Revised reply to anonymous referee #1

Thank you very much for your invaluable and extensive comments. We also address your comments line-by-line, please see below.

**General comments**

“The discussion paper ‘Living with Climate Change: Adapting to Environmental Change in Malawi’ in its current form is not of sufficient quality to be accepted for publication. While it contains some promising ideas and potentially interesting results it is conceptually weak, under-theorized and lacks in overall academic quality (see my detailed comments below). In sum, I would not recommend the publication of the paper in its current form. It would require a substantial effort to address the concerns I have with this paper. Having said that, it contains a potentially useful assessment and potentially valuable content and might be worthwhile if the authors managed to revise it accordingly.”

We have substantially revised and re-written the article with respect to your comments (Please see attached revised article in track changes).

**Aim and research questions:**

“The aim/objective of the paper remains somewhat unclear, mainly because I can find at least three different aims (p. 2419, line 24f): o ‘...to better understand human-environment interactions, more specifically climate change adaptation and its limitations’, OR o ‘...to what extent local communities are affected by climate change and how they adapt to it’ OR o to ‘critically evaluate[s] the long-term effectiveness and relevance of an adaptation project implemented in these communities’, OR o assess whether the ‘LCBCCAP has significantly increased their adaptive capacity’ (p. 2432, line 12f). If the purpose is to evaluate the LCBCCAP project (which section 5 & 6 seem to suggest), the paper lacks distance to the project (see for instance the sentence starting with ‘Thus, in communities throughout the...’ (p. 2432, line 29) and more critical evaluation.”

“Also, there are no clear evaluation criteria set out by which the authors could possibly proceed with their analysis. It might be a good idea to work with research questions instead. This might also help the authors improve the overall structure of the paper (see my next comment), as they could work their way ‘through’ a number of key questions.”

We tried to clarify the aim and research questions of the paper. We decided to focus on a better understanding of human-environment interactions with reference to climate change adaptation. In order to guide the reader and to better reflect the overall purpose of the article, we introduced two research questions, one dealing with the perceptions of climate change, and how local people are affected by it, and a second addressing the effectiveness of climate change adaptation strategies in the case study area.
Structure and focus:

“The paper lacks an overall structure. Especially section 4 and 5 seem to mix results/analysis and discussion of results. It might be worthwhile considering separating a summary of the interview responses (presentation of results) from a type of analysis/discussion (it does not matter really what label the authors want to use, but it is essential for the reader to understand where the data ends and the interpretation begins). In the current version this gets mixed up at times, e.g. the sentence on p. 2430, line 1f: ‘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” would for me be more of a conclusion than an analysis.”

Large sections of the paper have been re-written and edited to improve the structure, in particular to separate results (section 4 and 5) from the discussion (section 6). To do so, we have included also a scientific section on climate variability to contrast this with local perceptions of change. Moreover, and as suggested, we have made better use of the empirical material, and included direct quotes from the interview material. We also added section 7 on local knowledge, to demonstrate how adaptation can work for other vulnerable groups if local knowledge is embedded in the project design.

Methodology:

“For an empirical paper this needs a lot more attention! On page 2425f, the methods are described but these are not very detailed - more information on who, how, when, why - of those involved would provide more context. What methods were used for data collection, reduction, analysis? - E.g. how did the authors select the 18 participants, what was the focus of the interviews (specific questions or general themes)? Also: why did the authors interview members from ‘Women Fish Processing Groups’ on their agricultural practices (which seems the main focus of the results section 4)? This might make sense (for instance if this assessment is part of the broader ‘Lake Chilwa Basin Climate Change Adaptation Programme (LCBCCAP)’), but it needs to explained properly. - It also remains unclear why Lake Chilwa Basin in Malawi was chosen as a case and why it is interesting. - Finally, if interviews were recorded it might be a good idea to provide some quotes throughout the results and discussion sections to showcase these key results.”

Methodology and research ethics: This was a weakness, and we added an entire section on methodology that also makes reference to research ethics, and includes some more information about LCBCCAP. The methods section now explains why a qualitative research approach was chosen, and the rationale for selecting the Lake Chilwa Basin. We now explain why questions on agricultural practices are important. As suggested above, we also added some quotes to the results and discussion section. We also reflect briefly on research ethics and practicalities towards the end of this section.
Emphasis on conflict:

“The link to conflict (a focus in the title, section 2, and which also re-appears in the conclusions), seems a bit far fetched in my opinion and it remains entirely unclear what the semi-structured interviews with the 18 women possibly reveal in relation to these issues. The way the results are presented now do not justify these linkages to be drawn.

