fishing

87 communities in southern Malawi, hence climate change adaptation is becoming an  
88 important strategy for these communities to cope with the anticipated changes. This  
89 section sheds light on how climate change affects local fishing communities in the Basin  
90 and critically evaluates the long-term effectiveness and relevance of an adaptation  
91 project implemented in these communities.

## 92 **2 Human security, climate change adaptation and its limitations**

### 93 **2.1 Climate change and human security**

94 Malawi is extremely poor, with a high population growth, it is highly dependent on  
95 natural resources and is hence vulnerable to climate change. Despite existing and  
96 functioning coping mechanisms of climate variability, such as selling economic assets,  
97 agricultural diversification, and labour migration, climate change may have severe  
98 impacts on rural population and should therefore be considered as a real threat to the  
99 population's human security, including conflict (Redclift and Grasso 2013). Malawi has  
100 despite its challenging socio-economic development, impacting on both, climate change  
101 and conflict, not experienced major armed conflicts in the past decades (Hegre et al.  
102 2016). The low levels of conflict have helped to create an enabling environment for a  
103 large number of people that depend on a fragile resource base. Local knowledge and  
104 social capital are important factors in explaining some of the coping mechanisms of the  
105 poor in Malawi, factors that could develop in peaceful periods. The absence of conflict  
106 may also help to explain that an increasing number of natural hazards have not resulted  
107 into humanitarian disasters. A study conducted by ActionAid finds that the country has  
108 already seen an increase in the number of extreme weather events in terms of floods  
109 and droughts since the 1970s till 2006 (Action Aid 2006). Sustainable adaptation  
110 strategies can therefore be seen as a means to avoid human insecurity. This article  
111 argues that global environmental change, poverty, and society must be put into context  
112 rather than purely focusing on the causal links between climate change impacts and  
113 human security. The Lake Chilwa region in southern Malawi was selected as it displays  
114 great demographic and environmental challenges, to better understand what and why  
115 some adaptation mechanisms may work or not work.

116 **2.2 Climate change adaptation**

117 In the 1990s and early 2000s the climate change debate was mostly focused on how to  
118 mitigate climate change. In recent years growing attention has been given to climate  
119 change adaptation (Adger et al. 2009; Dodman and Mitlin 2011; UNFCCC 2011).

120  
121 The literature provides a broad spectrum of understandings of the concept. Adaptation  
122 has its origin from natural science. The term was later adopted by anthropologists and  
123 social scientists and used in relation to human systems and human-environment  
124 systems. (Smit and Wandel 2006). Adger et al. (2003: 192) provides a useful definition  
125 and refers to climate change adaptation as “the adjustment of a system to moderate the  
126 impacts of climate change, to take advantage of new opportunities or to cope with the  
127 consequences”.

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

136 According to the Forth Assessment Report of the IPCC (Niang et al. 2014; Boko et al.  
137 2007) Africa is one of the most vulnerable continents to climate change due to its high  
138 exposure (e.g. heavy reliance on climate sensitive agriculture) and low adaptive capacity  
139 (e.g. poverty). Key adaptation strategies are diversification of livelihood activities,  
140 adjustment in farming operations, income generating projects, selling of labour and the  
141 move towards off-farm or non-farm livelihood incomes (Boko et al. 2007). The results of  
142 this paper suggest that these adaptation strategies are relevant also for Malawi.

143

144 **2.3 Limitations of climate change adaptation**

145 Not all adaptation strategies are sustainable. For instance, physical adaptation  
146 strategies, such as dams to protect low-lying land from water intrusion caused by sea  
147 level rise, may require human migration and resettlement. This way, migration becomes  
148 an adaptation strategy. The debate whether migration may be an act of adaptation  
149 received attention among scholars (Tacoli 2009; Baldwin 2016; Brzoska and Frölich  
150 2016; Black et al. 2011; McLeman and Smit 2006). Recent research in low-lying island  
151 states demonstrates that local perceptions on climate change-induced migration differ  
152 from the dominant political discourse on climate-induced migration in the same  
153 location, and that not migrating can be both, a strategy to adapt or to fail to adapt  
154 (Kelman et al. 2015). Though there is little evidence that environmental-induced  
155 migration has the potential to trigger violent conflict, it likely will create major  
156 challenges for hosting communities, especially in regions that are already densely  
157 populated, for example Malawi (Webersik 2012). Climate related outmigration could  
158 also change the social fabric of those communities that stay behind. With shrinking  
159 populations, markets and political institutions can get distorted making it more difficult  
160 for those left behind to adapt to climate change (Barnett 2012). In other cases,  
161 adaptation strategies that do not take into consideration the long-term impacts of  
162 climate change may prove unsustainable. Livelihood diversification is a laudable  
163 approach, however, if farming diversification activities or commercialisation of  
164 agriculture remain sensitive to climate change impacts such as unpredictable rainy  
165 seasons, the long-term adaptation effect may remain limited as the following case study  
166 in the Lake Chilwa Basin in Malawi demonstrates. Other unintended social and  
167 environmental consequences of climate change adaptation can stem from large  
168 infrastructure projects, such as dam-building for hydropower and water storage, biofuel  
169 plantations, and water relocation projects, all relevant for the African context (de  
170 Sherbinin et al. 2011). For instance, the growing number of biofuel plantations bought  
171 by foreign investors has triggered a debate on land grabbing in Africa (Matondi 2011).  
172 Most important, if people are forced to relocate due to large infrastructure projects or  
173 land-use change, their economic potential and environmental vulnerability need to be  
174 evaluated for current and future climate change impacts, as well.

### 175 **3 Explaining the context of Malawi**

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

183 Malawi is one of the most densely populated countries in Africa with a population of  
184 approximately 15,380 000 on an area of 94,276 square kilometres (EAD 2010; UNDP  
185 2012). It has a high population growth of 2.80%, according to 2008 estimates (NSO  
186 2012). It is one of the least-developed countries (LDCs) with a gross national income  
187 (GNI) of USD 850 purchasing power parity (PPP) per capita and ranks as 171 out of 179  
188 on UNDP's human development index (UNDP 2011). 74 per cent of Malawi's population  
189 live on less than a dollar (PPP) a day (2004 estimate) (UNSTATS 2012).

