

1 **Living with Climate Change:**
2 **Climate change adaptation through supporting women fish**
3 **processing groups in Malawi**

4
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7 **Abstract:**

8 In recent years, research on climate change and human security has received much
9 attention among policy makers and academia alike. Communities in the Global South
10 that rely on an intact resource base and struggle with poverty, existing inequalities and
11 historical injustices will especially be affected by predicted changes in temperature and
12 precipitation. The objective of this article is to better understand under what conditions
13 local communities can adapt to anticipated impacts of climate change. The empirical
14 part of the paper answers the question to what extent local communities in the Chilwa
15 Basin in Malawi have experienced climate change and how they are affected by it.
16 Further, it assesses one of Malawi's adaptation projects designed to build resilience to a
17 warmer and more variable climate, and points to some of its limitations. This research
18 shows that not all adaptation strategies are suited to cope with a warmer and more
19 variable climate, and concludes that livelihood diversification can be an effective
20 adaptation strategy.

21
22 **Keywords:** climate change, Malawi, climate change adaptation, human security
23
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32 1 Introduction

33 It is a fact that anthropogenic climate change has and is going to have severe impact on
34 developing countries, especially those with a climate-sensitive economy (DARA, 2012).
35 Moreover, countries in the global South struggle with poverty, horizontal inequalities,
36 armed conflict, poor governance, and historical injustices, some of the additional
37 compounding factors that make them vulnerable (O'Brien et al. 2000). Therefore, by
38 framing climate change impacts as a human security concern fits with the discussion on
39 differential vulnerability, given the array of social, political, and economic factors that
40 make people vulnerable in the first place. The debate on the human security
41 implications of climate change has gained momentum in recent years. This is due to a
42 lively policy debate as well as to several publications in journals and books (Brzoska
43 and Scheffran 2013; Scheffran et al. 2012, Webersik 2010). Yet, climate change impacts
44 and their causal linkages with human security are complex and multifaceted, and
45 research needs to address "the limits of our capacity to understand complexity"
46 (Nicholson 2013: 158). Keeping this in mind, this research aims at contextualising
47 climate change adaption and its limitations in southern Malawi. Climate variability is a
48 perceived human security challenge among fishing communities in southern Malawi,
49 hence climate change adaption is becoming an important strategy for these
50 communities to cope with the anticipated changes. The term human security is
51 adequate in the context of climate change impacts as it includes issues pertinent to food
52 security, public health, or any type of loss in key livelihood assets as opposed to the
53 term security defined as freedom from physical force. The term human security,
54 acknowledges the fact that humans are both victims and agents of change. While
55 humans are affected by climate change impacts, they are at the same time able to
56 mitigate the drivers of climate change as well as able to adapt to real and anticipated
57 changes. Countries of the global South are, typically low-income countries and are least
58 responsible for anthropogenic climate change. Yet, given their predominantly climate-
59 sensitive economies, with rain-fed agriculture dominating, a large percentage of the
60 population economically dependent on agriculture, their low financial and institutional
61 capacity to cope with and to withstand natural hazards, they are most severely affected

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76 by it. Current and future changes in temperature and precipitation variability, and
77 changes in the intensity of natural hazards will most certainly affect food security,
78 public health and agricultural productivity in low-income countries.

79 This reflects the notion that climate change is a 'threat multiplier' exacerbating existing
80 tensions, such as poverty. Even when [climate change](#) adaptation becomes unavoidable,
81 it needs to be sustainable. Some adaptation strategies, [such as agricultural innovation in](#)
82 [the fisheries sector](#) as demonstrated in this article, are important in the short-term to
83 relieve some of the pressures climate change may pose but [may](#) fail in the long-term in
84 securing a sustainable livelihood.

85 The purpose of this article is to better understand human-environment interactions,
86 [bearing in mind their complexity](#), more specifically climate change adaptation and its
87 limitations. By taking the example of Lake Chilwa Basin in Malawi, this article [asks the](#)
88 [following research questions: To what extent have women in Lake Chilwa Basin](#)
89 [perceived changes in the climate, what have they experienced and how have they been](#)
90 [affected by it? To what extent do local climate change adaptation projects increase the](#)
91 [women' adaptive capacity? Evidence is drawn from a case study of the Lake Chilwa](#)
92 [Basin Climate Change Adaptation Programme \(LCBCCAP\) and its Women Fish](#)
93 [Processing Groups \(WFPGs\).](#) Most important, this [article](#) demonstrates that [some](#)
94 adaptation strategies [have limitations and](#) are [not](#) suited to cope with a warmer and
95 more variable climate.