It seems to me that either, a) the authors are trying to connect empirical material that did not have a specific focus on conflict to the broader conflict-climate discussion (which would provide a thin argument and would be highly problematic in my opinion) or, b) there has been an explicit focus on conflict in the empirical data (in which case it needs to be highlighted much clearer).”

The link to conflict or rather the missing link to conflict has also been raised by another anonymous reviewer, and we took this very serious. We now focus the paper on adaptation and its limitations with special reference to the case study, in order to make the paper more coherent and to pay credit to the empirical material. Accordingly, we have changed the title. In a nutshell, we discuss what the empirical material offers and what not. This has led to substantial editing throughout the paper, with some of the sections being omitted. Some of this has also been mentioned in the specific comments sections of the review, and we have addressed these specific comments.

One could argue that due to successful adaptation measures, conflict could be avoided, however, the empirical material does not support this hypothesis. Still, this aspect could be mentioned in the context of the special issue. There is a lot of room for adaption, for example out-migration, temporary re-location, that can ease tension, and some of these strategies have been mentioned in the article.

Specific comments

Referees are asked to take into account all of the following aspects:

“1. Does the paper address relevant scientific questions within the scope of ESD? The paper’s scientific questions/aims remain somewhat unclear, but the paper seems to fit within the scope of ESD.

2. Does the paper present novel concepts, ideas, tools, or data? No novel concepts, ideas or tools are presented as far as I can see, but the paper does present some empirical results from Malawi that, if improved, might provide some novel insights.”

Most important, we are extremely grateful for the rigorous and diligent work of the review, addressing the specific and even technical issues of the paper. Overall, we do agree with all of the specific and technical corrections and other comments, and tried to address them to a satisfactory level.
“3. Are substantial conclusions reached? Some of the paper's conclusions are very interesting and worthwhile – e.g. that for livelihood diversification to be an effective adaptation strategy, the additional income sources ought to not be vulnerable to the same climatic factors – but overall they remain weak (which might be due to the lack in overall focus and unclear research aim).”

We have focused in the conclusions on livelihood diversification as an adaptation strategy, and included a section on local knowledge to demonstrate under what circumstances climate change adaptation can work.

“4. Are the scientific methods and assumptions valid and clearly outlined? No, nor methods or underlying assumptions are discussed sufficiently in my opinion. As per my comments above, for an empirical paper the overall methodology needs a lot more attention! On page 2425f, the methods are described but these are not very detailed - more information on who, how, when, why - of those involved would provide more context. Finally, it would be great if you could use some quotes (or some specific data) throughout the results and discussion sections, showcase these key results, if possible. In addition, given that the authors academics from Europe and have interviewed 18 women from Malawi, a reflection on research ethics, informed consent and cross-cultural research practices is absolutely essential! Also: what language(s) were the interviews conducted in, was there a translator, how did you get access to the interview participants?"

We have added a methods section, and better linked the introduction and conclusions with the empirical material. We also included quotes from the empirical material, and outlined in what context, language and where the interviews took place.

“5. Are the results sufficient to support the interpretations and conclusions? No. Especially the link to social conflict (a focus in section 2 which re-appears in the conclusions), seems far fetched in my opinion and it remains entirely unclear what the semi-structured interviews with the 18 women possibly reveal in relation to these issues or the avoidance of conflict. The way the results are presented now do not justify these linkages to be drawn and I would urge the authors to be careful with making such statements.”

This point is well taken, and we have no focused the paper on the adaptation strategies and perceptions of climate variability.

“6. Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)? No. As per my comment above, how the data was collected, under what conditions, with what guiding questions remains unclear.”

We hope to better explain the data collection in the methods section that had been added.
“7. Do the authors give proper credit to related work and clearly indicate their own new/original contribution? To the best of my knowledge, the authors give proper credit to other people’s work.”

“8. Does the title clearly reflect the contents of the paper? Definitely not! As per my comment above on the results, the paper does not provide sufficient empirical data to be able to make any statement about the connection between climate change, adaptation and conflict in Malawi. I would strongly suggest the authors revise the title ‘Living with climate change: avoiding conflict through adaptation in Malawi’ to something that actually reflects the studies contents!”