190 According to the Government of Malawi, the country's economy is predominantly  
191 agricultural and Malawi depends on just a few cash crops. One-third of the country's  
192 gross domestic product (GDP) comes from agriculture, forestry and fishing. Agricultural  
193 goods dominate Malawi's export commodities such as tobacco, tea and sugar. Together  
194 they constitute nearly 80 per cent of Malawi's exports.

195 The country is highly vulnerable to the effects of climate change and variability in the  
196 rainy season due to the country's dependency on natural resources. Changes such as  
197 rainfall onset, dry spells and distribution patterns can seriously jeopardise the country's  
198 economy (EAD 2010). Such changes also threatens the country's food security and puts  
199 further pressure on Malawi's poor as most households rely on subsistence rainfed  
200 farming for their livelihood (Kalanda-Joshua et al. 2011). Climate change may therefore  
201 threaten the majority of Malawi's population, of whom approximately 90 per cent live in  
202 rural areas (Stringer et al. 2009). Hence, future impacts of climate change and climate  
203 variability will very much depend on the adaptive ability of the rural population  
204 (Fischer et al. 2010).

205

### 206 **3.1 Malawi and climate change**

207 There have been some studies conducted on Malawi and climate change. United Nations  
208 Development Programme's (UNDP) Climate Change Country Profile concludes that  
209 Malawi is experiencing an increase in mean annual temperature. From 1960 to 2006 the  
210 mean annual temperature has increased by 0.9°C, an average rate of 0.21°C per decade  
211 (McSweeney et al. 2012). It is predicted that the temperature will continue to rise by 1.1  
212 to 3.0°C by the 2060s and further by 1.5 to 5.0°C by the 2090s. Observations show a  
213 significant increase in the frequency of hot days and nights throughout the year, with  
214 the highest increase during the summer months (December, January and February).  
215 Vizy and colleagues moreover predict a shortening of the growing season in southern  
216 Malawi (Vizy et al. 2015).

217 While data on temperatures shows significant changes, long-term precipitation trends  
218 are more difficult to identify and predict.. McSweeney (et al. 2012) found no statistically  
219 significant trends in precipitation. The future predictions of annual rainfall show no  
220 substantial change but it is predicted that it will fall over a shorter period causing  
221 heavier rainfall events. It is however noted that the different models predict a wide  
222 range of possible outcomes. This is due to Malawi's geographical position, located as it is  
223 between two regions of opposing climatic response to El Niño. Eastern equatorial Africa  
224 usually receives above average rainfall during El Niño while south-eastern Africa tends  
225 to experience below average rainfall. La Niña normally cause the opposite effect  
226 (McSweeney et al. 2012).

227 A study conducted by the Department of Climate Change and Meteorological Services  
228 (DCCMS) in Malawi, found that there are some long-term changes in precipitation and a  
229 general decrease in precipitation is documented, but regional variations are also found.  
230 Just as UNDP, they conclude that the mean temperature in the whole country is higher  
231 than it was two decades ago with warmer winters and summers (EAD 2010). Further,  
232 when debating climate change it is often stated that extreme events will increase. The  
233 IPCC claims that there is not yet a sufficiently developed instrument to make possible  
234 conclusions about whether extreme events have increased globally and thus the IPCC  
235 can only answer to individual extreme events (IPCC 2012). For Malawi an increase in



236 extreme events would mean an increase in dry spells, seasonal droughts, intense rainfall,  
237 riverine floods and flash floods (Njaya et al. 2011).

