

Authors' response to:

Editor Decision: Publish subject to minor revisions (review by Editor) (06 Oct 2016) by Prof. Jürgen Scheffran

**Comments to the Author:**

The authors have addressed much of the comments of the reviewers and revised the paper accordingly, to make it more suitable for publication. In a separate note, remaining issues are highlighted that need to be addressed before publication, including a number of technical corrections.

**Non-public comments to the Author:**

Please address the following points and highlight with track change in the newly revised document to facilitate final review by the Editor:

*- Thank you very much for your invaluable comments. We have attached a revised version of the article including track changes.*

The emphasis on conflict has been largely abandoned, making the paper less suitable for the special issue. Some connection to climate vulnerability, adaptation and land use may still justify it. What would be interesting is how the level of conflict or non-conflict affects this connection which would strengthen the scope. A few sentences might suit.

*- We have included a few sentences within section 2.1 to strengthen the scope.*

Reviewer suggests to provide information about LCBCCAP (which has been done) and the role/connection of the authors to it (which needs short explanation).

*- We have included more information on the role of the authors in the methods section.*

**Specific Comments (SC) of reviewer:**

SC 2: Say what is novel about the paper, as suggested by the reviewer.

*- We included a short paragraph on page 3(112-116).*

SC 4: In response to reviewer, authors say they reflected on research ethics, but ethics could not be found in the paper. Where is ethics covered?

*- There is now more text on research ethics within the methodology section on page 13(417-422).*

SC 6 & SC 13: In the general part, the reviewer suggests to explain how the 18 participants were selected. The only explanation found was “that the respondents are not randomly selected but rather ‘handpicked’.” Still it is not clear how this selection worked. More information would be useful about how data were generated, how selection and interviews worked. Which questions were asked/given to the respondents? How were the response categories created?

*- There is now more text on sampling techniques and interview process within the methodology section on page 12 and 13.*

SC 8: The title has changed but can be still improved. The term “supporting” is not explicitly used in the paper which is not really about “Living with climate change”, rather about vulnerability and adaptation. What about “Vulnerability to climate change and adaptation strategies of local communities in Malawi: Experiences of women fish processing groups in the Lake Chilwa Basin”. The subtitle can be included or excluded.

*- Thank you, this is an appropriate title and we are gladly changed it.*

SC 9: The abstract is rather general und unspecific to the content of the paper. It should refer to the particular case of the women fish processing groups, the adaptation program and essential results.

*- The abstract is now more specific, indicating details on the adaptation programme and results.*

SC 14: In the Introduction one would expect a few more references to the state of literature (here it is only 5 references).

*- More references have been added to the introduction.*

**Additional specific corrections/suggestions/comments: X(Y): means page X, line Y**

*- Thank you for the specific corrections/suggestions/comments, we have tried to address all of them in an appropriate manner.*

*If you have any further questions or comments, please do not hesitate to contact us. We look forward to the publication, and we believe, your comments have substantially improved the article.*

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](#),  
3 Hanne Jørstad<sup>1</sup> and Christian Webersik<sup>1</sup>  
4 <sup>1</sup> University of Agder

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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](#).

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

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26 Planning, University of Agder, christian.webersik@uia.no

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## 45 1 Introduction

46 It is a fact that anthropogenic climate change has and is going to have severe impact on  
47 developing countries, especially those with a climate-sensitive economy (DARA, 2012).

48 Moreover, countries in the Global South struggle with poverty, horizontal inequalities,  
49 armed conflict, poor governance, and historical injustices, some of the additional  
50 compounding factors that make them vulnerable (O'Brien et al. 2000). Therefore,  
51 framing climate change impacts as a human security concern fits with the discussion on  
52 differential vulnerability, given the array of social, political, and economic factors that  
53 make people vulnerable in the first place (McDowell et al. 2016). The debate on the  
54 human security implications of climate change has gained momentum in recent years.  
55 This is due to a lively policy debate as well as to several publications in journals and  
56 books (Brzoska and Scheffran 2013; Scheffran et al. 2012, Webersik 2010). Yet, climate  
57 change impacts and their causal linkages with human security are complex and  
58 multifaceted, and research needs to address "the limits of our capacity to understand  
59 complexity" (Nicholson 2013: 158). Keeping this in mind, this research aims at  
60 contextualising climate change adaptation and its limitations in southern Malawi.

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

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93 variability, and changes in the intensity of natural hazards will most certainly affect  
94 food security, public health and agricultural productivity in low-income countries.

95 This reflects the notion that climate change is often seen as a 'threat multiplier'  
96 exacerbating existing tensions, such as poverty or inequalities (Hegre et al. 2016;  
97 Johnstone and Mazo 2011). Even when climate change adaptation becomes unavoidable,  
98 it needs to be sustainable. Some adaptation strategies, such as agricultural innovation in  
99 the fisheries sector as demonstrated in this article, are important in the short-term to  
100 relieve some of the pressures climate change may pose but may fail in the long-term in  
101 securing a sustainable livelihood.

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

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

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125 | [communities in southern Malawi, hence climate change adaptation is becoming an](#)  
126 | [important strategy for these communities to cope with the anticipated changes.](#) This  
127 | section sheds light on how climate change affects local fishing communities in the Basin  
128 | and critically evaluates the long-term effectiveness and relevance of an adaptation  
129 | project implemented in these communities.

