

Full Length Research Paper

Smallholder farmers perception on climate change in Rumph District, Malawi

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The effects and causes of climate change and variability have been a cause of controversy and debate for many years in many parts of the developing world. Perceptions vary about the effects and causes of climate change and variability. This study assessed smallholder farmers' perceptions of climate variability and climate change adaptation in Bolero Community, Rumph District in northern Malawi. Data were generated through a knowledge, attitude and practice survey using semi-structured interview and focus group discussions targeting 100 respondents in the study area. The data were analyzed using descriptive statistics and chi-square tests. The results revealed that 76% of the farmers that were interviewed perceived increased temperatures and 74% perceived decreased rainfall. Results on temperature were supported by meteorological data but rainfall data for Bolero area showed no significant changes overtime. Results, however, demonstrate increased awareness by smallholder farmers about the meaning of climate change and variability but are mixed on actual causes of this due to insufficient scientific knowledge. Some relate it to human activity while others associate it to traditional, cultural, and religious practices. Among the few who believe their own human activity contributes to the situation, they feel that easy access to markets, credit, water resources, irrigation services, tree seedlings and information on climate change, can motivate them to adopt coping and adaptation mechanisms to climate change and variability. Thus, it is important to improve the scientific knowledge of smallholder farmers in understanding the causes of climate change and variability through increasing the level of awareness among smallholder farmers about the impact and causes of climate change and variability. Furthermore, more programmes that motivate farmers to adopt coping and adaptation mechanisms in dealing with climate change and variability are needed. Such projects should consider cultural and traditional beliefs of smallholder farmers.

Key words: Adaptation, adoption, climate change, coping mechanism, Malawi, perception.

INTRODUCTION

In many parts of the world today, climate change and variability have affected rural livelihoods especially in

the developing world (IPCC, 2007). In Africa, human activity is attributed to this significant change in climate

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(Mings, 2008; Olsen, 2006). The increasing severity of droughts, floods, dry spells and strong winds are, at least in some part, due to human activity (IPCC, 2007; United Nations, 1992). However, issues of climate change and variability have been a cause of controversy and debate for many years around the world particularly in the low rainfall regions (Brody et al., 2012). It seems scientifically well established that clearing a forest reserve adversely affects rainfall. A reduced evaporation loss from a forest cover is regarded as a significant reason for low and erratic rainfall than other alternative land use cover (Lorup and Hansen, 1997). By examining climate change using the concepts, tools and languages of the sciences and humanities and the discourses and practices of economics, politics and religion will begin to see that depending on who one is and where one stands, the idea of climate change carries quite different meanings and seems to imply different courses of action (Hulme, 2009).

However, it seems most populations do not understand the fact that forests attract rainfall and that forests act as a sponge, whereby roots soak up water in the moist soils and release it slowly in the dry season as a result, there is increased levels of deforestation in most communities. Indecision by farmers about coping and adaptation mechanisms due to insufficient scientific knowledge shall remain a challenge especially in the agricultural sector (Vandamme, 2009). Understanding people's knowledge, attitudes and practices (KAP) about climate change and variability can bring about important coping and adaptation systems for climate change to promote agriculture and sustain rural livelihood and welfare. Although, there is an increase in the number of climate change and variability studies that are incorporating the KAP approach (Ojomo et al., 2015; Arbuckle et al., 2013; CIMC, 2012; Oepen, 2012; Bruinders et al., 2009; Chambers and Smith, 2007; JCEA, 2005), there is a limited number of location specific KAP surveys which is presumably the most important single factor bringing about increasing uncertainties in climate change and variability. Hence, there is a need to carry out community level studies that document farmers' perceptions, knowledge, attitudes and practices in climate variability and change, before designing climate change adaptation programmes and strategies. Such studies would provide better location specific insights and generate information relevant to policy and interventions that would contribute to a higher adoption rate of climate change adaptation strategies. In this paper, the KAP approach has been taken as a conceptual framework to study human behavior and not as a specific methodology.