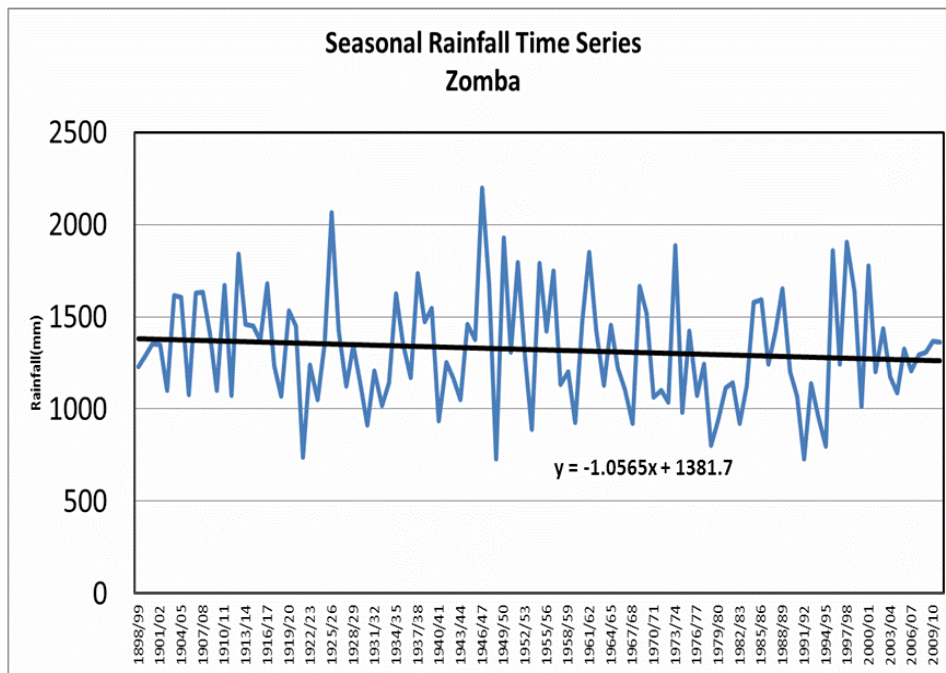
238

### 239 **3.2 Lake Chilwa Basin and climate change**

240 Some studies have also been conducted on climate change in the Lake Chilwa Basin. It  
241 must be noted, however, that Lake Chilwa Basin is located in a climatically unstable  
242 environment and fluctuations in rainfall and temperature have been recorded since the  
243 1960's. It is therefore not clear if the climate is changing significantly (EAD 2000). Data  
244 does however show a slight decrease in rainfall and an increase in temperature in the  
245 Lake Chilwa Basin. Statistics from the Meteorological Department show that the mean  
246 maximum temperatures in the basin have risen by approximately 1°C (EAD 2000). A  
247 decrease in precipitation since the mid-1980s has also been documented in the basin as  
248 shown in figure 1. The combined effects of higher temperatures and less rain is arguably  
249 the reason for the gradual decrease in Lake Chilwa's water level discussed in section  
250 5.2.2 (EAD 2000) (See figure 3). Scenarios of the basin vary that air temperatures in the  
251 basin will increase 2.6°C to 4.7°C by 2075 while scenarios of precipitation varies from a  
252 8.3 per cent increase to a 7 per cent decrease (EAD 2000). Moreover, local studies show  
253 that there is a chance of shorter growing seasons in the future in southern Malawi due  
254 to global warming (Cook et al. 2015), and this trend is already being experienced by the  
255 local population, as discussed in section 5.2.1.

256

257 **Figure 1: Seasonal rainfall time series Zomba**



258

259 Source: Carr (2012)

260

#### 261 **4. Methodology**

262 Given Malawi's economy is largely climate-sensitive, with a large subsistence rain-fed  
 263 agricultural sector, climate change adaptation is paramount to ensure food security for  
 264 the predominantly rural population. A qualitative research approach was chosen for the  
 265 study, as it was believed that it would better equip the authors to answer the objectives  
 266 and research questions of the study. The research has been conducted as a case study  
 267 on the LCBCCAP and more specifically the WFPGs. The rationale for choosing a case  
 268 study approach is related to the benefits of being able to study the LCBCCAP and the  
 269 WFPG in detail. The case study approach allows research to devote all the time and  
 270 resources on one specific case and it therefore implies that the study will be more in-  
 271 depth. The strength of a case study is that it does not only focus on the outcome, but  
 272 also the processes. This is beneficial, as the study intends to do look at the processes  
 273 involved in designing the project as well as the process of enhancing the women's  
 274 adaptive capacity. The Lake Chilwa Basin was chosen, as it is predominantly rural with

275 low levels of development. It is not only one of the poorest regions in the country, but  
276 arguably in all of Africa.

277 The empirical part of this study is based on a case study of the Lake Chilwa Basin  
278 Climate Change Adaptation Programme. LCBCCAP is a five-year joint programme  
279 (2010-2014) implemented by Leadership for Environment and Development Southern  
280 & Eastern Africa (LEAD SEA), WorldFish Centre (WFC) and Forestry Research Institute  
281 of Malawi (FRIM). The programme is funded by the Norwegian Government through the  
282 Norwegian Embassy in Malawi. LCBCCAP main objective is to secure the livelihood of  
283 the 1.5 million people living in the Lake Chilwa Basin and enhance the resilience of the  
284 natural resource base they depend on. To meet the objective, LCBCCAP develop and  
285 implement basin-wide climate change adaptation strategies and works towards  
286 increasing the capacity of communities to adopt sustainable livelihood and natural  
287 resource management practices (LEAD 2011). The programme has a number of  
288 projects in the basin and one of them is the WFPG, facilitated by WFC. The LCBCCAP was  
289 selected due to its relevance to the topic and theoretical issues of the study. The WFPG  
290 was selected on similar terms. The objective of the WFPGs is to enhance adaptive  
291 capacity through fish processing. The WFPG-project does this by 1) improving  
292 traditional methods of processing fish in order to increase quality and reduce wastage,  
293 which increases the women's income and savings, and 2) providing the WFPG members  
294 with training, such as business management, climate change, gender-issues and group  
295 dynamics. The majority of the women participating in the programme were in the fish  
296 sector prior to the project.

297 The research for this article adopted a qualitative methodology and the data was  
298 collected over two months from January to March 2012 by one of the authors, Hanne  
299 Jørstad. Both of the months were spent as independent researcher with LEAD in Zomba  
300 who coordinates the LCBCCAP. The findings are based on semi-structured interviews  
301 and focus group discussions with 18 women who were members of the three different  
302 WFPGs located in separate locations around the lake, Swang'oma, Tadala and Kachulu.  
303 Staff from the Department of Fisheries assisted in planning the meetings with the  
304 WFPGs. In addition to talking with the beneficiaries of the project interviews were also  
305 held with Leadership for Environment and Development Southern & Eastern Africa

306 (LEAD SEA), WorldFish Centre (WFC) and Department of Fisheries (DoF). Apart from  
307 questions on perceptions of climate change and climate variability, such as “Do you  
308 think the climate is changing?”, “Have you experienced any changes in the climate?”, or  
309 “What have you experienced?”, interviewees were also asked about agricultural  
310 practices to get a better understanding of the diversification of livelihood activities  
311 relevant for assessing the adaptive capacity of local communities.

312 The purposive sampling technique was chosen for this study in order to select  
313 respondents that are relevant for the study. The sampling technique is commonly used  
314 for qualitative research and especially small-scale projects (Bryman 2008, Denscombe  
315 2007). Because purposive sampling is under the category of non-probability sampling it  
316 entails that the respondents are not randomly selected but rather ‘handpicked’. It also  
317 implies that findings cannot be generalised to the enlarged population nor can one  
318 assume that the respondents represent the overall population (Denscombe 2007).  
319 However for this research it is not seen as necessary nor is it the intention for the  
320 research to reveal the general Malawian’s experience with climate change, but rather  
321 focus on the specific case study of LCBCCAP and its women fish processing groups, how  
322 these women experience climate change and if the project increases their long-term  
323 adaptive capacity.

324 To gain as broad understanding of the WFPG as possible, interviews were carried out  
325 with members from all three women groups as there were only three women groups  
326 with eleven to fifteen members. It was further decided that it would be sufficient to  
327 have individual interviews with approximately half of the members and focus group  
328 discussions with the rest of the members from each women group.