## 130 | **2 Human security, climate change adaptation and its limitations**

### 131 | **2.1 Climate change and human security**

132 | Malawi is extremely poor, with a high population growth, it is highly dependent on  
133 | natural resources and is hence vulnerable to climate change. Despite existing and  
134 | functioning coping mechanisms of climate variability, such as selling economic assets,  
135 | agricultural diversification, and labour migration, climate change may have severe  
136 | impacts on rural population and should therefore be considered as a real threat to the  
137 | population's human security, [including conflict \(Redclift and Grasso 2013\).](#) [Malawi has](#)  
138 | [despite its challenging socio-economic development, impacting on both, climate change](#)  
139 | [and conflict, not experienced major armed conflicts in the past decades \(Hegre et al.](#)  
140 | [2016\).](#) [The low levels of conflict have helped to create an enabling environment for a](#)  
141 | [large number of people that depend on a fragile resource base. Local knowledge and](#)  
142 | [social capital are important factors in explaining some of the coping mechanisms of the](#)  
143 | [poor in Malawi, factors that could develop in peaceful periods. The absence of conflict](#)  
144 | [may also help to explain that an increasing number of natural hazards have not resulted](#)  
145 | [into humanitarian disasters.](#) A study conducted by ActionAid finds that the country has  
146 | already seen an increase in the number of extreme weather events in terms of floods  
147 | and droughts since the 1970s till 2006 (Action Aid 2006). Sustainable adaptation  
148 | strategies can therefore be seen as a means to avoid human insecurity. This article  
149 | argues that global environmental change, poverty, and society must be put into context  
150 | rather than purely focusing on the causal links between climate change impacts and  
151 | human security. [The Lake Chilwa](#) region in southern Malawi was selected [as it displays,](#)  
152 | great demographic and environmental challenges, to better understand what and why  
153 | some [adaptation](#) mechanisms may work or not [work,](#)

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## 160 2.2 Climate change adaptation

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

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

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

180 According to the ~~Forth~~ Assessment Report of the IPCC (Niang et al. 2014; Boko et al.  
181 2007) Africa is one of the most vulnerable continents to climate change due to its high  
182 exposure (e.g. heavy reliance on climate sensitive agriculture) and low adaptive capacity  
183 (e.g. poverty). Key adaptation strategies are diversification of livelihood activities,  
184 adjustment in farming operations, income generating projects, selling of labour and the  
185 move towards off-farm or non-farm livelihood incomes (Boko et al. 2007). The results of  
186 this paper suggest that these adaptation strategies are relevant also for Malawi.

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## 188 2.3 Limitations of climate change adaptation

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195 Not all adaptation strategies are sustainable. For instance, physical adaptation  
196 strategies, such as dams to protect low-lying land from water intrusion caused by sea  
197 level rise, may require human migration and resettlement. This way, migration becomes  
198 an adaptation strategy. The debate whether migration may be an act of adaptation  
199 received attention among scholars (Tacoli 2009; Baldwin 2016; Brzoska and Frölich  
200 2016; Black et al. 2011; McLeman and Smit 2006). Recent research in low-lying island  
201 states demonstrates that local perceptions on climate change-induced migration differ  
202 from the dominant political discourse on climate-induced migration in the same  
203 location, and that not migrating can be both, a strategy to adapt or to fail to adapt  
204 (Kelman et al. 2015). Though there is little evidence that environmental-induced  
205 migration has the potential to trigger violent conflict, it likely will create major  
206 challenges for hosting communities, especially in regions that are already densely  
207 populated, for example Malawi (Webersik 2012). Climate related outmigration could  
208 also change the social fabric of those communities that stay behind. With shrinking  
209 populations, markets and political institutions can get distorted making it more difficult  
210 for those left behind to adapt to climate change (Barnett 2012). In other cases,  
211 adaptation strategies that do not take into consideration the long-term impacts of  
212 climate change may prove unsustainable. Livelihood diversification is a laudable  
213 approach, however, if farming diversification activities or commercialisation of  
214 agriculture remain sensitive to climate change impacts such as unpredictable rainy  
215 seasons, the long-term adaptation effect may remain limited as the following case study  
216 in the Lake Chilwa Basin in Malawi demonstrates. Other unintended social and  
217 environmental consequences of climate change adaptation can stem from large  
218 infrastructure projects, such as dam-building for hydropower and water storage, biofuel  
219 plantations, and water relocation projects, all relevant for the African context (de  
220 Sherbinin et al. 2011). For instance, the growing number of biofuel plantations bought  
221 by foreign investors has triggered a debate on land grabbing in Africa (Matondi 2011).  
222 Most important, if people are forced to relocate due to large infrastructure projects or  
223 land-use change, their economic potential and environmental vulnerability need to be  
224 evaluated for current and future climate change impacts, as well.

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### 232 **3 Explaining the context of Malawi**

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

240 Malawi is one of the most densely populated countries in Africa with a population of  
241 approximately 15,380 000 on an area of 94,276 square kilometres (EAD 2010; UNDP  
242 2012). It has a high population growth of 2.80%, according to 2008 estimates (NSO  
243 2012). It is one of the least-developed countries (LDCs) with a gross national income  
244 (GNI) of USD 850 purchasing power parity (PPP) per capita and ranks as 171 out of 179  
245 on UNDP's human development index (UNDP 2011). 74 per cent of Malawi's population  
246 live on less than a dollar (PPP) a day (2004 estimate) (UNSTATS 2012).