*This point is well taken, and as a consequence, we have changed the overall title of the paper to better reflect the empirical study on climate change adaptation.*

“9. Does the abstract provide a concise and complete summary? After revising the entire paper (aims, questions, structure, conclusions) the abstract will need to be rewritten.”

*The abstract has been modified.*

“10. Is the overall presentation well structured and clear? No. As per my overall comment above, the author lacks a clear structure and the line between results, analysis and conclusions gets very blurry at times.”

*We have now improved the structure, and hopefully made the distinction between results (section 5) and discussion (section 6 and 7) more clear.*

“11. Is the language fluent and precise? The language is OK.

12. Are mathematical formulae, symbols, abbreviations, and units correctly defined and used? Yes.”

“13. Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated? Yes. P. 2421, entire section ‘2.2 Climate change adaptation’: there have been gazillions of summaries about the development of the concept of ‘climate adaptation’ so I think the first four paragraphs can be entirely deleted or at least collapsed into a few (!) sentences.

*We have reduced the text of 2.2 substantially.*

“Table 1 seems redundant, I suggest deleting it.

*Yes, we agree, the former table 1 was deleted.*

“Figure 1: What do the numbers from 0-10 on the vertical axis represent? The numbers of respondents for each impact? Needs clarification!

*We clarified former figure 1, now figure 2.*
“Figure 3: Unclear how this figure came about: What was the question posed to the 18 respondents? Was it an open or closed question? Where the answers pre-given (i.e. could respondents only choose between these two) or did the authors develop these three (very generic) categories based on what respondents talked about? Requires more explanation.”

Text has been added to better explain former figure 3, now figure 4.

14. Are the number and quality of references appropriate? Generally the paper would benefit from more references (I have made concrete comments in the ‘Specific comments’ section below.)

We have added more references to the text, where appropriate.

15. Is the amount and quality of supplementary material appropriate? Figure 3 does not contain much information at present, but might be useful once revised (see my comments in response to question 13)

Technical corrections and other comments

- P. 2418, line 4&5, also line 15: The way the authors discuss the ‘climate sensitive economy’ of developing countries excludes any discussion of differential vulnerability to existing inequalities and historical injustices. People are not simply climate vulnerable or have ‘low adaptive capacity’ because they rely on agriculture, but because there are many social, economic, political etc. factors that render them vulnerable in the first place. There is a breadth of academic literature on this, which should be at least be noted here in my opinion.

Yes, we have mentioned the concept of differential vulnerability in the 1.

- P. 2418, line 19-21: ‘While the debate on climate change and violent conflict remains inconclusive, new research on linking climate change to human security seems to be more promising’. In what sense ‘promising’? Promising of what, for what?

We have omitted this sentence.

- P. 2418, line 26f: Sentence starting with ‘Climate change adaptation ...’. This is a bit of a weird sentence. First of all, adaptation is not only highly relevant in a ‘developing country context’, but also for ‘developed countries’ (think of London, of the Netherlands). Second, how does the limited responsibility for GHG emissions create a greater need for adaptation? I suggest revising this sentence.

We revised this sentence.

- P. 2419, line 5: Suddenly the authors speak of ‘low- and middle-income countries’. This contrasts somewhat with p. 2418, line 26f (also see my previous comment). Needs revising.
Yes, we agree, we have changed this.

- P. 2419: What do you mean by ‘climate-centric research’? I think I do understand what the authors mean, but this needs explanation! Do you mean positivistic, deterministic, reductionist, causal?

Yes, this is what we mean but for the sake of clarity and new structure, we have omitted this part.

- P. 2419, line 12: Sentence starting with ‘Though the authors introduce control variables ... ’. My question to you: To what extent can you possibly ‘model’ human behavior across cultural communities? This is a huge fault of research built on positivistic assumptions (common for instance in Actor Based Modeling approaches) which has been criticized widely e.g. by sociologists, anthropologists, human geographers. This needs to be reflected here if your aim is to discuss ‘What is missing from this analysis is to put climate change impacts and its social consequences into context’.

Yes, we agree, though we have omitted this discussion as it does not centre around climate change adaptation and its limitations.

- P. 2420, line 3f: How do you ‘evaluate’ the linkages? By what criteria?