329 The data collection took place over a period of two months from mid-January to mid-  
330 March, 2012. Both of the months were spent with LEAD in Zomba who coordinates the  
331 LCBCCAP. From Zomba I took several fieldtrips to the WFPG that are located in Kachulu,  
332 Swang’oma and Manguluni. A notice was sent out to the group members in advance,  
333 though it varied how many group members turned up for the interviews. The  
334 interviews were carried out at the natural settings of the respondents, meaning either  
335 at LEADs office, WFCs office or in the communities at the WFPG sites. An interpreter  
336 assisted me for the interviews with the WFPG members.

337 Semi-structured interviews were used for WFPG members, LEAD and WFC and DoF.  
338 Three different interview guides were made for each group (WFPG members, LCBCCAP  
339 staff and DoF). Each interview guide consisted of between 13 to 49 questions depending  
340 on the context, with questions relevant *inter alia* for respondents' livelihoods, socio-  
341 economic factors, natural hazards, and more long-term environmental change.  
342 All respondents participated voluntarily and were thoroughly introduced to the  
343 purpose and topic of the study. Moreover, ethical considerations, such as informed  
344 consent, do no harm, or invasion of privacy, were all reflected upon prior to collecting  
345 data, and at all times during the fieldwork. The WFPG members were thoroughly  
346 introduced to the purpose and topic of the study. Even though LEAD and WFC assisted  
347 me in field, the women understood that I did not represent these organisations. All  
348 respondents participated voluntarily and their identities are held confidential.  
349 A local interpreter was used for all interviews with the WFPG members due to language  
350 barriers. The language barrier was a major challenge. Without any Chichewa knowledge,  
351 which is one of Malawi's official languages and one of the most dominant languages in  
352 the region, it was impossible to communicate with the women in the groups without an  
353 interpreter. This created a distance between the authors and the interviewees, which  
354 may have affected the quality of the data collected.

## 355 **5 Living with climate change: Experiences from Lake Chilwa Basin.**

356  
357 The scientific material presented above illustrates a Malawi in change. These studies are  
358 further strengthened by testimonies from local communities in the Lake Chilwa Basin.  
359 Findings from a case study of the Lake Chilwa Basin Climate Change Adaptation  
360 Programme (LCBCCAP) and its Women Fish Processing Groups (WFPGs), revealed that  
361 the women members of the groups have experienced and were impacted by changes in  
362 the climate in the Lake Chilwa Basin.

363

### 364 **5.1 Local perceptions of climate change**

365 For the women in the Women Fish Processing Groups (WFPG), who rely on natural  
366 resources for their food security and livelihood every day, climate change is part of the

367 present. The authors' study found that for the women in the WFPG climate change is  
368 already affecting their lives. Out of the eighteen women that participated in the study,  
369 all agreed that the climate is changing.

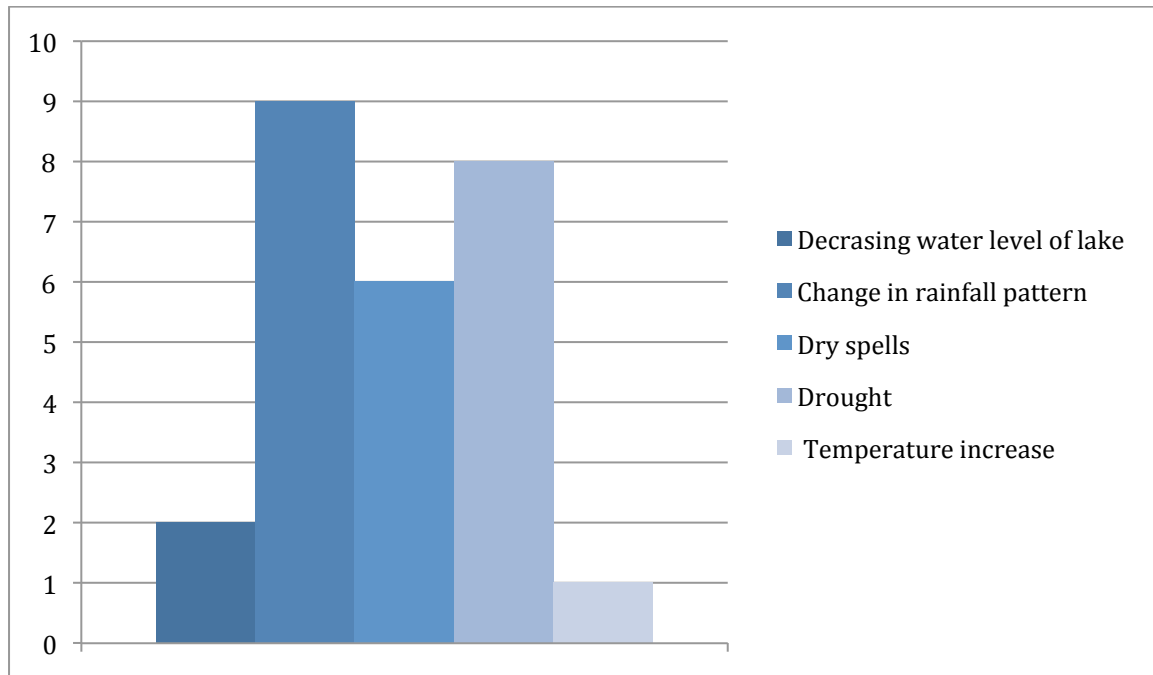
370 The major concern for the WFPG members is related to changes in rainfall pattern.  
371 There are two main seasons in Malawi, one dry and one wet. The rainy season normally  
372 starts in November and ends by the end of March and throughout the period they  
373 expect daily rain. The rainy season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

378 According to the respondents, the rainy seasons had become highly unpredictable in the  
379 past four to five years as they had been delayed, inconsistent and short. The women  
380 explained they had experienced erratic rain, unpredictable rain and there were longer  
381 drier periods within the rain season, also known as dry spells. The rainy season of  
382 2011-2012 is a good example of the recent trend. The women expected the rain to start  
383 in October-November, but instead it started in late December and ended in February  
384 instead of March. When the rain came, it was erratic and frequently interrupted by dry  
385 spells.