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

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

262

### 263 3.1 Malawi and climate change

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

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

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

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

298

### 299 **3.2 Lake Chilwa Basin and climate change**

300 Some studies have also been conducted on climate change in the Lake Chilwa Basin. It  
301 must be noted, however, that Lake Chilwa Basin is located in a climatically unstable  
302 environment and fluctuations in rainfall and temperature have been recorded since the  
303 1960's. It is therefore not clear if the climate is changing significantly (EAD 2000). Data  
304 does however show a slight decrease in rainfall and an increase in temperature in the  
305 Lake Chilwa Basin. Statistics from the Meteorological Department show that the mean  
306 maximum temperatures in the basin have risen by approximately 1°C (EAD 2000). A  
307 decrease in precipitation since the mid-1980s has also been documented in the basin as  
308 shown in figure 1. The combined effects of higher temperatures and less rain is arguably  
309 the reason for the gradual decrease in Lake Chilwa's water level discussed in section  
310 5.2.2 (EAD 2000) (See figure 3). Scenarios of the basin vary that air temperatures in the  
311 basin will increase 2.6°C to 4.7°C by 2075 while scenarios of precipitation varies from a  
312 8.3 per cent increase to a 7 per cent decrease (EAD 2000). Moreover, local studies show  
313 that there is a chance of shorter growing seasons in the future in southern Malawi due  
314 to global warming (Cook et al. 2015), and this trend is already being experienced by the  
315 local population, as discussed in section 5.2.1.

316

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

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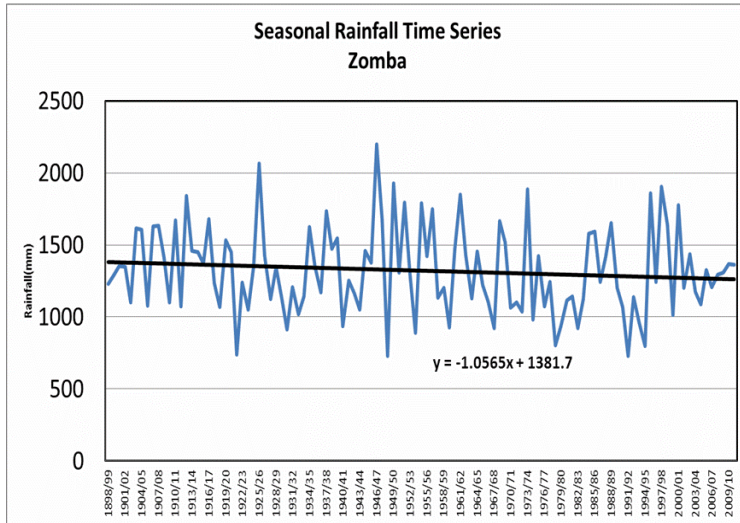
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323  
324 Source: Carr (2012)

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326 **4. Methodology**

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

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

345 The empirical part of this study is based on a case study of the Lake Chilwa Basin  
346 Climate Change Adaptation Programme. LCBCCAP is a five-year joint programme  
347 (2010-2014) implemented by Leadership for Environment and Development Southern  
348 & Eastern Africa (LEAD SEA), WorldFish Centre (WFC) and Forestry Research Institute  
349 of Malawi (FRIM). The programme is funded by the Norwegian Government through the  
350 Norwegian Embassy in Malawi. LCBCCAP main objective is to secure the livelihood of  
351 the 1.5 million people living in the Lake Chilwa Basin and enhance the resilience of the  
352 natural resource base they depend on. To meet the objective, LCBCCAP develop and  
353 implement basin-wide climate change adaptation strategies and works towards  
354 increasing the capacity of communities to adopt sustainable livelihood and natural  
355 resource management practices (LEAD 2011). The programme has a number of  
356 projects in the basin and one of them is the WFPG, facilitated by WFC. The LCBCCAP was  
357 selected due to its relevance to the topic and theoretical issues of the study. The WFPG  
358 was selected on similar terms. The objective of the WFPGs is to enhance adaptive  
359 capacity through fish processing. The WFPG-project does this by 1) improving  
360 traditional methods of processing fish in order to increase quality and reduce wastage,  
361 which increases the women's income and savings, and 2) providing the WFPG members  
362 with training, such as business management, climate change, gender-issues and group  
363 dynamics. The majority of the women participating in the programme were in the fish  
364 sector prior to the project.

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

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

381 The purposive sampling technique was chosen for this study in order to select  
382 respondents that are relevant for the study. The sampling technique is commonly used  
383 for qualitative research and especially small-scale projects (Bryman 2008, Denscombe  
384 2007). Because purposive sampling is under the category of non-probability sampling it  
385 entails that the respondents are not randomly selected but rather ‘handpicked’. It also  
386 implies that findings cannot be generalised to the enlarged population nor can one  
387 assume that the respondents represent the overall population (Denscombe 2007).  
388 However for this research it is not seen as necessary nor is it the intention for the  
389 research to reveal the general Malawian’s experience with climate change, but rather  
390 focus on the specific case study of LCBCCAP and its women fish processing groups, how  
391 these women experience climate change and if the project increases their long-term  
392 adaptive capacity.