Not applicable as this part has been removed.

- P. 2420, line 13f: ‘As the introduction illustrates, Malawi meets the dominant indicators used by typical neo-Malthusian resource scarcity-conflict studies’. The introduction says nothing about Malawi (as a country), nor does it discuss neo-Malthusian studies (this follows in the paragraphs after this sentence). Perhaps this is a remnant sentence of an earlier version of the paper? I suggest revising this sentence or moving it to a part of the paper where it makes sense.

We removed this sentence and the discussion on neo-Malthusian resource scarcity-conflict studies to better reflect the empirical case study on climate change adaptation.

- P. 2420, line 16 and line 18: ‘Malawi is yet to see any major armed political conflicts’ AND ‘Sustainable adaptation strategies can therefore be seen as a means to avoid conflict situations’: these two sentences suggests the authors buy into the simplistic/reductionist/deterministic/causal scarcity=conflict narrative. From the introduction I got the impression they were criticizing this perspective...? I am confused and suggest a clarification is needed here.

Yes, this claim cannot be supported with the empirical material, and therefore has been omitted from the paper.

- P. 2420, line 20: ‘Much of the literature on climate change conflict has been dominated by neo-Malthusian ideas, emphasising a deterministic view of linking population pressures and resource scarcity to undesirable outcomes’. This is
nothing new (i.e. the authors invention), nor is it too common of knowledge. Hence this sentence needs references.

This sentence has been omitted.

- P. 2421, line 1: Sentence starting with ‘One explanation for Malawi’s peaceful pathway ... ’. Is this an assumption or one of your conclusions you made after the analysis? To me it sounds more like the latter.

This also has been omitted.

- P. 2421, entire section ‘2.2 Climate change adaptation’: there have been gazillions of summaries about the development of the concept of ‘climate adaptation’ so I think the first four paragraphs can be entirely deleted or at least collapsed into a few (!) sentences.

We have significantly reduced text and collapsed text into few sentences here.

- P. 2422, line 23: ‘These adaptation strategies are considered to be relevant also for Malawi.’ By who? The IPCC or the authors? If the latter, that needs to be clarified, if the latter, it would be a conclusions the authors can make after having done their analysis. If so, I’d suggest to rewrite the sentence into something like ‘The results of this paper suggest that these strategies can also be considered relevant in the context of Malawi’.

Sentence has been re-written.

- P. 2422, line 26f: Whether ‘adapting to climate change may require human migration and resettlement’ is a widely contested and hugely political issue. This sentence needs references! The authors may also want to consider reflecting a bit more on this.

We very much agree and have added a couple of sentences to reflect this discussion.

- P. 2424, line 8-12: This whole paragraph is missing references. Unless the authors have made all these assessments themselves (which would of course need to be reflected a revised methodology section) they are needed here.

We have added the source for this.

- P. 2424, line 22: Sentence starting with ‘It must be noted that there is still no consensus ... ’. The word ‘consensus’ would suggest some kind of disagreement or at least differing accounts. If so, if would be good to briefly explain what that entails and who (e.g. between authors, organizations?).

We have deleted this sentence.

- P. 2425, line 26f (running over to the next page): Is this paragraph about the paper’s methodology or that of the referenced LCBCCAP/WF- PGs programme. If
the latter, I suggest deleting the entire paragraph. If the former, this would need to come much earlier in the paper (for instance on page 2420) between the aims and the overview of the paper.

*This part has now been integrated into the new methodology section.*

- P. 2426, line 9: ‘For many, climate change is something that belongs to the future’, generic sentence. I suggest deleting.

Yes, this sentence has been deleted.

- P. 2426, line 11f: Again, this is confusing: ‘The study found …’ is this someone else’s study or the paper’s authors study? – It remains unclear why section ‘4.1 Climate change in the Lake Chilwa Basin: local experiences’ and section ‘4.2 Impacts of climate change: local perspectives’ are separated. The content seems very similar.

Where appropriate, we added the qualifier “authors” to make clear which study is meant.

- P. 2428, line 12: Suddenly you talk about the ‘rural poor in Malawi’. You may want to explain who they are, what differentiates them from non-poor rural populations and poor urban populations.

Good point. We focused now on smallholder farmers rather than rural poor to make the focus on agriculture more clear.