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

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Deleted: ; 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). - ... (1)

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136 **2 Human security, climate change adaptation and its limitations**

137 **2.1 Climate change and human security**

138 Malawi is extremely poor, with a high population growth, it is highly dependent on
139 natural resources and is hence vulnerable to climate change. Despite existing and
140 functioning coping mechanisms of climate variability, such as selling economic assets,
141 agricultural diversification, and labour migration, climate change may have severe
142 impacts on rural population and should therefore be considered as a real threat to the
143 population's human security. A study conducted by ActionAid finds that the country has
144 already seen an increase in the number of extreme weather events in terms of floods
145 and drought since the 1970s till 2006 (Action Aid 2006). Sustainable adaptation
146 strategies can therefore be seen as a means to avoid human insecurity. This article
147 argues that global environmental change, poverty, and society must be put into context
148 rather than purely focusing on the causal links between climate change impacts and
149 human security. A region in southern Malawi was selected with great demographic and
150 environmental challenges, to better understand what and why some adaption
151 mechanisms may work or may not function.

152 **2.2 Climate change adaptation**

153 In the 1990s and early 2000s the climate change debate was mostly focused on how to
154 mitigate climate change. In recent years growing attention has been given to climate
155 change adaptation (Adger et al. 2009; Dodman and Mitlin 2011; UNFCCC 2011).
156 The literature provides a broad spectrum of understandings of the concept. Adaptation
157 has its origin from natural science and was later adopted by anthropologists and social
158 scientists and used in relation to human systems and human-environment systems.
159 (Smit and Wandel 2006). Adger et al. (2003: 192) provides a useful definition and refers
160 to climate change adaptation as "the adjustment of a system to moderate the impacts of
161 climate change, to take advantage of new opportunities or to cope with the
162 consequences".
163
164 Adaptation initiatives may be carried out by governments, IGOs, NGOs, CBOs or
165 individuals and may be either anticipatory or a reactive action. The aim of adaptation is

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Deleted: As the introduction illustrates, Malawi meets the dominant indicators used by typical neo-Malthusian resource scarcity-conflict studies. It

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Deleted: these facts, Malawi is yet to see any major armed political conflicts. Nonetheless

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

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Deleted: 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 2011). 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 [3]

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Deleted: 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.

213 reduced vulnerability or increased resilience and it involves changing processes or
214 practices in social and ecological systems through reducing potential damages or
215 engaging in new opportunities (Adger et al. 2007). Climate change adaptation rarely
216 only focuses on factors related to climate change. Adaptation may incorporate any
217 practices or initiatives that increase resilience to elements constituting threats to
218 communities that may aggravate through climate change, such as poverty.

219 According to the Fifth Assessment Report of the IPCC (Niang et al. 2014; [Boko et al.](#)
220 [2007](#)) Africa is one of the most vulnerable continents to climate change due to its high
221 exposure (e.g. [heavy reliance on climate sensitive agriculture](#)) and low adaptive capacity
222 (e.g. [poverty](#)). Key adaptation strategies are diversification of livelihood activities,
223 adjustment in farming operations, income generating projects, selling of labour and the
224 move towards off-farm or non-farm livelihood incomes (Boko et al. 2007). The [results of](#)
225 [this paper suggest that these](#) adaptation strategies [are](#) relevant also for Malawi.

227 **2.3 Limitations of climate change adaptation**

228 Not all adaptation strategies are sustainable, with limited long-term effectiveness. For
229 instance, adapting to climate change may require human migration and resettlement.

230 [This debate is highly contested and received attention among scholars \(Tacoli 2009;](#)
231 [Baldwin 2016; Brzoska and Frölich 2016\). Recent research in low-lying island states](#)
232 [demonstrates that local perceptions on climate change-induced migration differ from](#)
233 [the dominant political discourse on climate-induced migration in the same location, and](#)
234 [that not migrating can be both, a strategy to adapt or to fail to adapt \(Kelman et al.](#)
235 [2015\).](#) Though there is little evidence that environmental-induced migration has the
236 potential to trigger [violent](#) conflict, it most certainly will create major challenges for
237 hosting communities, especially in regions that are already densely populated, for
238 example Malawi (Webersik 2012). Climate related outmigration could also change the
239 social fabric of those communities that stay behind. With shrinking populations,
240 markets and political institutions can get distorted making it more difficult for those left
241 behind to adapt to climate change (Barnett 2012). In other cases, adaptation strategies
242 that do not take into consideration the long-term impacts of climate change may prove
243 unsustainable. Livelihood diversification is a laudable approach, however, if farming

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Deleted: 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 continent's economic vulnerability as there is a heavy reliance on agriculture in both local livelihoods and national GDP (Boko et al. 2007).

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266 diversification activities or commercialisation of agriculture remain climate-sensitive,
267 the long-term adaptation effect may remain limited as the following case study in the
268 Lake Chilwa Basin in Malawi demonstrates. Other unintended social and environmental
269 consequences of climate change adaptation can stem from large infrastructure projects,
270 such as dam-building for hydropower and water storage, biofuel plantations, and water
271 relocation projects, all relevant for the African context (de Sherbinin et al. 2011). For
272 instance, the growing number of biofuel plantations bought by foreign investors has
273 triggered a debate on land grabbing in Africa (Matondi 2011). Most important, if people
274 are forced to relocate due to large infrastructure projects or land-use change, their
275 economic potential and environmental vulnerability need to be evaluated for current
276 and future climate change impacts, as well.