393 To gain as broad understanding of the WFPG as possible, interviews were carried out  
394 with members from all three [women groups as there were only three women groups](#)  
395 [with eleven to fifteen members. It was further decided that it would be sufficient to](#)  
396 [have individual interviews with approximately half of the members and focus group](#)  
397 [discussions with the rest of the members from each women group.](#)

398 [The data collection took place over a period of two months from mid-January to mid-](#)  
399 [March, 2012. Both of the months were spent with LEAD in Zomba who coordinates the](#)  
400 [LCBCCAP. From Zomba I took several fieldtrips to the WFPG that are located in Kachulu,](#)  
401 [Swang’oma and Manguluni. A notice was sent out to the group members in advance,](#)  
402 [though it varied how many group members turned up for the interviews. The](#)  
403 [interviews were carried out at the natural settings of the respondents, meaning either](#)  
404 [at LEADs office, WFCs office or in the communities at the WFPG sites. An interpreter](#)  
405 [assisted me for the interviews with the WFPG members.](#)

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

## 429 **5 Living with climate change: Experiences from Lake Chilwa Basin.**

430 The scientific material presented above illustrates a Malawi in change. These studies are  
431 further strengthened by testimonies from local communities in the Lake Chilwa Basin.  
432 Findings from a case study of the Lake Chilwa Basin Climate Change Adaptation  
433 Programme (LCBCCAP) and its Women Fish Processing Groups (WFPGs), revealed that  
434 the women members of the groups have experienced and were impacted by changes in  
435 the climate in the Lake Chilwa Basin.  
436

437

### 438 **5.1 Local perceptions of climate change**

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

441 present. The authors' study found that for the women in the WFG climate change is  
442 already affecting their lives. Out of the eighteen women that participated in the study,  
443 all agreed that the climate is changing.

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

452 According to the respondents, the rainy seasons had become highly unpredictable in the  
453 past four to five years as they had been delayed, inconsistent and short. The women  
454 explained they had experienced **erratic** rain, unpredictable rain and there were longer  
455 drier periods within the rain season, also known as dry spells. The rainy season of  
456 2011-2012 is a good example of the recent trend. The women expected the rain to start  
457 in October-November, but instead it started in late December and ended in February  
458 instead of March. When the rain came, it was erratic and frequently interrupted by dry  
459 spells.

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

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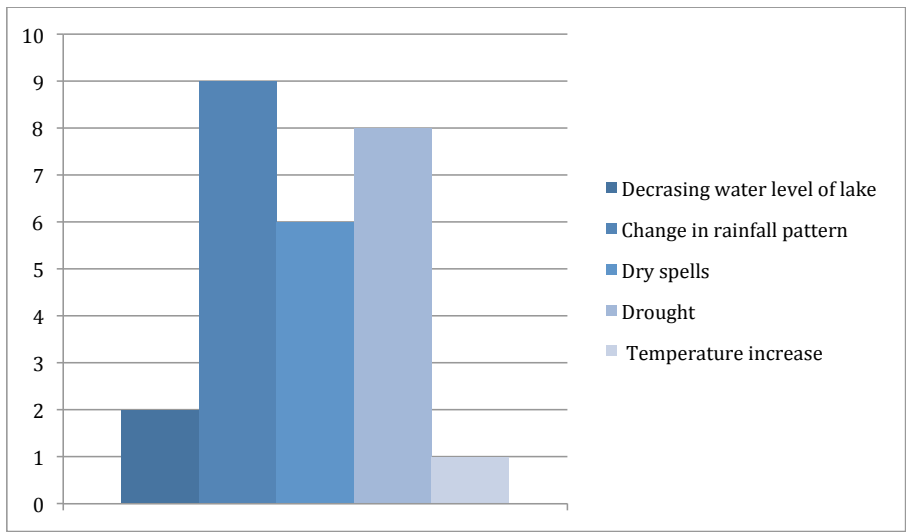
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473 As mentioned earlier, Malawi is a country that is prone to extreme weather events such  
474 as flood and drought and since the late 1970's the country has experienced an increase  
475 of such events (Chipotha and Mphepo 2011). Out of eighteen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

478

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



480

481 | Source: Authors research 2012.

482

## 483 **5.2. Climate change impacts in the Lake Chilwa Basin**

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

### 488 **5.2.1 Food security and subsistence farming**

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

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

502 One of the main challenges for smallholder farmers in Malawi is to know when to plant.  
503 Farmers have usually relied on their local knowledge to make decisions regarding  
504 sowing (Kalanda-Joshua et al. 2011). According to the WFPG members, it used to be  
505 common to plant when the first rain came. Previously it was considered optimal as the  
506 rain usually continued to come consistently. Now they find that the rain is not as  
507 predictable as dry spells often occur right after the first rain. When a dry spell occurs  
508 the planted crops will fail to grow and consequently the households will have to replant.

509 One of the women from Kachulu explains how the unpredictable rain is increasing their  
510 vulnerability. “This season I have planted maize three times, but every time it has  
511 withered due to lack of rain. Because of the poor rain I am becoming poorer as it is  
512 expensive to replant. I cannot afford to replant again, so I will have to purchase food  
513 instead”. As a consequence of the poor and unpredictable rain season, the women are  
514 being pushed further into poverty.

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

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

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

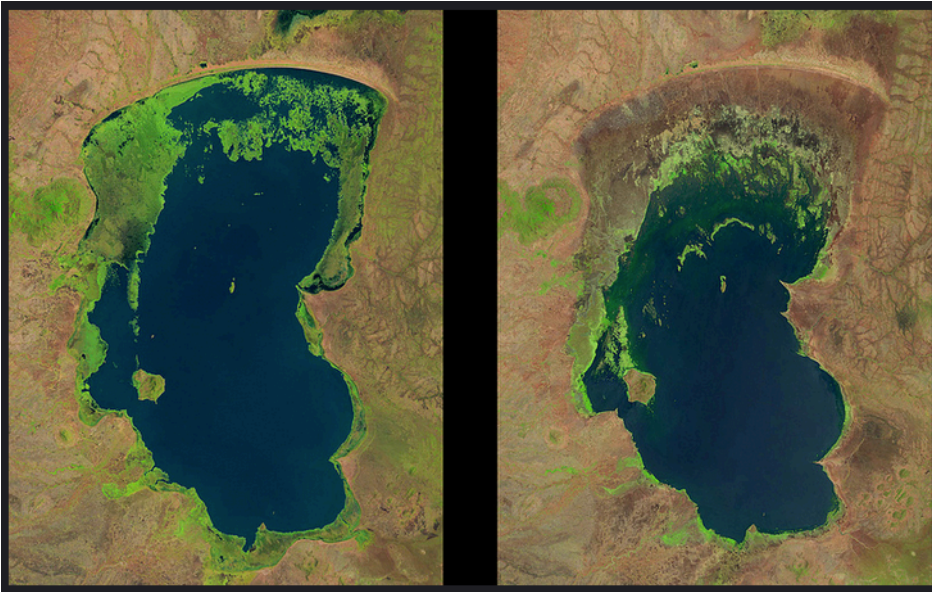
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536 **5.2.2. Impacts on livelihoods**