- P. 2428, line 13: Sentence starting with ‘In Africa …’. I have two problems with this formulation: First, it generalizes ‘Africa’ thereby ignoring the significant cultural and agricultural diversity that exists across this gigantic continent. Second, it presupposes that farmers outside of ‘Africa’ do not rely on their local knowledge for agriculture. I think both assumptions are wrong and this sentence should be revised.

Point well taken, we have removed the word ‘Africa’ and instead use the word ‘Malawi’ to better reflect the local context.

- P. 2429, line 4f: ‘The women had however been able to increase their income and savings substantially through the WFPG and were therefore capable of doing so.’ If the interviewees have increasing access to income from other work through the WFPG, it could also be the case that they decided not to continue with subsistence farming as previously. Might be worthwhile to reflect on this here?

Yes, we added a sentence to clarify the impact of women’s decision to stop farming.

- P. 2430, line 20: ‘The case study found that the members of the WFPG were satisfied with their involvement in the LCBCCAP programme’. This conclusion cannot be drawn from reading the above sections (4.4.1, 4.2). If you want to
discuss this, I suggest you include responses by the 18 members to back this claim.

*We put this sentence into context to better explain why members of the WFPG are satisfied.*

- P. 2431, line 20: 'This is a concern that also Chiotha is worried about in the Lake Chilwa district (Ngozo, 2012). Who is Chiotha? Is that the given name of the referenced author?

*Chiotha is a member of the the LCBCCAP programme.*

- P. 2433, line 4f: The authors state that ‘The majority of the women however, were not diversifying their livelihood strategies’, but I thought all 18 women engaged in subsistence agriculture and fish processing – isn’t this a diversification?

*Yes, this is diversification but not sufficient to offset the loss from the fish sector.*

- P. 2435, line 2: As I understand the study looked at one adaptation project. It in unclear to me how the authors can make a statement about ‘policy makers’ (this might make sense once the authors have provided more background to the LCBCCAP project).

*Yes, we agree and have deleted the last sentence of the conclusions.*

- Line 18: delete ‘prominent’, this sounds like the authors are advertising. I suggest deleting this word.

*Word has been deleted.*

- P. 2424, line 6f: Missing word, insert ‘of Malawi’s population’ after 74% as in ‘74 % of Malawi’s population live on less than a dollar (PPP) a day (2004, estimate) (UNSTATS, 2012).

*Added missing word.*

- P. 2425, line 22: Missing word, insert ‘a’, as in ‘Findings from a case study of the Lake Chilwa Basin Climate Change Adaptation Programme (LCBCCAP) and its Women Fish Processing Groups (WF- PGs), revealed …’

*Yes, done.*


*Yes, done.*

*We hope you find our review satisfactory, and look forward to further additions and comments. Once again, your review is greatly appreciated and has*
substantially improved the paper. To follow the changes, the revised article in track changes is attached.
Revised reply to anonymous referee #2

Thank you very much for your invaluable comments. We have substantially revised the article with respect to your comments (Please see attached revised article including track changes for better readability).

We have now focused the article on adaptation and its limitations to give credit to the empirical material presented in the article. As suggested, we have changed the title of the article, to better reflect the purpose of the study. More references have been added where needed, in particular for sub-section 2.1. It is worth mentioning here that the works of Nicholson and McCusker have been useful in improving the article. As mentioned, we have included a methods part explaining the research approach and methods used, and we made better use of the empirical material. Also, the article now contains a scientific analysis on climate variability in the region using empirical evidence from local weather stations comparing it with local people’s perceptions of the experienced changes. Finally, we added a section on local knowledge to illustrate how adaption strategies can work for other vulnerable groups. Once again, we would like thank you for your insightful review.

To follow the changes, the revised article in track changes is attached.
Abstract:

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

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

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1 Introduction

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

Moreover, countries in the global South struggle with poverty, horizontal inequalities, armed conflict, poor governance, and historical injustices, some of the additional compounding factors that make them vulnerable (O’Brien et al., 2000). Therefore, by framing climate change impacts as a human security concern fits with the discussion on sensitive economies, with rain-fed agriculture dominating, a large percentage of the population economically dependent on agriculture, their low financial and institutional capacity to cope with and to withstand natural hazards, they are most severely affected.