This paper presents preliminary results of a study conducted at Bolero Extension Planning Area (EPA) in Rumphi district, northern part of Malawi about people's knowledge, attitude and practice about climate change

and variability vis a vis their perceptions about coping and adaptation mechanisms to promote the rural livelihood. In Bolero area, the most susceptible sectors of human life which are sensitive to climate change and variability are agriculture, food security and natural resources.

METHODOLOGY

Study area

Bolero EPA was purposively selected being a designated community of practice (CoP) for rural livelihood by Mzuzu University. Bolero EPA is situated at approximately 10 km west of Rumphi district headquarters (Figure 1). The area falls under the jurisdiction of Paramount Chief Chikulamayembe with an estimated population of 58,550 people of which 51% are female². The EPA has 11,710 farming families with average land holding size of 2.7 hectares each. Maize is the main staple food grown in the EPA, and tobacco and paprika are the main cash crops. These farming families also domesticate livestock mainly pigeons, chicken, goats and pigs as their main source of protein dietary intake. According to a socio-economic profile of Rumphi District, deforestation is rampant in the area due to increased demands for fuelwood, charcoal, burnt bricks, tobacco curing, and new farm lands is due in part to the burgeoning population. Poor land management, resulting in loss of soil fertility is also high in the area.

Data collection and analysis

The study was initiated during the 2014/2015 farming season between October and May. One of the aims was to monitor the impact of people's knowledge, attitude and practice (KAP) on climate change and variability, thereby contributing to the process of replacing beliefs with facts regarding the effect of climate change and variability on agricultural productivity and rural livelihood, in particular. Semi-structured interviews (SSIs) were conducted covering a sample size of 100 households in four (4) villages. SSI was used to generate both quantitative and qualitative data from the sample unit about their knowledge, attitude, practice and perceptions about climate change and variability including their coping and adaptation mechanisms. The method was also used to gather qualitative data about the motivation factors by farmers to adapt to climate change and variability to improve their rural livelihood and welfare. In addition, meteorological data on rainfall and temperature for the area was collected from the Malawi Department of Climate Change and Meteorological Services. This data was used for comparisons with farmers' perceptions on climate change. The quantitative data gathered was analysed by using Statistical Package for Social Sciences (SPSS) version 16.0. Meteorological data was analyzed using Microsoft Excel. In order to interpret the data, all results were presented in form of charts, graphs and tables. Chi-square test was used to test statistical significance particularly among the different respondents and their responses. A 0.05 level of significance was set. Qualitative data was analyzed by using content analysis.

² Rumphi Fertilizer Input Subsidy Programme Database (2012/2013).