277 **3 Explaining the context of Malawi**

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

285 Malawi is one of the most densely populated countries in Africa with a population of
286 approximately 15,380 000 on an area of 94,276 square kilometres (EAD 2010; UNDP
287 2012). It has a high population growth of 2.80%, according to 2008 estimates (NSO
288 2012). It is one of the least-developed countries (LDCs) with a gross national income
289 (GNI) of USD 850 purchasing power parity (PPP) per capita and ranks as 171 out of 179
290 on UNDP's human development index (UNDP 2011). 74 per cent [of Malawi's population](#)
291 live on less than a dollar (PPP) a day (2004 estimate) (UNSTATS 2012).

292 [According to the Government of Malawi](#), the country's economy is predominantly
293 agricultural and Malawi depends on just a few cash crops. One-third of the country's
294 gross domestic product (GDP) comes from agriculture, forestry and fishing. [Agricultural](#)

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297 | goods dominate Malawi's export commodities, such as tobacco, tea and sugar. Together
298 | they constitute nearly 80 per cent of Malawi's exports.

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

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311 | **3.1 Malawi and climate change**

312 | There have been some studies conducted on Malawi and climate change. UNDPs
313 | Climate Change Country Profile concludes that Malawi is experiencing an increase in
314 | mean annual temperature. From 1960 to 2006 the mean annual temperature has
315 | increased by 0.9°C, an average rate of 0.21°C per decade (McSweeney et al. 2012). It is
316 | predicted that the temperature will continue to rise by 1.1 to 3.0°C by the 2060s and
317 | further by 1.5 to 5.0°C by the 2090s. Observations show a significant increase in the
318 | frequency of hot days and nights throughout the year, with the highest increase during
319 | the summer months (December, January and February). Vizy and colleagues moreover
320 | predict a shortening of the growing season in southern Malawi (Vizy et al. 2015).

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Deleted: Table 1: Export commodities 2010 - Value (K'mn) ... [4]

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Deleted: It must be noted that there is still no consensus among scholars if the changes in precipitation 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 (Vizy et al. 2015).

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321 | While data on temperatures shows significant changes, long-term precipitation trends
322 | are more difficult to identify and predict. McSweeney (et al. 2012) found no statistically
323 | significant trends in precipitation. The future predictions of annual rainfall show no
324 | substantial change but it is predicted that it will fall over a shorter period causing
325 | heavier rainfall events. It is however noted that the different models predict a wide
326 | range of possible outcomes. This is due to Malawi's geographical position, located as it is
327 | between two regions of opposing climatic response to El Niño. Eastern equatorial Africa
328 | usually receives above average rainfall during El Niño while south-eastern Africa tends

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354 to experience below average rainfall. La Niña normally cause the opposite effect
355 (McSweeney et al. 2012).

356 A study conducted by the Department of Climate Change and Meteorological Services
357 (DCCMS) in Malawi, found that there are some long-term changes in precipitation and a
358 general decrease in precipitation is documented, but regional variations are also found.
359 Just as UNDP, they conclude that the mean temperature in the whole country is higher
360 than it was two decades ago with warmer winters and summers (EAD 2010). Further,
361 when debating climate change it is often stated that extreme events will increase. The
362 IPCC claims that there is not yet a sufficiently developed instrument to make possible
363 conclusions about whether extreme events have increased globally and thus they can
364 only answer to individual extreme events (IPCC 2012). For Malawi an increase in
365 extreme events would mean an increase in dry spells, seasonal droughts, intense rainfall,
366 riverine floods and flash floods (Njaya et al. 2011).

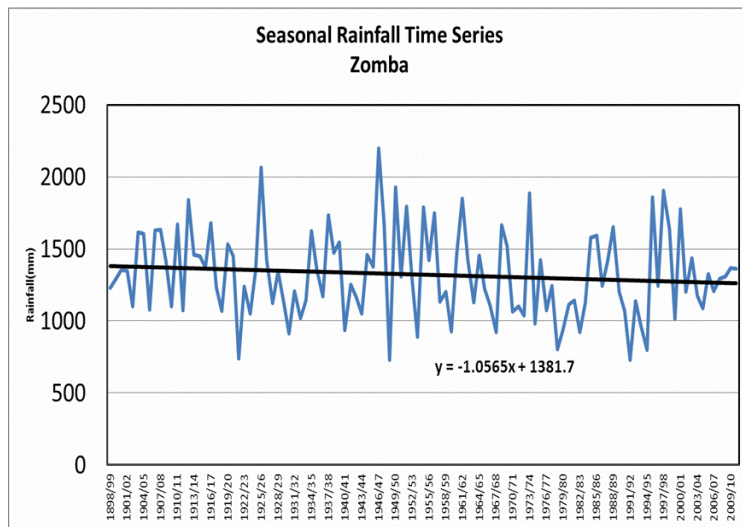
367

368 **3.1.1 Lake Chilwa Basin and climate change**

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

384

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



386
387 [Source: Carr \(2012\)](#)