Implications of climate change has gained momentum in recent years. This is due to a lively policy debate as well as to several publications in journals and books (Brzoska and Scheffran, 2013; Scheffran et al., 2012; Webersik, 2010). Yet, climate change impacts and their causal linkages with human security are complex and multifaceted, and research needs to address "the limits of our capacity to understand complexity" (Nicholson, 2013: 158). Keeping this in mind, this research aims at contextualising climate change adaption and its limitations in southern Malawi. Climate variability is a perceived human security challenge among fishing communities in southern Malawi, hence climate change adaption is becoming an important strategy for these communities to cope with the anticipated changes. The term human security is adequate in the context of climate change impacts as it includes issues pertinent to food security, public health, or any type of loss in key livelihood assets as opposed to the term security defined as freedom from physical force. The term human security acknowledges the fact that humans are both victims and agents of change. While humans are affected by climate change impacts, they are at the same time able to mitigate the drivers of climate change as well as able to adapt to real and anticipated changes. Countries of the global South are typically low-income countries and are least responsible for anthropogenic climate change. Yet, given their predominantly climate-sensitive economies, with rain-fed agriculture dominating, a large percentage of the population economically dependent on agriculture, their low financial and institutional capacity to cope with and to withstand natural hazards, they are most severely affected.
by it. Current and future changes in temperature and precipitation variability, and changes in the intensity of natural hazards will most certainly affect food security, public health and agricultural productivity in low-income countries.

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

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

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

2.1 Climate change and human security

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

2.2 Climate change adaptation

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

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

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

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

### 2.3 Limitations of climate change adaptation

Not all adaptation strategies are sustainable, with limited long-term effectiveness. For instance, adapting to climate change may require human migration and resettlement. This debate is highly contested and received attention among scholars (Tacoli 2009; Baldwin 2016; Brzoska and Frölich 2016). Recent research in low-lying island states demonstrates that local perceptions on climate change-induced migration differ from the dominant political discourse on climate-induced migration in the same location, and that not migrating can be both, a strategy to adapt or to fail to adapt (Kelman et al. 2015). Though there is little evidence that environmental-induced migration has the potential to trigger violent conflict, it most certainly will create major challenges for hosting communities, especially in regions that are already densely populated, for example Malawi (Webersik 2012). Climate related outmigration could also change the social fabric of those communities that stay behind. With shrinking populations, markets and political institutions can get distorted making it more difficult for those left behind to adapt to climate change (Barnett 2012). In other cases, adaptation strategies that do not take into consideration the long-term impacts of climate change may prove unsustainable. Livelihood diversification is a laudable approach, however, if farming
diversification activities or commercialisation of agriculture remain climate-sensitive, the long-term adaptation effect may remain limited as the following case study in the Lake Chilwa Basin in Malawi demonstrates. Other unintended social and environmental consequences of climate change adaptation can stem from large infrastructure projects, such as dam-building for hydropower and water storage, biofuel plantations, and water relocation projects, all relevant for the African context (de Sherbinin et al. 2011). For instance, the growing number of biofuel plantations bought by foreign investors has triggered a debate on land grabbing in Africa (Matondi 2011). Most important, if people are forced to relocate due to large infrastructure projects or land-use change, their economic potential and environmental vulnerability need to be evaluated for current and future climate change impacts, as well.

3 Explaining the context of Malawi

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

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

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

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

3.1 Malawi and climate change

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

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

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

3.1.1 Lake Chilwa Basin and climate change
Some studies have also been conducted on climate change in the Lake Chilwa Basin. It must be
noted, however, that Lake Chilwa Basin is located in a climatically unstable environment and
fluctuations in rainfall and temperature has been recorded since the 1960’s. It is therefore not
clear if the climate is changing significantly (EAD 2000). Data does however show a slight
decrease in rainfall and an increase in temperature in the Lake Chilwa Basin. Statistics from the
Meteorological Department show that the mean maximum temperatures in the basin have risen
by approximately 1°C (EAD 2000). A decrease in precipitation since the mid-1980s has also
been documented in the basin as shown in figure 1. The combined effects of higher
temperatures and less rain is arguably the reason for the gradual decrease in Lake Chilwa’s
water level discussed in section 5.2.2 (EAD 2000) (See figure 3). Scenarios of the basin predicts
that air temperatures in the basin will increase 2.6°C to 4.7°C by 2075 while scenarios of
precipitation varies from a 0.3 per cent increase to a 7 per cent decrease (EAD 2000).
Moreover, local studies show that there is a chance of shorter growing seasons in the
future in southern Malawi due to global warming (Cook et al. 2015), and this trend is
already being experienced by the local population, as discussed in section 5.2.1.
4. Methodology