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

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

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



553

554 Source: USGS 2014 <https://www.flickr.com/photos/usgeologicalsurvey/11963785293/in/photostream/>

555 <https://eros.usgs.gov/imagegallery/image-week-2#lake-chilwa-top>

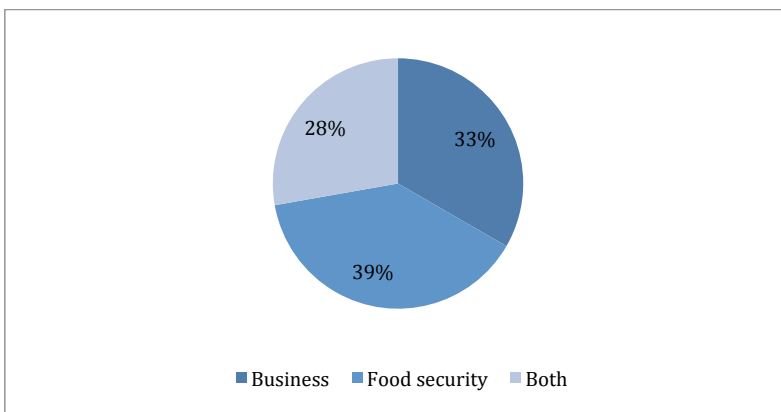
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557 When the water level sinks the fish stock is reduced, which increases the price of the  
558 remaining catch and reduces the women's income. If the lake dries completely the  
559 women are temporary out of business for two to four years. During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

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

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

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



583

584 Source: Authors' research 2012.

## 585 6 Climate change adaptation, its success and limitations in Malawi

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

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

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

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

612

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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.

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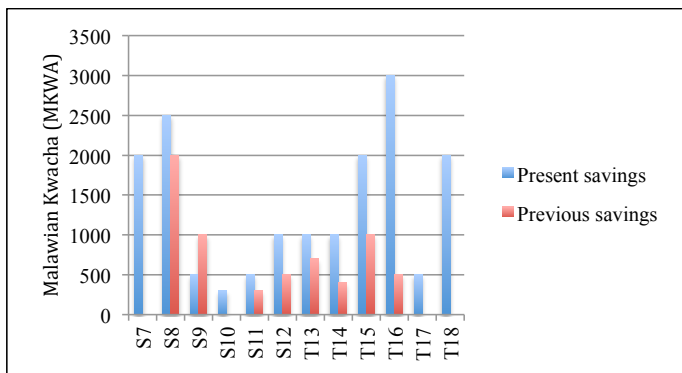
Respondent	Present Income (MKWA)	Previous Income (MKWA)	Difference	Increase in income
S7	3000	1000	2000	200 %
S8	5000	1250	3750	300 %
S9	2000	1500	500	33 %
S10	600	300	300	100 %
S11	2000	1000	1000	100 %
S12	2500	600	1900	317 %
T13	3000	1000	2000	200 %
T14	3000	1000	2000	200 %
T15	4000	1500	2500	167 %
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 WFGP, T:Tandala WFGP

614 | Source: Authors research 2012.

615

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



617

618 | Source: Authors research 2012.

619

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

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

636 Nine out of eighteen WFPG members remember the last time the lake dried in  
637 1995/1996. Looking back at how communities and individuals were able to cope at that  
638 time gives valuable insight into people's ability to adapt to present and future climate  
639 changes. The women were asked about what they remember and how they responded  
640 to the incident. They mentioned that the fish sector collapsed and people started  
641 migrating to other areas to find work and food. They got involved with casual day  
642 labour, known as *ganyu* or utilised the empty land of the lake to cultivate vegetables.  
643 Others started processing maize flour instead of processing fish and the women were  
644 forced to walk further to fetch water.

645 The findings indicate that the communities struggled when Lake Chilwa dried in  
646 1995/1996. In order to survive people engaged in alternative income generating  
647 activities or migrated to find employment and food. During a new incident, the women  
648 will most likely have to take the same measures, as their source of income will vanish.  
649 While **income diversification and migration** indicate that they are able to cope, it does  
650 not indicate that LCBCCAP has significantly increased their adaptive capacity as their  
651 reliance on the fish and farming sector still makes them highly vulnerable to future  
652 events. It can therefore be argued that LCBCCAP should bear this in mind and design  
653 adaptation strategies that are not solely dependent on a sector and a resource that is  
654 threatened by climate change like the WFPG-project is.