388
389 **4. Methodology,**

390 Given Malawi's economy is largely climate-sensitive, with a large subsistence rain-fed
391 agricultural sector, climate change adaption is paramount to ensure food security for
392 the predominantly rural population. A qualitative research approach was chosen for the
393 study, as it was believed that it would better equip the researcher to answer the
394 objectives and research questions of the study. The research has been conducted as a
395 case study on the LCBCCAP and more specifically the WFPGs. The rationale for choosing
396 a case study approach is related to the benefits of being able to study the LCBCCAP and
397 the WFPG in detail. The case study approach allows research to devote all the time and
398 resources on one specific case and it therefore implies that the study will be more in-
399 depth. The strength of a case study is that it does not only focus on the outcome, but
400 also the processes. This is beneficial, as the study intent do look at the processes
401 involved in designing the project as well as the process of enhancing the women's
402 adaptive capacity. The Lake Chilwa Basin was chosen, as it is predominantly rural with

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

406 The empirical part of this study is based on a case study of the Lake Chilwa Basin
407 Climate Change Adaptation Programme. LCBCCAP is a five-year joint programme
408 (2010-2014) implemented by Leadership for Environment and Development Southern
409 & Eastern Africa (LEAD SEA), WorldFish Centre (WFC) and Forestry Research Institute
410 of Malawi (FRIM). The programme is funded by the Norwegian Government through the
411 Norwegian Embassy in Malawi. LCBCCAP main objective is to secure the livelihood of
412 the 1.5 million people living in the Lake Chilwa Basin and enhance the resilience of the
413 natural resource base they depend on. To meet the objective, LCBCCAP develop and
414 implement basin-wide climate change adaptation strategies and works towards
415 increasing the capacity of communities to adopt sustainable livelihood and natural
416 resource management practices (LEAD 2011). The programme has a number of
417 projects in the basin and one of them is the WFPG, facilitated by WFC. The objective of
418 the WFPGs is to enhance adaptive capacity through fish processing. WFPG-project does
419 this by 1) improving traditional methods of processing fish in order to increase quality
420 and reduce wastage, which increases the women's income and savings, and 2) providing
421 the WFPG members with training, such as business management, climate change,
422 gender-issues and group dynamics. The majority of the women participating in the
423 programme were in the fish sector prior to the project.

424 The research for this article adopted a qualitative methodology and the data was
425 collected over two months from January to March 2012 by one of the authors, Hanne
426 Jørstad. The findings are based on semi-structured interviews and focus group
427 discussions with 18 women who were members of the three different WFPGs located in
428 separate locations around the lake, Swang'oma, Tadala and Kachulu. In addition to
429 talking with the beneficiaries of the project interviews were also held with Leadership
430 for Environment and Development Southern and Easter Africa (LEAD), WorldFish
431 Centre (WFC) and Department of Fisheries (DoF). Apart from questions on perceptions
432 of climate change and climate variability, interviewees were also asked about
433 agricultural practices to get a better understanding of the diversification of livelihood
434 activities relevant for assessing the adaptive capacity of local communities.

435 [The purposive sampling technique was chosen for this study in order to select](#)
 436 [respondents that are relevant for the study. The sampling technique is commonly used](#)
 437 [for qualitative research and especially small-scale projects \(Bryman 2008, Denscombe](#)
 438 [2007\). Because purposive sampling is under the category of non-probability sampling it](#)
 439 [entails that the respondents are not randomly selected but rather 'handpicked'. It also](#)
 440 [implies that findings cannot be generalised to the enlarged population nor can one](#)
 441 [assume that the respondents represent the overall population \(Denscombe 2007\).](#)
 442 [However for this research it is not seen as necessary nor is it the intention for the](#)
 443 [research to reveal the general Malawian's experience with climate change, but rather](#)
 444 [focus on the specific case study of LCBCCAP and its women fish processing groups, how](#)
 445 [these women experience climate change and if the project increases their long-term](#)
 446 [adaptive capacity. To gain as broad understanding of the WFPG as possible, interviews](#)
 447 [were carried out with members from all three groups. A notice was sent out to the](#)
 448 [group members in advance, though it varied how many group members turned up for](#)
 449 [the interviews. All respondents participated voluntarily and were thoroughly](#)
 450 [introduced to the purpose and topic of the study. A local interpreter was used for all](#)
 451 [interviews with the WFPG members due to language barriers.](#)

452 **5 Living with climate change: Experiences from Lake Chilwa Basin.**

453 [The scientific material presented above illustrates a Malawi in change. These studies are](#)
 454 [further strengthened by testimonies from local communities in the Lake Chilwa Basin.](#)
 455 [Findings from a case study of the Lake Chilwa Basin Climate Change Adaptation](#)
 456 [Programme \(LCBCCAP\) and its Women Fish Processing Groups \(WFPGs\), revealed that](#)
 457 [the women members of the groups have experienced and were impacted by changes in](#)
 458 [the climate in the Lake Chilwa Basin.](#)

461 **5.1 Local perceptions of climate change**

462 [For the women in the Women Fish Processing Groups \(WFPG\), who rely on natural](#)
 463 [resources for their food security and livelihood every day, climate change is part of the](#)
 464 [present. The authors' study found that for the women in the WFPG climate change is](#)

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Deleted: Climate change in the Lake Chilwa Basin:

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Deleted: For many, climate change is something that belongs to the future.