386 Even though there is no significant reduction in the annual rainfall, unpredictable rainy  
387 seasons can be just as challenging for subsistence farmers as a reduction in rainfall.  
388 Despite the scientific evidence of significant warmer annual mean temperatures and a  
389 significant increase of hot days (McSweeney et al. 2012), the women did not put much  
390 emphasis on it when asked for specific experiences with climate change. In fact, only  
391 one woman spoke of warmer temperatures explaining that it had become increasingly  
392 difficult to work outside during the day due to higher temperatures. The woman  
393 however linked it to the fact that there are fewer trees than before due to over-  
394 exploitation of trees for firewood. Without the shade from the trees, the temperatures  
395 felt significantly warmer.

396 As mentioned earlier, Malawi is a country that is prone to extreme weather events such  
397 as flood and drought and since the late 1970's the country has experienced an increase  
398 of such events (Chipotha and Mphepo 2011). Out of eighteen women, eight had noticed  
399 an increase in droughts, and six women had mentioned dry spells. Floods were not  
400 mentioned, but it should be noted that the area is not prone to floods (See figure 2).  
401

402 **Figure 2: The respondents experience with climate change (number of respondents on y-axis)**



403

404 Source: Authors research 2012.

405

## 406 **5.2. Climate change impacts in the Lake Chilwa Basin**

407 Our study found that the climatic changes the women experienced had a significant  
408 impact on their everyday life such as their food security, subsistence farming and  
409 livelihood. In other words, climate change exacerbates some of the most important  
410 human security issues of smallholder farmers.

### 411 **5.2.1 Food security and subsistence farming**

412 In the Lake Chilwa Basin 85 per cent of the population rely on rainfed subsistence  
413 farming for their food consumption (Njaya et al. 2011). Since it is impossible to cultivate  
414 without irrigation during the dry season, which the majority do not have access to, it is  
415 crucial that the rainy season is predictable and stable for the households to be able to  
416 cultivate sufficient amounts for the whole years. According to one of the women from  
417 Swang'oma " It is the fourth year that we have had poor harvest because of the poor  
418 rain season". A woman from the same area explains, "during the past years the rain has  
419 been unpredictable and there has been several dry spells when the rain first came. Then  
420 it has stopped before the maize matured".



421 The women had tried different types of crops such as hybrid maize, groundnuts, pigeon  
422 peas and cassava, but none have produced satisfying results.

423 One of the main challenges for smallholder farmers in Malawi is to know when to plant.  
424 Farmers have usually relied on their local knowledge to make decisions regarding  
425 sowing (Kalanda-Joshua et al. 2011). According to the WFPG members, it used to be  
426 common to plant when the first rain came. Previously it was considered optimal as the  
427 rain usually continued to come consistently. Now they find that the rain is not as  
428 predictable as dry spells often occur right after the first rain. When a dry spell occurs  
429 the planted crops will fail to grow and consequently the households will have to replant.  
430 One of the women from Kachulu explains how the unpredictable rain is increasing their  
431 vulnerability: “This season I have planted maize three times, but every time it has  
432 withered due to lack of rain. Because of the poor rain I am becoming poorer as it is  
433 expensive to replant. I cannot afford to replant again, so I will have to purchase food  
434 instead”. As a consequence of the poor and unpredictable rain season, the women are  
435 being pushed further into poverty.

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

443 As a consequence of the uncertainties in the rainy season and the harvest, the women  
444 felt that they no longer could rely on subsistence farming. The majority of the women  
445 therefore cultivated less and bought bigger proportions of their food from markets. It is  
446 however viewed as a luxury that many cannot afford. The women had however been  
447 able to increase their income and savings substantially through the WFPG and were  
448 therefore capable of doing so. This may also pose a threat to sustainability of the  
449 adaptation strategy, also discussed later in this article, as women of the WFPG may

450 decide not to continue with subsistence farming, making them more vulnerable when  
451 the lake will dry up once again.