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

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

669 It is recognized that resilience to climate change involves household's  
670 diversifying their livelihood strategies to have options for managing drought,  
671 floods, and temperature increases. Thus, in communities throughout the Basin,  
672 the project will work to identify ways in which to diversify and enhance their  
673 livelihoods, increase productivity of ecosystems and rural incomes, and reduce  
674 vulnerability to economic and environmental shocks (LEAD et al. 2009: 15).  
675

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

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698 **Table 2: Livelihood diversification**

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

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

699 Source: Authors research 2012.

700

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

706 In order for LCBCCAP to improve the WFPG-project and further reduce the women's  
 707 vulnerability towards climate variability and climate change, diversification may be a  
 708 step in the right direction However, for diversification to be an effective adaptation  
 709 strategy for the WFPG members it is necessary that the additional income sources do  
 710 not react similar to a change in the climate as the fish sector. Finding a source of income  
 711 that is not dependent on a natural resource may very well be the best option.  
 712

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714 **7 Making climate change adaptation work for vulnerable groups**

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

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719 The study has identified two ways, though closely linked, where LCBCCAP has utilised  
720 local knowledge. First, LCBCCAP employs local knowledge through participatory means.  
721 The findings indicate that participation was crucial for the development of the WFGP.  
722 Representative bodies were involved in identifying the WFGP as an appropriate  
723 adaptation strategy for the community. The women have further participated in  
724 analysis and their opinions have influenced the design of the project. The women have  
725 for example made suggestions to the design of the solar fish driers, which have  
726 improved the quality of the dried fish. Second, LCBCCAP adaptation is based on  
727 strategies that have proved to work elsewhere. All but one woman worked with fish  
728 processing before joining the WGPG. The traditional way of processing fish is very  
729 similar to the way the women process fish now, except they have better tools than  
730 increase the quality and value of the product. Hence, the project was rich in local  
731 content in the sense that the project was built on a local foundation.

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

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

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

## 757 8 Conclusion and lessons learned

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

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

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

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

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

795 **References**

- 796 Action Aid (2006). *Climate change and smallholder farmers in Malawi: Understanding*  
797 *poor people's experience in climate change* [adaptation](#), Action Aid International.
- 798 Adger, W. Neil (2003). Social Capital, Collective Action and Adaptation to Climate  
799 Change, *Economic Geography*, Vol. 79, No. 4, pp. 387-404.
- 800 Adger, W. Neil, Katrina Brown, Declan Conway, Mike Hulme and Saleemul Huq (2003).  
801 [Adaptation](#) to climate change in the developing world, *Progress in Development*  
802 *Studies*, Vol. 3, No. 3, pp. 179-195.
- 803 Agder, W. Neil, Suraje Deesai, Marisa Goulden, Mike Hulme, Irene Lorenzoni, Donald R.  
804 Nelson, Lars Otto Naess, Johanna Wolf and Anita Wreford (2009). Are there  
805 social limits to adaptation to climate change?, *Climate Change*, Vol. 93, pp.335-  
806 354.
- 807 Baldwin, A. (2016). Premediation and white affect: climate change and migration in  
808 critical perspective. *Transactions of the Institute of British Geographers*, 41(1), 78-  
809 90. doi:10.1111/tran.12106
- 810 Barnett, Jon. 2012. "On the risks of engineering mobility to reduce vulnerability to  
811 climate change: insights from a small island state" In *Climate Change and Human*  
812 *Mobility: Challenges to the Social Sciences*, eds. Kirsten Hastrup and Karen Fog  
813 Olwig. Cambridge: Cambridge University Press.
- 814 [Black, R., Bennett, S. R. G., Thomas, S. M., & Beddington, J. R. \(2011\). Climate change:](#)  
815 [Migration as adaptation. \*Nature\*, 478\(7370\), 447-449.](#)
- 816 Boko, M., I. Niang, A. Nyong, C. Vogel, A. Githeko, M. Medany, B. Osman-Elasha, R. Tabo  
817 and P. Yanda (2007). Africa. *Climate Change 2007: Impacts, Adaptation and*  
818 *Vulnerability*. Contribution of Working Group II to the Fourth Assessment Report  
819 of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P.  
820 Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press,  
821 Cambridge UK, pp. 433-467.
- 822 Brzoska, M., & Fröhlich, C. (2016). Climate change, migration and violent conflict:  
823 vulnerabilities, pathways and adaptation strategies. *Migration and Development*,  
824 5(2), 190-210. doi:10.1080/21632324.2015.1022973
- 825 Brzoska, M., & Scheffran, J. (2013). Climate and war: No clear-cut schism. *Nature*,  
826 498(171).
- 827 Central Intelligence Agency (2015). *The world factbook: Malawi, Central Intelligence*  
828 *Agency*, Online. Available from: [https://www.cia.gov/library/publications/the-](https://www.cia.gov/library/publications/the-world-factbook/geos/mi.html)  
829 [world-factbook/geos/mi.html](https://www.cia.gov/library/publications/the-world-factbook/geos/mi.html) (Accessed 13.10.15).
- 830 Chapotera, Mphatso (2012). *Stream flow and water level monitoring report*,  
831 Zomba:WorldFish Centre.
- 832 Chiotha, Sosten and Gibson Mphepo (2011). Integrating climate change adaptation in  
833 farming – Building on community knowledge of flooding and drought, pp. 64-66,  
834 in Bass, James L.L. Banda, Sosten Chiotha, Joseph Kalowekamo, Themba Kalua,  
835 Daisy Kambalame-Kalima, Boyd Hamella, Michael Mmangisa, Gibson Mphepo,

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Christian Webersik 13/10/2016 11:13