519 already affecting their lives. Out of the eighteen women that participated in the study,
520 all agreed that the climate is changing.

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

529 According to the respondents, the rainy seasons had become highly unpredictable in the
530 past four to five years as they had been delayed, inconsistent and short. The women
531 explained that they had experienced that the rain came as erratic, unpredictable rain
532 and there were longer drier periods within the rain season, also known as dry spells.
533 The rainy season of 2011-2012 is a good example of the recent trend. The women
534 expected the rain to start in [October](#)-November, but instead it started in late December
535 and ended in February instead of March. When the rain came, it was erratic and
536 frequently interrupted by dry spells.

537 Even though there is no [significant](#) reduction in the annual rainfall, unpredictable rainy
538 seasons can be just as challenging for subsistence farmers as a reduction in rainfall.

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

547 [As mentioned earlier](#), Malawi is a country that is prone to extreme weather events such
548 as flood and drought and since the late 1970's the country has experienced an increase

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Moved up [1]: 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 (McSweeney et al. 2012) predictions for the future is that the rain will fall over a shorter period of time and cause heavier rainfall events.

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Deleted: This is in line with the women's experience of the rainy season of 2011-2012.

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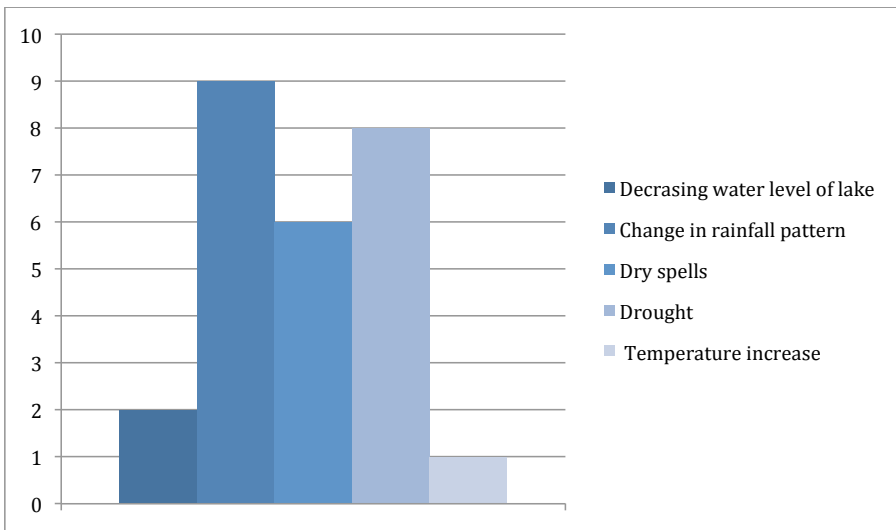
Deleted: A study examining climate variability would be of interest in order to compare and evaluate the respondents' experiences, but as noted by Jury and Mwafulirwa (2002) very little work has been done on Malawi and climate variability.

567 of such events (Chipotha and Mphepo 2011). Out of eighteen women, eight had noticed
568 an increase in droughts, **and six women had mentioned dry spells**. Floods were not
569 mentioned, but it should be noted that the area is not prone to floods (See figure 2).
570

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



573

574 Source: Author's research 2012.

575

576 **5.2. Climate change impacts in the Lake Chilwa Basin**

577 The authors' study found that the climatic changes the women experienced had a
 578 significant impact on their everyday life such as their food security, subsistence farming
 579 and livelihood. In other words, climate change exacerbates some of the most important
 580 human security issues of smallholder farmers.

581 **5.2.1. Food security and subsistence farming**

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

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

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Deleted: the past four years have been challenging, as their garden plots have produced fewer crops.

603 | One of the main challenges for [smallholder farmers](#) in Malawi is to know when to plant.

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604 | Farmers have usually relied on their local knowledge to make decisions regarding
605 | sowing (Kalanda-Joshua et al. 2011). According to the WFPG members, it used to be
606 | common to plant when the first rain came. Previously it was considered optimal as the
607 | rain usually continued to come consistently. Now they find that the rain is not as
608 | predictable as dry spells often occur right after the first rain. When a dry spell occurs
609 | the planted crops will fail to grow and consequently the households will have to replant.

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610 | One of the women [from Kachulu](#) explains [how the unpredictable rain is increasing their](#)
611 | [vulnerability](#). [“This season I have planted maize three times,](#) but every time it has
612 | withered due to lack of rain. [Because of the poor rain I am becoming poorer as it is](#)
613 | [expensive to replant. I cannot afford to replant again, so I will have to purchase food](#)
614 | [instead”](#). [As a consequence of the poor and unpredictable rain season, the women are](#)
615 | [being pushed further into poverty.](#)

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616 | Several studies have similar findings (Action Aid 2006, Nagoli 2010, Kalanda-Joshua et
617 | al. 2011). In Action Aid’s (2006) study on climate change and smallholder farmers in
618 | Malawi, farmers complained about changes in the rainfall pattern and higher
619 | temperatures, which has made it difficult to know when to plant and additionally
620 | reduced the harvest. Climate variability is therefore making local knowledge less
621 | reliable and it is threatening their main source of knowledge (Kalanda-Joshua et al.
622 | 2011).