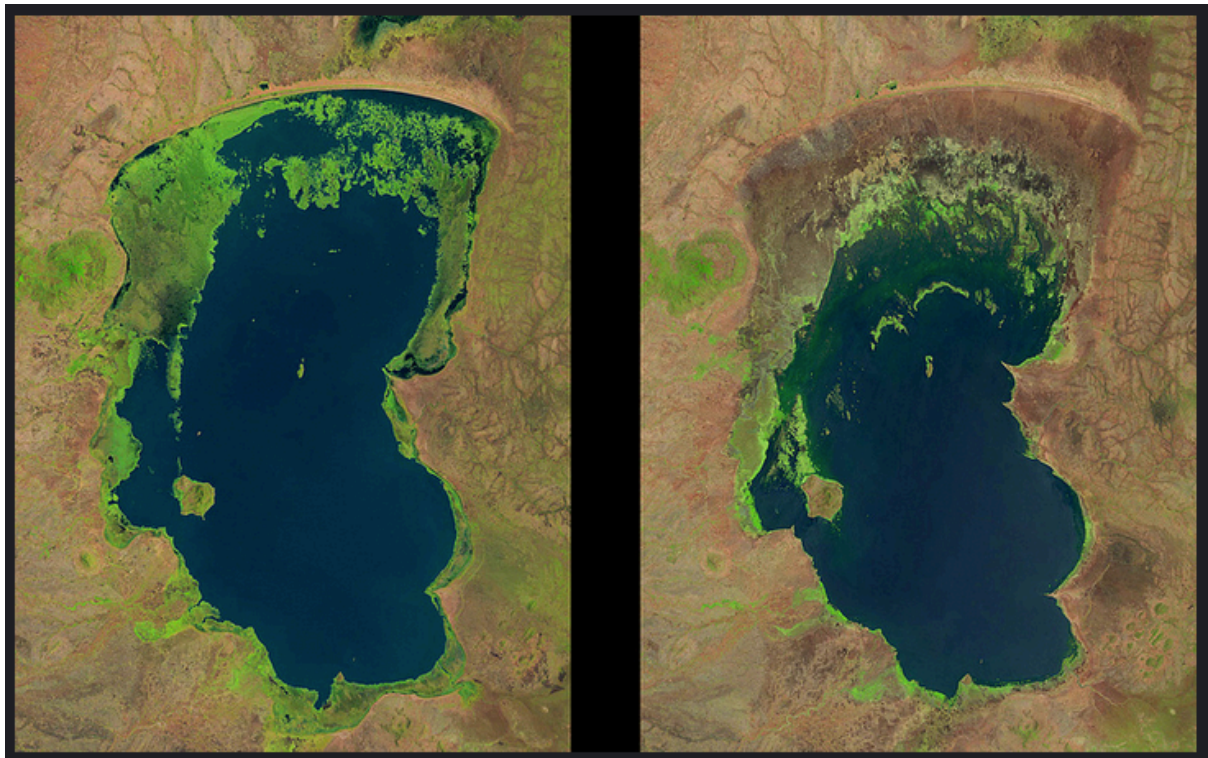
452

### 453 **5.2.2. Impacts on livelihoods**

454 The poor rain seasons and higher temperatures also had a negative effect on the  
455 women's business. With fish processing as their main income generating activity they  
456 were highly dependent on the fish stock in the lake, largely Matemba (*Barbus* spp.) and  
457 Makumba (*Oriochromis* spp.) fish (FAO 2005).

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

467 **Figure 3: The Landsat images show the size of Lake Chilwa in October 1990 and November 2013**  
468 **and the changes in the internationally recognised wetland areas (in bright green) surrounding the**  
469 **lake**



470

471 Source: USGS 2014 <https://www.flickr.com/photos/usgeologicalsurvey/11963785293/in/photostream/>  
472 <https://eros.usgs.gov/imagegallery/image-week-2#lake-chilwa-top>

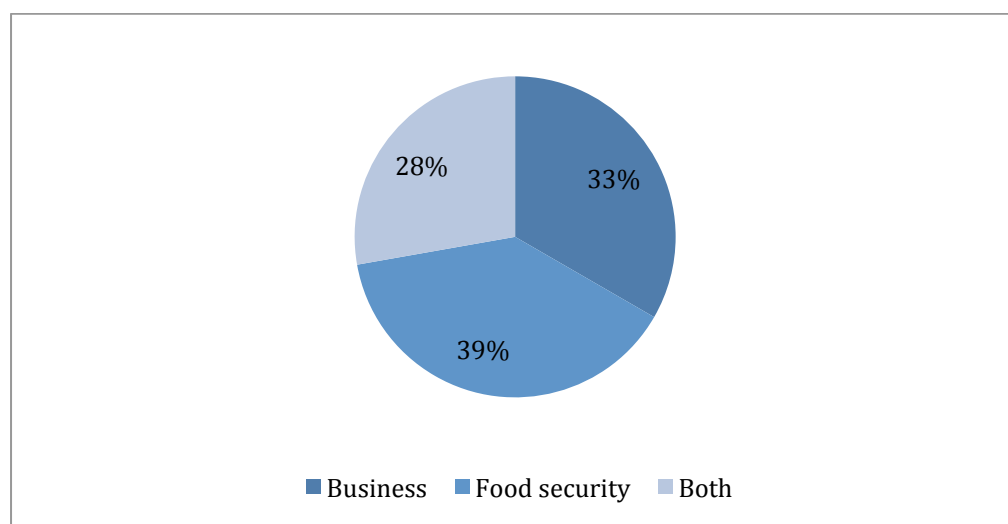
473

474 When the water level sinks the fish stock is reduced, which increases the price of the  
475 remaining catch and reduces the women's income. If the lake dries completely the  
476 women are temporary out of business for two to four years. During the data collection  
477 the women were worried that the lake would dry within 2013. The drying of the lake  
478 was considered the biggest threat posed by climate change. When asked if she  
479 considered climate change a threat, a woman from Tadala responded, "Yes, the lake will  
480 dry up and I will not have a business". Another woman from the same area expressed  
481 the same concern: "Yes, lower water level in the lake is threatening my fish business".  
482 As figure 3 demonstrates, the lake did not dry up at the end of 2013 but lost quite some  
483 wetland areas, especially in the northern part of the lake, and as a consequence,  
484 decreased in size. In 1993 and 1994 the region had similar records that caused the lake  
485 to dry the following year (Ngozo 2012).

486 Unpredictable rainy seasons have made subsistence farming challenging and there is a  
487 concern that Lake Chilwa will dry up more frequently. It is questionable whether or not

488 the changes are a result of climate change and hence a long-term trend or if it is a result  
489 of climate variability and therefore a short-term trend. Nevertheless, the WFPG  
490 members express that the changes are serious threats to the livelihood and food  
491 security of the whole Lake Chilwa Basin (See figure 4). Figure 4 shows the respondent's  
492 perception of how climate change affects their lives. Six of the respondents explained  
493 that it affected their business and another seven said it affected their crops and hence  
494 their food security. The last five respondents stated that their food security is  
495 threatened because their business has been reduced. In the figure, this response is  
496 shown as 'both'. The study therefore indicates that climate change may have effects on  
497 the most fundamental needs for the rural farmers. Such issues may further exacerbate  
498 into health issues such as malnutrition, starvation and diseases.

499 Figure 4: Respondents' perception of how climate change affects them



500

501 Source: Authors research 2012.

## 502 **6 Climate change adaptation, its success and limitations in Malawi**

503 Climate variability and climate change will have serious implications for smallholder  
504 farmers in Malawi that depend on natural resources for their livelihood and food  
505 security. Adaptation programmes are developed in order to reduce the vulnerability of  
506 the poor to present and future events of environmental hazards. LCBCCAP is such a  
507 programme. While there are positive outcomes from the WFPG-project, there are also

508 certain limitations that are important to recognise as these may have a significant effect  
509 on the members' ability to adapt to climate change.