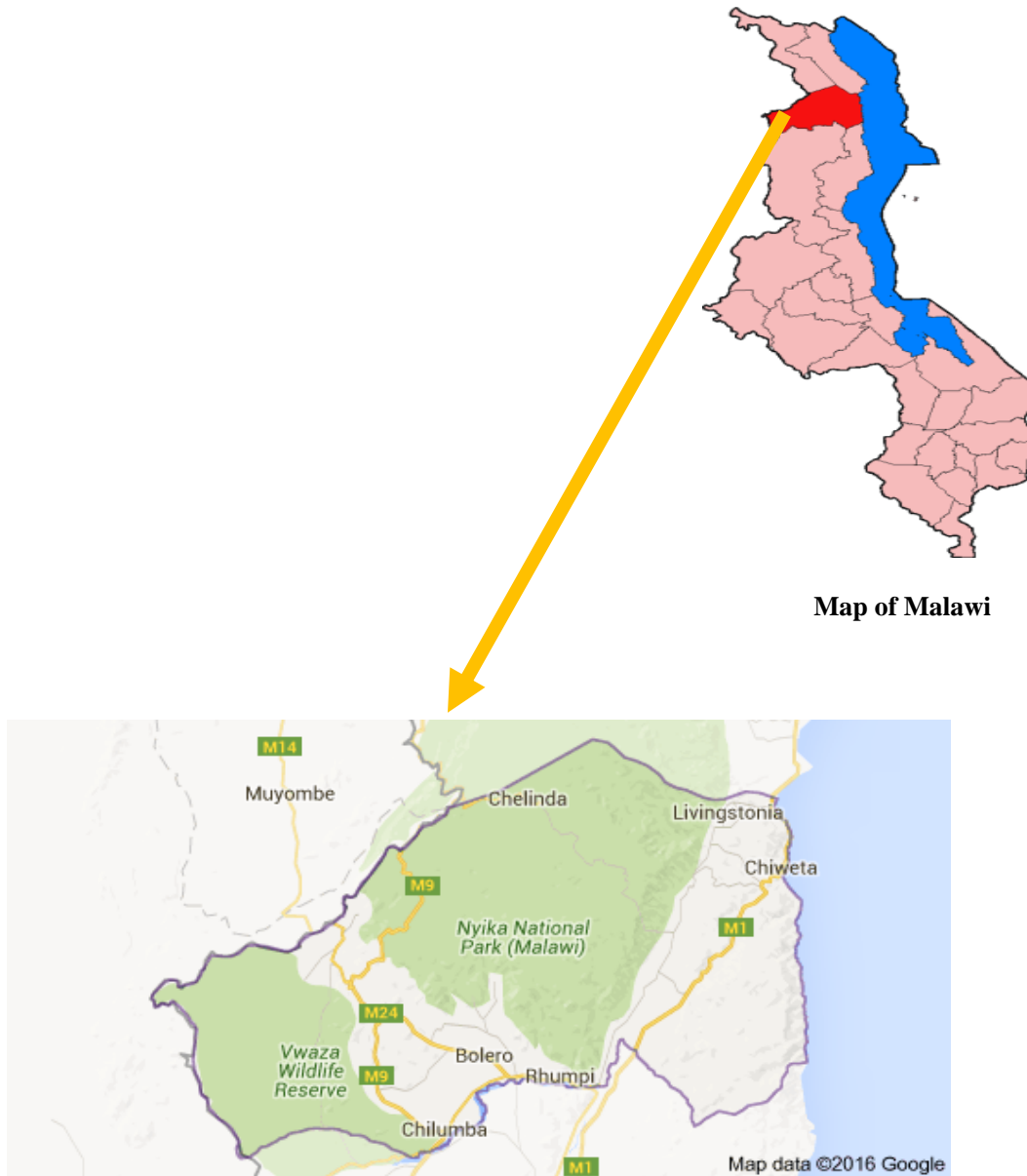


Figure 1. Location of Bolero area.

RESULTS AND DISCUSSION

Respondents profile

Out of the 100 respondents that participated in the study, 51% were females and 49% of the total was within the age range of 30 to 40 years. Majority (78%) of the respondents were married. On education levels, about 65% had attained primary education and 3% had not attended any formal education. In terms of occupation, majority of the respondents (98%) earned their living through subsistence farming and reported living for an average of 29 years in their current villages.

Smallholder farmers' perception on climate variability

Temperature

Respondents were asked to indicate whether they had observed increased or decreased temperature trends over the past 10 years. The study results shows that more than half of the respondents (76%) reported that they had experienced increased temperatures in Bolero community for the past 10 years. A Chi-square test showed that the differences in farmers' responses is statistically significant ($\chi^2 = 109.000$; $DF = 4$; $P\text{-Value} =$