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Deleted: 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.

623 | As a consequence of the uncertainties in the rainy season and the harvest, the women
624 | felt that they no longer could rely on subsistence farming. The majority of the women
625 | therefore cultivated less and bought bigger proportions of their food from markets. It is
626 | however viewed as a luxury that many cannot afford. The women had however been
627 | able to increase their income and savings substantially through the WFPG and were
628 | therefore capable of doing so. [This may also pose a threat to sustainability of the](#)
629 | [adaptation strategy, also discussed later in this article, as women of the WFPG may](#)

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

646

647 | **5.2.2. Impacts on livelihoods**

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

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

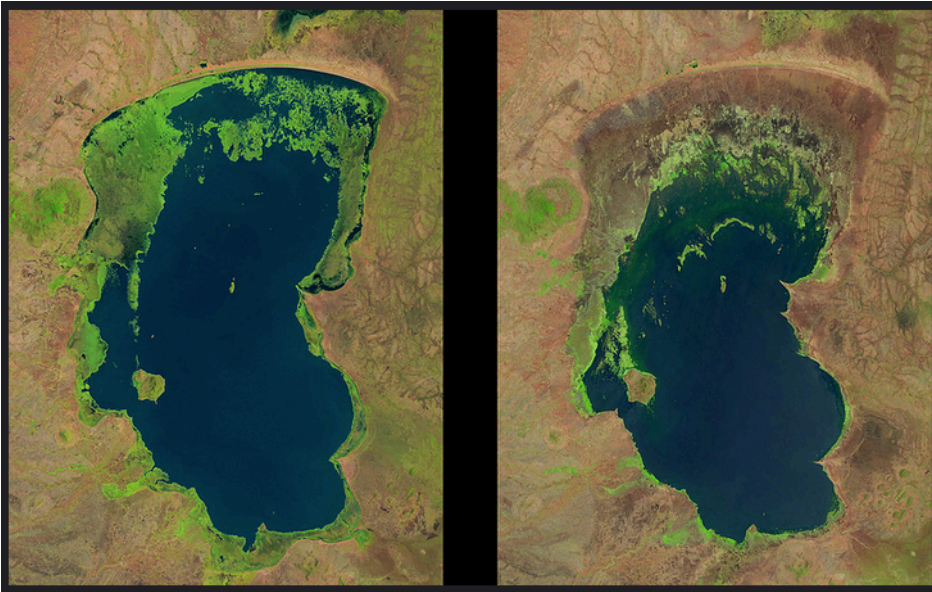
660 | **Figure 3: The Landsat images show the size of Lake Chilwa in October 1990 and November 2013**
661 | **and the changes in the internationally recognised wetland areas (in bright green) surrounding the**
662 | **lake**

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

668

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

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

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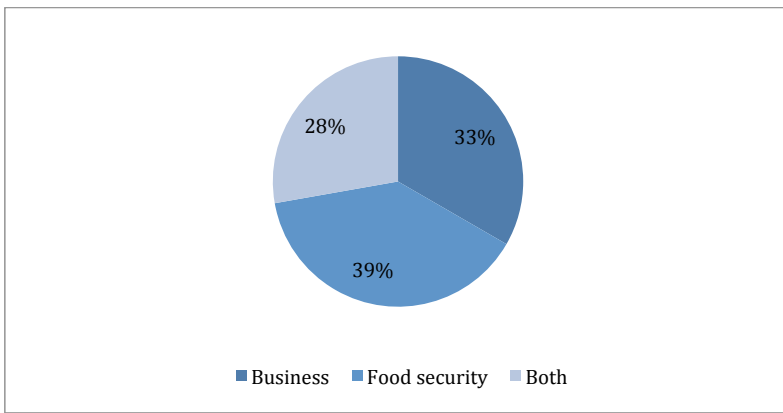
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Deleted: The changing climate is having a significant impact on the rural poor's human security. It is pushing the people living in the Lake Chilwa Basin further into poverty by affecting the natural resources they depend on.

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

701 Figure 4: The respondents' perception of how climate change affects them



703 Source: Author's research 2012.

704 6 Climate change adaptation, its success and limitations in Malawi

705 Climate variability and climate change will have serious implications for smallholder
 706 farmers in Malawi that depend on natural resources for their livelihood and food
 707 security. Adaptation programmes are developed in order to reduce the vulnerability of
 708 the poor to present and future events of environmental hazards. LCBCAP is such a
 709 programme. While there are undoubtedly positive outcomes from the WFPG-project,

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717 there are also certain limitations that are important to recognise as these may have a
718 significant affect on the members' ability to adapt to climate change.