510

511 The authors' study found that the members of the WFPG were satisfied with their  
512 involvement in the LCBCCAP programme, mainly due their economic betterment  
513 despite the challenging environment described above. Their income and savings had  
514 increased<sup>1</sup>, they were no longer dependent on their own harvest for food consumption  
515 as they had enough money to purchase food (despite the poor harvests being a  
516 substantial concern), they enjoyed working in a group instead of individually and were  
517 pleased with the different training LCBCCAP offered them (See table 1 and figure 5). The  
518 programme had also managed to increase the fish value chain in the lake. Because of the  
519 new strategies that the women were using there was less waste and the women were  
520 able to produce a product with higher quality and better taste, hence they could also  
521 increase the price of the fish product. These are all positive outcomes and the LCBCCAP  
522 has in many ways contributed towards enhancing the women's financial and social  
523 position, but there are some concerns.<sup>2</sup>

524 **Table 1: Respondents' income before and after joining a WFPG**

525

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<sup>1</sup> 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 women is nonetheless a reflection of the positive impact the project has had on their income and savings.

<sup>2</sup> It should be noted that during the time of data collection in January 2012 the WFPG were still in the start-up phase 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 their experience and from the feedback given by the WFPG members.

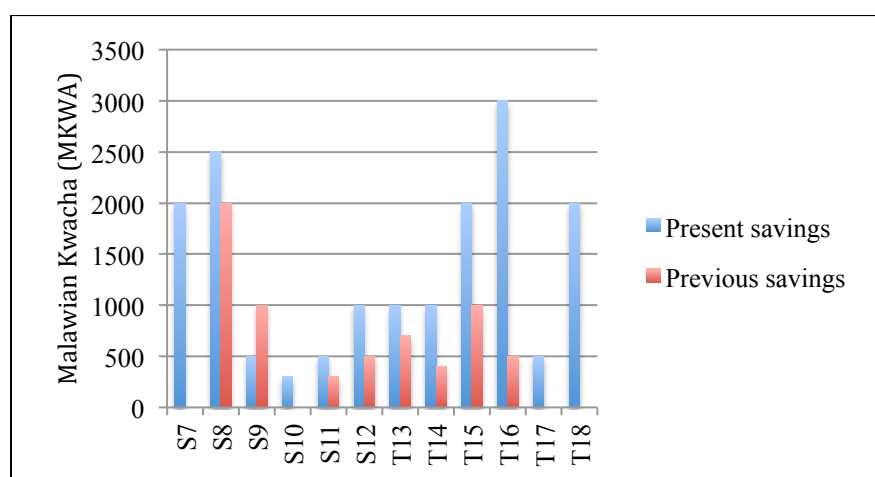
Respondent	Present Income (MKWA)	Previous Income (MKWA)	Difference	Increase in income
S7	3000	1000	2000	200 %
S8	5000	1250	3750	300 %
S9	2000	1500	500	33 %
S10	600	300	300	100 %
S11	2000	1000	1000	100 %
S12	2500	600	1900	317 %
T13	3000	1000	2000	200 %
T14	3000	1000	2000	200 %
T15	4000	1500	2500	167 %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

S: Swang'oma WFPG, T:Tandala WFPG

526 Source: Authors research 2012.

527

528 **Figure 5: Respondent's savings before and after joining a WFPG**



529

530 Source: Authors research 2012.

531

532 It is problematic that the women's livelihood is dependent on Lake Chilwa. In the last  
533 century the lake has dried and it is considered normal that it happens every ten to  
534 twenty years (Chapotera 2012, Njaya et al. 2009). It is therefore not a question whether  
535 the lake will dry again, but when. Further, a concern is that climate change, with higher  
536 temperatures and more unpredictable precipitation, will cause the lake to dry even  
537 more frequently. Previous experiences have proven that when the lake dries completely  
538 the whole fish sector collapses. However, according to Njaya et al. (2011) the people

539 who depend on the lake are well adapted to the cycles of change. When the lake dries  
540 there are large-scale shifts from fishing to farming, pastoralism and other occupations.  
541 Migration is also common. However, migration may be problematic as it puts extra  
542 constraints on the natural resources in the area where people migrate and conflicts may  
543 arise between the locals and the migrants. This is a concern that also LCBCCAP is  
544 worried about in the Lake Chilwa district (Ngozo 2012).

545 Nine out of eighteen WFPG members remember the last time the lake dried in  
546 1995/1996. Looking back at how communities and individuals were able to cope at that  
547 time gives valuable insight into people's ability to adapt to present and future climate  
548 changes. The women were asked about what they remember and how they responded  
549 to the incident. They mentioned that the fish sector collapsed and people started  
550 migrating to other areas to find work and food. They got involved with casual day  
551 labour, known as *ganyu* or utilised the empty land of the lake to cultivate vegetables.  
552 Others started processing maize flour instead of processing fish and the women were  
553 forced to walk further to fetch water.

554 The findings indicate that the communities struggled when Lake Chilwa dried in  
555 1995/1996. In order to survive people engaged in alternative income generating  
556 activities or migrated to find employment and food. During a new incident, the women  
557 will most likely have to take the same measures, as their source of income will vanish.  
558 While income diversification and migration indicate that they are able to cope, it does  
559 not indicate that LCBCCAP has significantly increased their adaptive capacity as their  
560 reliance on the fish and farming sector still makes them highly vulnerable to future  
561 events. It can therefore be argued that LCBCCAP should bear this in mind and design  
562 adaptation strategies that are not solely dependent on a sector and a resource that is  
563 threatened by climate change like the WFPG-project is.

564 Livelihood diversification is recognised as an effective strategy for smallholder farmers  
565 to decrease their vulnerability towards environmental and economic shocks, and hence  
566 climate change (Simtowe 2010). Nelson et al. (2009) explain that there is a correlation  
567 between the diversity of livelihood strategies and adaptive capacity due to the  
568 possibility to substitute between alternative livelihood strategies. By having more than

569 one source of income it is possible to spread the risk in case there is a poor season  
570 within one sector. A study conducted on fishermen in the basin from the 1970s  
571 identified that the wealthiest fishermen in the basin were the ones who had diversified  
572 their income (Njaya et al. 2011). LCBCCAP also view diversification as an effective  
573 adaptation strategy as they write:

574           It is recognized that resilience to climate change involves household's  
575           diversifying their livelihood strategies to have options for managing drought,  
576           floods, and temperature increases. Thus, in communities throughout the Basin,  
577           the project will work to identify ways in which to diversify and enhance their  
578           livelihoods, increase productivity of ecosystems and rural incomes, and reduce  
579           vulnerability to economic and environmental shocks (LEAD et al. 2009: 15).