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- 838 Nyuma Mughogho, Dennis Mulebe, Friday Njaya, Elliot Phiri, Benon Yassin, and  
 839 Gil Yaron (2011). *Mainstreaming the environment in Malawi's development:  
 840 experience and next steps*, London: IIED.
- 841 de Sherbinin, A., M. Castro, F. Gemenne, M. M. Cernea, S. Adamo, P. M. Fearnside, G.  
 842 Krieger, S. Lahmani, A. Oliver-Smith, A. Pankhurst, T. Scudder, B. Singer, Y. Tan, G.  
 843 Wannier, P. Boncour, C. Ehrhart, G. Hugo, B. Pandey and G. Shi. 2011. "Preparing  
 844 for Resettlement Associated with Climate Change." *Science* 334(6055):456-457.
- 845 | Dodman, David and Diana Mitlin (2011). Challenges for Community-Based Adaptation,  
 846 *Journal of International Development*, Available through: Wiley Online Library,  
 847 (accessed 06.04.08).
- 848 EAD (2010). *Malawi State of Environment and Outlook: Environment for Sustainable  
 849 Economic Growth*, Lilongwe: Environmental Affairs Department.
- 850 EAD (2000). *Lake Chilwa Wetland State of the Environment*, Lilongwe: Environmental  
 851 Affairs Department.
- 852 FAO (2005). *FAO Fishery Country Profile*, Lilongwe: The Republic of Malawi.
- 853 Fisher, M., Chaudhury, M., & McCusker, B. (2010). Do Forests Help Rural Households  
 854 Adapt to Climate Variability? Evidence from Southern Malawi. *World  
 855 Development*, 38(9), 1241-1250.  
 856 [doi:http://dx.doi.org/10.1016/j.worlddev.2010.03.005](http://dx.doi.org/10.1016/j.worlddev.2010.03.005)
- 857 GoM (2010). *Statistical Yearbook: 2010*, Zomba: National Statistical Office.
- 858 Hegre, H., Buhaug, H., Calvin, K. V., Nordkvelle, J., Waldhoff, S. T., & Gilmore, E. (2016).  
 859 *Forecasting civil conflict along the shared socioeconomic pathways.*  
 860 *Environmental Research Letters*, 11(5), 054002
- 861 Johnstone, S., & Mazo, J. (2011). *Global Warming and the Arab Spring. Survival*, 53(2),  
 862 11-17. doi:10.1080/00396338.2011.571006
- 863 Jury, M. R., and N. D. Mwafulirwa (2002). Climate variability in Malawi, part 1: Dry  
 864 summers, statistical associations and predictability, *Int.J. Climatol*, Vol. 22, pp.  
 865 1289-1302.
- 866 Kalanda-Joshua, Miriam, Cosmo Ngongondo, Lucy Chipeta and F. Mpembeka (2011).  
 867 Integrating indigenous knowledge with conventional science: Enhancing  
 868 localised climate and weather forecasts in Nessa, Mulanje, Malawi, *Physics and  
 869 chemistry of the earth*, Vol 36, pp. 996-1003.
- 870 Kelman, I., Stojanov, R., Khan, S., Gila, O. A., Duží, B., & Vikhrov, D. (2015). Viewpoint  
 871 paper. Islander mobilities: any change from climate change? *International  
 872 Journal of Global Warming*, 8(4), 584-602. doi:10.1504/IJGW.2015.073056
- 873 LEAD (Leadership for Environment and Development), Forestry Research Institute of  
 874 Malawi and national Herbarium and Botanical Gardens of Malawi (2009).  
 875 *Addressing Climate Change by Building Social and Ecological Resilience in the Lake  
 876 Chilwa Basin*, Funding proposal submitted to the Royal Norwegian Embassy,  
 877 Zomba: LEAD.