719

720 The authors' study found that the members of the WFPG were satisfied with their
721 involvement in the LCBCCAP programme, mainly due their economic betterment
722 despite the challenging environment described above. Their income and savings had
723 increased¹, they were no longer dependent on their own harvest for food consumption
724 as they had enough money to purchase food (despite the poor harvests being a
725 substantial concern), they enjoyed working in a group instead of individually and were
726 pleased with the different training LCBCCAP offered them (See table 1, and figure 5). The
727 programme had also managed to increase the fish value chain in the lake. Because of the
728 new strategies that the women were using there was less waste and the women were
729 able to produce a product with higher quality and better taste, hence they could also
730 increase the price of the fish product. These are all positive outcomes and the LCBCCAP
731 has in many ways contributed towards enhancing the women's financial and social
732 position, but there are some concerns.²

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

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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 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.

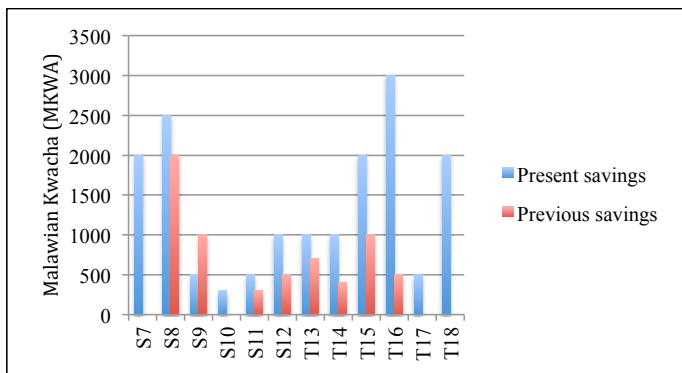
Respondent	Present Income (MKWA)	Previous Income (MKWA)	Difference	Increase in income
S7	3000	1000	2000	200 %
S8	5000	1250	3750	300 %
S9	2000	1500	500	33 %
S10	600	300	300	100 %
S11	2000	1000	1000	100 %
S12	2500	600	1900	317 %
T13	3000	1000	2000	200 %
T14	3000	1000	2000	200 %
T15	4000	1500	2500	167 %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

S: Swang'oma WFGP, T:Tandala WFGP

739 Source: Author's research 2012.

740

741 **Figure 5: Respondent's savings before and after joining a WFGP**



742

743 Source: Author's research 2012.

744

745 It is problematic that the women's livelihood is dependent on Lake Chilwa. In the last
746 century the lake has dried up nine times and it is considered normal that it happens
747 every ten to twenty years (Chapotera 2012, Njaya et al. 2009). It is therefore not a
748 question whether the lake will dry again, but when. Further, a concern is that climate
749 change, with higher temperatures and more unpredictable precipitation, will cause the
750 lake to dry even more frequently. Previous experiences have proven that when the lake
751 dries completely the whole fish sector collapses. However, according to Njaya et al.

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753 (2011) the people who depend on the lake are well adapted to the cycles of change.
754 When the lake dries there are large-scale shifts from fishing to farming, pastoralism and
755 other occupations. Migration is also common. However, migration may be problematic
756 as it puts extra constrain on the natural resources in the area where people migrate and
757 conflicts may arise between the locals and the migrants. This is a concern that also
758 **LCBCCAP** is worried about in the Lake Chilwa district (Ngozo 2012).

759 Nine out of eighteen WFPG members remember the last time the lake dried in
760 1995/1996 well. Looking back at how communities and individuals were able to cope at
761 that time gives valuable insight into people's ability to adapt to present and future
762 climate changes. The women were asked about what they remember and it how they
763 responded to the incident. They mentioned that the fish sector collapsed and people
764 started migrating to other areas to find work and food. They got involved with casual
765 day labour, known as *ganyu* or utilised the empty land of the lake to cultivate vegetables.
766 Others started processing maize flour instead of processing fish and the women were
767 forced to walk further to fetch water.

768 The findings indicate that the communities struggled when Lake Chilwa dried in
769 1995/1996. In order to survive people engaged in alternative income generating
770 activities or migrated to find employment and food. During a new incident, the women
771 will most likely have to take the same measures as their source of income will vanish.
772 While it indicates that they are able to cope, it does not indicate that LCBCCAP has
773 significantly increased their adaptive capacity as their reliance on the fish and farming
774 sector still makes them highly vulnerable to future events. It can therefore be argued
775 that LCBCCAP should bear this in mind and design adaptation strategies that are not
776 solely dependent on a sector and a resource that is threatened by climate change like
777 the WFPG-project is.