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

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

The research for this article adopted a qualitative methodology and the data was collected over two months from January to March 2012 by one of the authors, Hanne Jørstad. The findings are based on semi-structured interviews and focus group discussions with 18 women who were members of the three different WFPGs located in separate locations around the lake, Swang’oma, Tadala and Kachulu. In addition to talking with the beneficiaries of the project interviews were also held with Leadership for Environment and Development Southern and Easter Africa (LEAD), WorldFish Centre (WFC) and Department of Fisheries (DoF). Apart from questions on perceptions of climate change and climate variability, interviewees were also asked about agricultural practices to get a better understanding of the diversification of livelihood activities relevant for assessing the adaptive capacity of local communities.
The purposive sampling technique was chosen for this study in order to select respondents that are relevant for the study. The sampling technique is commonly used for qualitative research and especially small-scale projects (Bryman 2008, Denscombe 2007). Because purposive sampling is under the category of non-probability sampling it entails that the respondents are not randomly selected but rather 'handpicked'. It also implies that findings cannot be generalised to the enlarged population nor can one assume that the findings represent the overall population (Denscombe 2007).

However for this research it is not seen as necessary nor is it the intention for the research to reveal the general Malawian’s experience with climate change, but rather focus on the specific case study of LCBCCAP and its women fish processing groups, how these women experience climate change and if the project increases their long-term adaptive capacity. To gain as broad understanding of the WFPG as possible, interviews were carried out with members from all three groups. A notice was sent out to the group members in advance, though it varied how many group members turned up for the interviews. All respondents participated voluntarily and were thoroughly introduced to the purpose and topic of the study. A local interpreter was used for all interviews with the WFPG members due to language barriers.

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

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

5.1 Local perceptions of climate change.

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

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

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

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

As mentioned earlier, Malawi is a country that is prone to extreme weather events such as flood and drought and since the late 1970’s the country has experienced an increase...
of such events (Chipota and Mphepo 2011). Out of eighteen women, eight had noticed an increase in droughts, and six women had mentioned dry spells. Floods were not mentioned, but it should be noted that the area is not prone to floods (See figure 2).
**Figure 2**: The respondents experience with climate change (number of respondents on y-axis)

- Decreasing water level of lake
- Change in rainfall pattern
- Dry spells
- Drought
- Temperature increase

Source: Author’s research 2012.

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

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

**5.2.1. Food security and subsistence farming**

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

Hanne Jørstad 7/7/2016 21:23
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Christian Webersik 6/7/2016 10:46
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Hanne Jørstad 7/7/2016 21:30
Deleted: Discussion
Christian Webersik 11/8/2016 09:37
Deleted: rural poor
Hanne Jørstad 7/7/2016 21:23
Deleted: 4
Hanne Jørstad 7/7/2016 21:23
Deleted: 3.1
Hanne Jørstad 7/7/2016 14:45
Deleted: to the women,
The women had tried different types of crops such as hybrid maize, groundnuts, pigeon peas and cassava, but none have produced satisfying results.

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

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

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

As a consequence of the uncertainties in the rainy season and the harvest, the women felt that they no longer could rely on subsistence farming. The majority of the women therefore cultivated less and bought bigger proportions of their food from markets. It is however viewed as a luxury that many cannot afford. The women had however been able to increase their income and savings substantially through the WFPG and were therefore capable of doing so. This may also pose a threat to sustainability of the adaptation strategy, also discussed later in this article, as women of the WFPG may...
decide not to continue with subsistence farming, making them more vulnerable when the lake will dry up once again.

5.2.2. Impacts on livelihoods

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

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

Figure 3: The Landsat images show the size of Lake Chilwa in October 1990 and November 2013 and the changes in the internationally recognised wetland areas (in bright green) surrounding the lake
When the water level sinks the fish stock is reduced, which increases the price of the remaining catch and reduces the women’s income. If the lake dries completely the women are temporary out of business for two to four years. During the data collection the women were worried that the lake would dry within 2013. The drying of the lake was considered the biggest threat posed by climate change. When asked if she considered climate change a threat, a woman from Tadala responded, “Yes, the lake will dry up and I will not have a business”. Another woman from the same area expressed the same concern “Yes, lower water level in the lake is threatening my fish business”. As figure 3 demonstrates, the lake did not dry up at the end of 2013 but lost quite some wetland areas, especially in the northern part of the lake, and as a consequence, decreased in size. In 1993 and 1994 the region had similar records that caused the lake to dry the following year (Ngozo 2012).