Christian Webersik 13/10/2016 11:14

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- 879 Leichenko, R. M., & O'Brien, K. L. (2008). *Environmental change and globalization :  
880 double exposures*. Oxford ; New York: Oxford University Press.
- 881 Matondi, Prosper Bvumiranayi, Kjell J. Havnevik and Beyene Atakilte. 2011. Biofuels,  
882 land grabbing and food security in Africa. London; New York; Uppsala: Zed  
883 Books; Published in association with Nordic Africa Institute; Palgrave Macmillan  
884 [distributor].
- 885 [McDowell, G., Ford, J., & Jones, J. \(2016\). Community-level climate change vulnerability  
886 research: trends, progress, and future directions. \*Environmental Research Letters\*,  
887 \*11\*\(3\), 033001.](#)
- 888 [McLeman, R., & Smit, B. \(2006\). Migration as an Adaptation to Climate Change. \*Climatic  
889 Change\*, \*76\*\(1\), 31-53. doi:10.1007/s10584-005-9000-7](#)
- 890 McSweeney, C., M. New and G. Lizcano (2012). *UNDP Climate Change Country Profile:  
891 Malawi*, <http://country-profiles.geog.ox.ac.uk> (Accessed 13.09.11).
- 892 Nagoli, Joseph (2010). *Lake Chilwa Basin Climate Change Adaptation Programme:  
893 Livelihood Analysis Report*, Zomba: WorldFish Centre.
- 894 Nelson, R, P. Kocic, S. Crimp, P. Martin, H. Meinke, S.M. Howden, P. de Voil, U. Nidumolu  
895 (2009). The vulnerability of Australian rural communities to climate variability  
896 and change: Part II – Integrating impacts with adaptive capacity, *Environmental  
897 Science & Policy*, Vol. 13, pp. 18-27.
- 898 Ngozo, Claire (2012). Livelihoods drying up on Malawi's Lake Chilwa, *Inter Press Service  
899 News Agency* (17.08.12), [http://www.ipsnews.net/2012/08/livelihoods-drying-  
900 up-on-malawis-lake-chilwa/](http://www.ipsnews.net/2012/08/livelihoods-drying-up-on-malawis-lake-chilwa/) (Accessed 04.09.12)
- 901 Niang, I., O.C. Ruppel, M.A. Abdrabo, A. Essel, C. Lennard, J. Padgham, and P. Urquhart,  
902 (2014). Africa. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability*.  
903 Part B: Regional Aspects. Contribution of Working Group II to the Fifth  
904 Assessment Report of the Intergovernmental Panel on Climate Change [Barros,  
905 V.R., C.B. Field, D.J. Dokken, M.D. Mastrandrea, K.J. Mach, T.E. Bilir, M. Chatterjee,  
906 K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken,  
907 P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge,  
908 United Kingdom and New York, NY, USA, pp. 1199-1265.
- 909 Nicholson, C. T. M. (2014). Climate change and the politics of causal reasoning: the case  
910 of climate change and migration. *The Geographical Journal*, *180*(2), 151-160.  
911 doi:10.1111/geoj.12062
- 912 Njaya, Friday (2011). Integrating environments in fisheries- co-management and  
913 traditional knowledge helping shift Lake Chilwa from recession to recovery, pp.  
914 58-63, in Bass, James L.L. Banda, Sosten Chiotha, Joseph Kalowekamo, Themba  
915 Kalua, Daisy Kambalame-Kalima, Boyd Hamella, Michael Mmangisa, Gibson  
916 Mphemo, Nyuma Mughogho, Dennis Mulebe, Friday Njaya, Elliot Phiri, Benon  
917 Yassin, and Gil Yaron (2011). *Mainstreaming the environment in Malawi's  
918 development: experience and next steps*, London: IIED.
- 919 NSO (2012). CountrySTAT: Key Indicators,  
920 <http://www.countrystat.org/mwi/cont/pages/page/indicators/en> (Accessed

921 29.09.12)

922 Njaya, Friday, Katherine A. Snyder, Daniel Jamu, John Wilson, Clive Howard-Williams,  
 923 Edward H. Allison and Neil L. Andrew (2011). The natural history and fisheries  
 924 ecology of Lake Chilwa, southern Malawi, *Journal of Great Lakes Research*, Vol 37,  
 925 pp. 15-25.

926 Redclift, M. R., & Grasso, M. (2013). *Handbook on climate change and human security*.  
 927 Cheltenham, UK ; Northampton, MA, USA: Edward Elgar.

928 Scheffran, Jürgen, Michael Brzoska, Jasmin Kominek, P. Michael Link and Janpeter  
 929 Schilling. 2012. "Climate Change and Violent Conflict." *Science* 336(869).

930 Simtowe, Franklin Peter (2010). Livelihoods diversification and gender in Malawi,  
 931 *African Journal of Agricultural Research*, Vol. 5, No. 3, pp.204-216.

932 Smith, Barry and Johanna Wandel (2006). Adaptation, adaptive capacity and  
 933 vulnerability, *Global Environment Change*, Vol. 16, pp. 282-292.

934 Stringer, Lindsay C., Jen C. Dyer, Mark S. Reed, Andrew J. Dougill, Chasca Twyman and  
 935 David Mkwambisi (2009). Adaptation to climate change, drought and  
 936 desertification: local insight to enhance policy in southern Africa, *Environmental  
 937 Science & Policy*.

938 Tacoli, C. (2009). Crisis or adaptation? Migration and climate change in a context of high  
 939 mobility. *Environment and Urbanization*, 21(2), 513-525.

940 UNDP (2011). *Human Development Report 2011: Sustainability and Equity: A Better  
 941 Future for All*, Hampshire: Palgrave Macmillan.

942 UNDP (2012). *Malawi: Country Profile: Human Development Indicators*,  
 943 <http://hdrstats.undp.org/en/countries/profiles/MWI.html> (Accessed 02.04.12).

944 UNFCCC (2011). *Report of the Conference of the Parties on its sixteenth  
 945 session, held in Cancun from 29 November to 10 December 2010*, UNFCCC,  
 946 <http://unfccc.int/resource/docs/2010/cop16/eng/07a01.pdf#page=4>  
 947 (Accessed 24.05.12).

948 UNSTATS (2012). *Millennium Development Goals Indicators*,  
 949 <http://mdgs.un.org/unsd/mdg/Data.aspx> (Accessed 29.09.12)

950 USGS (2014). Image of the week, Lake Chilwa, Malawi. Online. U.S. Geological Survey.  
 951 Available from: [https://eros.usgs.gov/imagegallery/image-week-2#lake-chilwa-  
 952 top](https://eros.usgs.gov/imagegallery/image-week-2#lake-chilwa-top)

953 Webersik, Christian. 2010. *Climate change and security: a gathering storm of global  
 954 challenges*. Santa Barbara, Calif.: Praeger.

955 Webersik, Christian. 2012. "Climate-Induced Migration and Conflict: What are the  
 956 Links?" In *Climate Change and Human Mobility: Challenges to the Social Sciences*,  
 957 eds. Kirsten Hastrup and Karen Fog Olwig. Cambridge: Cambridge University  
 958 Press.

Christian Webersik 13/10/2016 11:14

Deleted: Adaption

960 Vizzy, E. K., Cook, K. H., Chiphamba, J., & McCusker, B. (2015). Projected changes in  
961 Malawi's growing season. *Climate Dynamics*, 45(5), 1673-1698.  
962 doi:10.1007/s00382-014-2424-x  
963