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

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

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

797

798 While most women cultivated some small plots of land for subsistence, the majority of
799 the women however, were not diversifying their livelihood strategies to an extent that
800 would compensate for the loss of income from fish processing and marketing. Out of
801 eighteen women only two reported that they had another income generating activity
802 and only one women were planning on introducing a new strategy. The two women
803 were involved in beer brewing and boat construction and the third woman wanted to
804 start cultivating rice. The rest were relying on fish processing as their source of income.
805 Eight out of the women did however mention that they were involved with *ganyu* when
806 facing economic difficulties. *Ganyu* refers to casual daily wage labour. It is often
807 unskilled agricultural labour and is a common livelihood strategy in Malawi (Simtowe
808 2010). While it serves as a backup strategy for poor seasons, it is not a reliable source of
809 income. Further, out of the ten women who were married, eight of the husbands were
810 working either in the fish sector or as farmers, hence also their income was dependent
811 on natural resources. This is problematic because the lake dries due to low precipitation
812 over more than one year, which will also have a negative effect on the agriculture sector.
813 Overall the study found that the WFPG members and their household had a weak
814 income base that is highly vulnerable to climate change due to their dependence on
815 natural resources and their low livelihood diversification (See table 2).

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821 **Table 2: Livelihood diversification**

Respondents	Wife	Husband
	Main source of income	Other sources of income
K1	Fish processing	Ganyu
K2	Fish processing	Ganyu
K3	Fish processing	
K4 (separated)	Fish processing	Ganyu, beer brewing
K5	Fish processing	Building boats
K6 (widow)	Fish processing	Ganyu
S7	Fish processing	
S8	Fish processing	Ganyu
S9	Fish processing	
S10 (widow)	Fish processing	
S11	Fish processing	
S12	Fish processing	
T13 (divorced)	Fish processing	
T14	Fish processing	
T15 (widow)	Fish processing	Ganyu
T16 (separated)	Fish processing	
T17 (widow)	Fish processing	Ganyu
T18 (separated)	Fish processing	Ganyu

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

822 Source: Author's research 2012.

823

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

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

835

837 **7 Making climate change adaptation work for vulnerable groups**

838 The previous discussion on the success and the limitations of climate adaptation offers

839 some practical solutions to make climate change adaptation work for vulnerable groups.

840 Apart from diversifying income opportunities, the authors' study offers insights into

841 how local knowledge can enhance climate change adaptation.

842 The study has identified two ways, though closely linked, where LCBCCAP has utilised

843 local knowledge. First, LCBCCAP employs local knowledge through participatory means.

844 The findings indicate that participation was crucial for the development of the WFGP.

845 Representative bodies were involved in identifying the WFGP as an appropriate

846 adaptation strategy for the community. The women have further participated in

847 analysis and their opinions have influenced the design of the project. The women have

848 for example made suggestions to the design of the solar fish driers, which have

849 improved the quality of the dried fish. Second, LCBCCAP adaptation strategies are based

850 on strategies that have proved to work elsewhere. All but one woman worked with fish

851 processing before joining the WGPG. The traditional way of processing fish is very

852 similar to the way the women process fish now, except they have better tools than

853 increase the quality and value of the product. Hence, the project was rich in local

854 content in the sense that the project was built on a local foundation.

855 The way in which local knowledge has been utilised has generated several benefits for

856 both the programme and the beneficiaries. The benefits of utilising local knowledge that

857 have been documented are increased awareness of local development issues and the

858 local environment through dialogues with the community, by having in-depth

859 understanding of local conditions and needs it is possible to design a tailor made

860 adaptation programmes, which increases sustainability. Utilising local knowledge

861 increases efficiency and it is cost-effective, it further improves communication and

862 reduces the chance of conflicts and it was found that it enhances local empowerment.

863 The authors' study can therefore conclude that local knowledge can be a crucial element

864 in enhancing climate change adaptation programmes, also for other vulnerable groups.

865 In the case of LCBCCAP, the appropriate way of utilising local knowledge was through

866 participatory means, and merging local practices with technical solutions.

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

876 8 Conclusion and lessons learned

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

883 The changing climate is having a significant impact on smallholder farmers' human
884 security. It is pushing the people living in the Lake Chilwa Basin further into poverty by
885 affecting the natural resources they depend on.

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

891 However, if adaptation strategies fail and local communities are for example forced to
892 resettle (for instance in case Lake Chilwa is to dry up), this may pose a new challenge to
893 a vulnerable population.

894 However, if adaptation strategies fail the participants' adaptive capacity may in fact
895 decrease as they have invested their time in a project that failed, pushing them further
896 into poverty and making them more vulnerable to climate change.

897 The example of Lake Chilwa and the likely increase in frequency of drying illustrates
898 that for adaptation strategies to increase the smallholder farmers' vulnerability to the

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Deleted: , 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.

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907 long-term as well as the short-term impacts of climate change, it is essential that they
908 take into account the affect of climate change on the natural resources that the
909 communities rely on. Adapting existing income-generation activities may prove to be
910 insufficient. Strategies that focus on reducing the overall dependency on climate-
911 sensitive natural resources by diversifying livelihoods will arguably increase the
912 communities capacity to adapt to and cope with adverse effects of climate change to a
913 greater extent. In sum, limitations and unintended consequences of climate change
914 adaptation strategies need to be taken seriously to ensure effective and lasting
915 adaptation.

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Deleted: 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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