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

[https://eros.usgs.gov/imagegallery/image-week-2#lake-chilwa-top](https://eros.usgs.gov/imagegallery/image-week-2#lake-chilwa-top)
the changes are a result of climate change and hence a long-term trend or if it is a result of climate variability and therefore a short-term trend. Nevertheless, the WFPG members express that the changes are serious threats to the livelihood and food security of the whole Lake Chilwa Basin (See figure 4). Figure 4 shows the respondent’s perception of how climate change affects their lives. Six of the respondents explained that it affected their business and another seven said it affected their crops and hence their food security. The last five respondents stated that their food security is threatened because their business has been reduced. In the figure, this response is shown as ‘both’. The study therefore indicates that climate change may have devastating effects on the most fundamental needs for the rural farmers. Such issues may further exacerbate into health issues such as malnutrition, starvation and diseases. Figure 4: The respondents’ perception of how climate change affects them

Source: Author’s research 2012.

6 Climate change adaptation, its success and limitations in Malawi

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

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

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 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.
Figure 5: Respondent’s savings before and after joining a WFPG

Source: Author’s research 2012.

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

Mean: 3091 971 2120 218 %

S: Swang’oma WFPG, T: Tandala WFPG

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

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

The findings indicate that the communities struggled when Lake Chilwa dried in 1995/1996. In order to survive people engaged in alternative income generating activities or migrated to find employment and food. During a new incident, the women will most likely have to take the same measures as their source of income will vanish.

While it indicates that they are able to cope, it does not indicate that LCBCAP has significantly increased their adaptive capacity as their reliance on the fish and farming sector still makes them highly vulnerable to future events. It can therefore be argued that LCBCAP should bear this in mind and design adaptation strategies that are not solely dependent on a sector and a resource that is threatened by climate change like the WFPG-project is.

Livelihood diversification is recognised as an effective strategy for smallholder farmers to decrease their vulnerability towards environmental and economic shocks, and hence climate change (Simtowe 2010). Nelson et al. (2009) explain that there is a correlation between the diversity of livelihood strategies and adaptive capacity due to the possibility to substitute between alternative livelihood strategies. By having more than
one source of income it is possible to spread the risk in case there is a poor season
within one sector. A study conducted on fishermen in the basin from the 1970s
identified that the wealthiest fishermen in the basin were the ones who had diversified
their income (Njaya et al. 2011). LCBCCAP also view diversification as an effective
adaptation strategy as they state that

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

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

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

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

Source: Author’s research 2012.

The case study of the LCBCCAP and WFPG illustrates the importance of designing climate change adaptation strategies that take into consideration future environmental events and how the strategies will affect the beneficiaries’ adaptive capacity during the event. Enhanced capacities within the fish sector will be of little value when the lake actually dries. Without an income the WFPG will be pushed further into poverty. In order for LCBCCAP to improve the WFPG-project and further reduce the women’s vulnerability towards climate variability and climate change, diversification may be a step in the right direction. However, for diversification to be an effective adaptation strategy for the WFPG members it is necessary that the additional income sources do not react similar to a change in the climate as the fish sector. Finding a source of income that is not dependent on a natural resource may very well be the best option.
Making climate change adaptation work for vulnerable groups

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

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

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

The authors’ study can therefore conclude that local knowledge can be a crucial element in enhancing climate change adaptation programmes, also for other vulnerable groups. In the case of LCBCCAP, the appropriate way of utilising local knowledge was through participatory means, and merging local practices with technical solutions.
Utilising local knowledge is not about extracting valuable knowledge from communities and utilising it elsewhere. Though there is nothing wrong with learning from or adopting successful practices, either based on ‘local knowledge’ or ‘scientific knowledge’, it is crucial that adaptation strategies are identified together with the communities and further adapted to fit into the local context. When carried out correctly, local knowledge may indeed play a crucial role in climate change adaptation.

8 Conclusion and lessons learned

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

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

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

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

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

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