580

581 While most women cultivated some small plots of land for subsistence, the majority of  
582 the women however, were not diversifying their livelihood strategies to an extent that  
583 would compensate for the loss of income from fish processing and marketing. Out of  
584 eighteen women only two reported that they had another income generating activity  
585 and only one women was planning on introducing a new strategy. The two women were  
586 involved in beer brewing and boat construction and the third woman wanted to start  
587 cultivating rice. The remaining women were relying on fish processing as their source of  
588 income. Eight out of the women did however mention that they were involved with  
589 *ganyu* when facing economic difficulties. *Ganyu* refers to casual daily wage labour. It is  
590 often unskilled agricultural labour and is a common livelihood strategy in Malawi  
591 (Simtowe 2010). While it serves as a backup strategy for poor seasons, it is not a  
592 reliable source of income. Further, out of the ten women who were married, eight of the  
593 husbands were working either in the fish sector or as farmers, hence also their income  
594 was dependent on natural resources. This is problematic because the lake dries due to  
595 low precipitation over more than one year, which will also have a negative effect on the  
596 agriculture sector. Overall the study found that the WFPG members and their household  
597 had a weak income base that is highly vulnerable to climate change due to their  
598 dependence on natural resources and their low livelihood diversification (See table 2).



599 **Table 2: Livelihood diversification**

Respondents	Wife		Huband
	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

K: Kachulu, WFPG, S: Swang'oma WFPG, T:Tandala WFPG

600 Source: Authors research 2012.

601

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

607 In order for LCBCCAP to improve the WFPG-project and further reduce the women's  
 608 vulnerability towards climate variability and climate change, diversification may be a  
 609 step in the right direction However, for diversification to be an effective adaptation  
 610 strategy for the WFPG members it is necessary that the additional income sources do  
 611 not react similar to a change in the climate as the fish sector. Finding a source of income  
 612 that is not dependent on a natural resource may very well be the best option.

613

## 614 **7 Making climate change adaptation work for vulnerable groups**

615 The previous discussion on the success and the limitations of climate adaptation offers  
616 some practical solutions to make climate change adaptation work for vulnerable groups.  
617 Apart from diversifying income opportunities, this study offers insights into how local  
618 knowledge can enhance climate change adaptation.

619 The study has identified two ways, though closely linked, where LCBCCAP has utilised  
620 local knowledge. First, LCBCCAP employs local knowledge through participatory means.  
621 The findings indicate that participation was crucial for the development of the WFG.  
622 Representative bodies were involved in identifying the WFG as an appropriate  
623 adaptation strategy for the community. The women have further participated in  
624 analysis and their opinions have influenced the design of the project. The women have  
625 for example made suggestions to the design of the solar fish driers, which have  
626 improved the quality of the dried fish. Second, LCBCCAP adaptation is based on  
627 strategies that have proved to work elsewhere. All but one woman worked with fish  
628 processing before joining the WFG. The traditional way of processing fish is very  
629 similar to the way the women process fish now, except they have better tools than  
630 increase the quality and value of the product. Hence, the project was rich in local  
631 content in the sense that the project was built on a local foundation.

632 The way in which local knowledge has been utilised has generated several benefits for  
633 both the programme and the beneficiaries. The benefits of utilising local knowledge that  
634 have been documented are increased awareness of local development issues and the  
635 local environment through dialogues with the community, by having in-depth  
636 understanding of local conditions and needs it is possible to design a tailor made  
637 adaptation programmes, which increases sustainability. Utilising local knowledge  
638 increases efficiency and cost-effectiveness, further improves communication, may  
639 reduce the chance of conflicts and enhances local empowerment.

640 The authors' study can therefore conclude that local knowledge can be a crucial element  
641 in enhancing climate change adaptation programmes, also for other vulnerable groups.  
642 In the case of LCBCCAP, the appropriate way of utilising local knowledge was through  
643 participatory means, and merging local practices with technical solutions.

644 Utilising local knowledge is not about extracting valuable knowledge from communities  
645 and utilising it elsewhere. Though there is nothing wrong with learning from or  
646 adopting successful practices, either based on 'local knowledge' or 'scientific knowledge'  
647 it is crucial that adaptation strategies are identified together with the communities and  
648 further adapted to fit into the local context. When carried out correctly, local knowledge  
649 may indeed play a crucial role in climate change adaptation.

## 650 **8 Conclusion and lessons learned**

651 Climate change poses a significant threat to human security in Malawi, much due to the  
652 population's dependency on climate-sensitive resources for their livelihood, high  
653 poverty rates and thus limited adaptive capacity. This study presents empirical  
654 evidence of fishing communities' experiences with changing climate patterns around  
655 the Lake Chilwa Basin in Malawi and how these threaten their livelihood and  
656 subsistence farming and thus exacerbating poverty and food insecurity in the region.  
657 The changing climate is having a significant impact on smallholder farmers' human  
658 security. It is pushing the people living in the Lake Chilwa Basin further into poverty by  
659 affecting the natural resources they depend on.

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

665 However, if adaptation strategies fail and local communities are forced to resettle (for  
666 instance in case Lake Chilwa is to dry up), this may pose a new challenge to a vulnerable  
667 population. In such cases the participants' adaptive capacity may in fact decrease as  
668 they have invested their time in a project that failed, pushing them further into poverty  
669 and making them more vulnerable to climate change.

670 The likely increase in frequency of drying of Lake Chilwa illustrates that for adaptation  
671 strategies to work in the long-term as well as the short-term, it is essential that they  
672 take into account the effect of climate change on the natural resources that the

673 communities rely on. Adapting existing income-generation activities may prove to be  
674 insufficient. Strategies that focus on reducing the overall dependency on climate-  
675 sensitive natural resources by diversifying livelihoods will arguably increase the  
676 communities capacity to adapt to and cope with adverse effects of climate change to a  
677 greater extent. In sum, limitations and unintended consequences of climate change  
678 adaptation strategies need to be taken seriously to ensure effective and lasting  
679 adaptation.

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