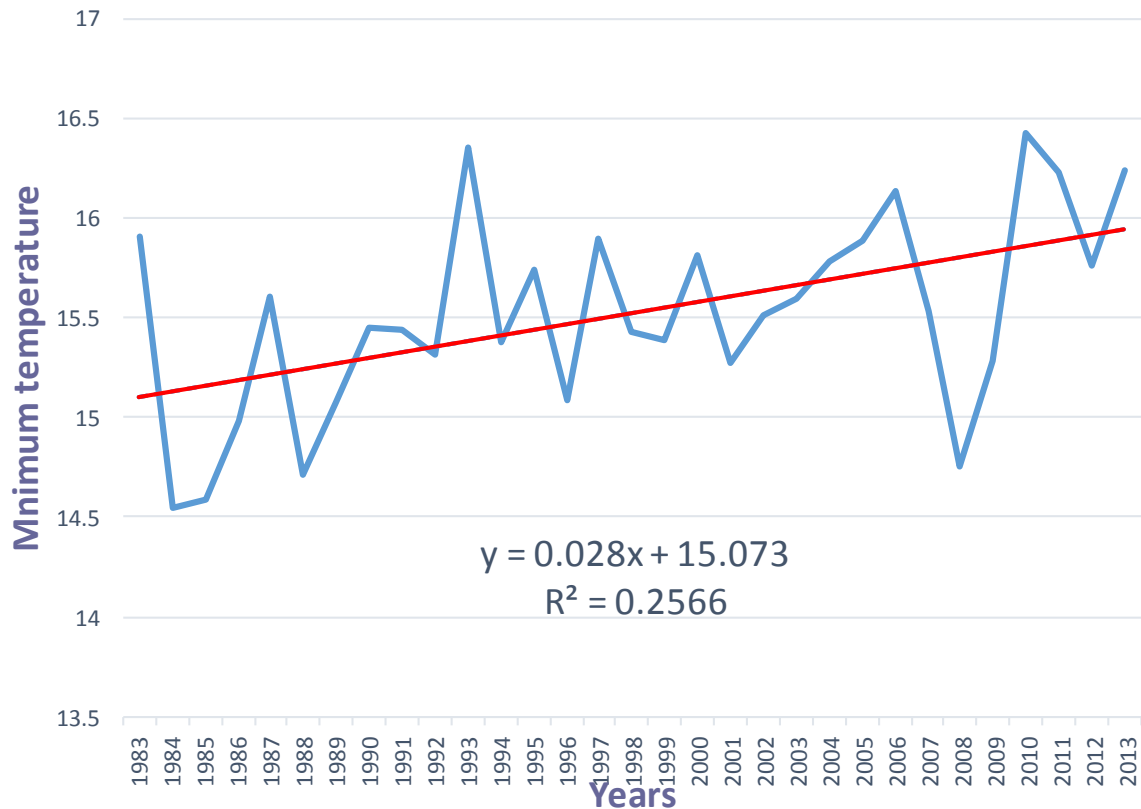


Figure 2. Annual Mean Minimum Temperature Series from 1983- 2013 for Bolero; Source: Department of Climate Change and Meteorological Services in Malawi.

0.0001) implying that it is unlikely that the differences in perceptions could be due to chance alone. The perception of farmers was compared with the meteorological data from Malawi Meteorological Services. Both minimum and maximum temperature readings for Bolero show a positive trend in temperature which indicates that there has been an increase in temperature for the past 33 years (Figures 2 and 3). Statistical analysis of the change in in both maximum and minimum temperatures over time shows that they are significant ($P = 0.0036$ and $P = 0.0017$ respectively).

The above statistical analysis is in tandem with many other studies on farmers' perceptions and adaptations to climate change and variability including Ethiopia, Zimbabwe, South Africa and Ghana (ATPS, 2013; Moyo et al., 2012; Fosu-Mensah et al., 2010; Gbetibouo, 2009) respectively. According to Shankara et al. (2013), farmers' perceptions about changes in temperature often fall within observed meteorological data. Farmers' perception of changes in temperature is usually in line with meteorological data since the farmers are in a position to rightly judge changes in evapotranspiration and dehydration in human bodies over time (Shankara et al., 2013).

Rainfall

Majority (74%) of the respondents indicated that there has been a decrease in rainfall over the past 10 years. A Chi-square test showed that the differences in farmers' responses is statistically significant ($\chi^2 = 172.720$; $DF = 6$; $P\text{-Value} = 0.0001$) implying that it is unlikely that the differences in perceptions could be due to chance alone. However, the rainfall data from Malawi Meteorological Services for Bolero, shows that there has been a moderate increase in rainfall during the past 10 years (Figure 4). However, a statistical analysis of the changes in rainfall over the period shows that it is statistically insignificant ($P = 0.603$). These findings on rainfall pattern do not match with perceived rainfall patterns. Over the past 10 years, the actual rainfall data for the study area shows little variability. This is common in many studies which examine people's perceptions about climate change and variability due to a number of reasons (Moyo et al., 2012; ATPS, 2013). In the study area, the smallholder farmers perceptions on rainfall pattern may have been influenced by the declining maize yield, which may not be related to rainfall as shown by meteorological data that the rainfall pattern has not significantly changed. It could be for the

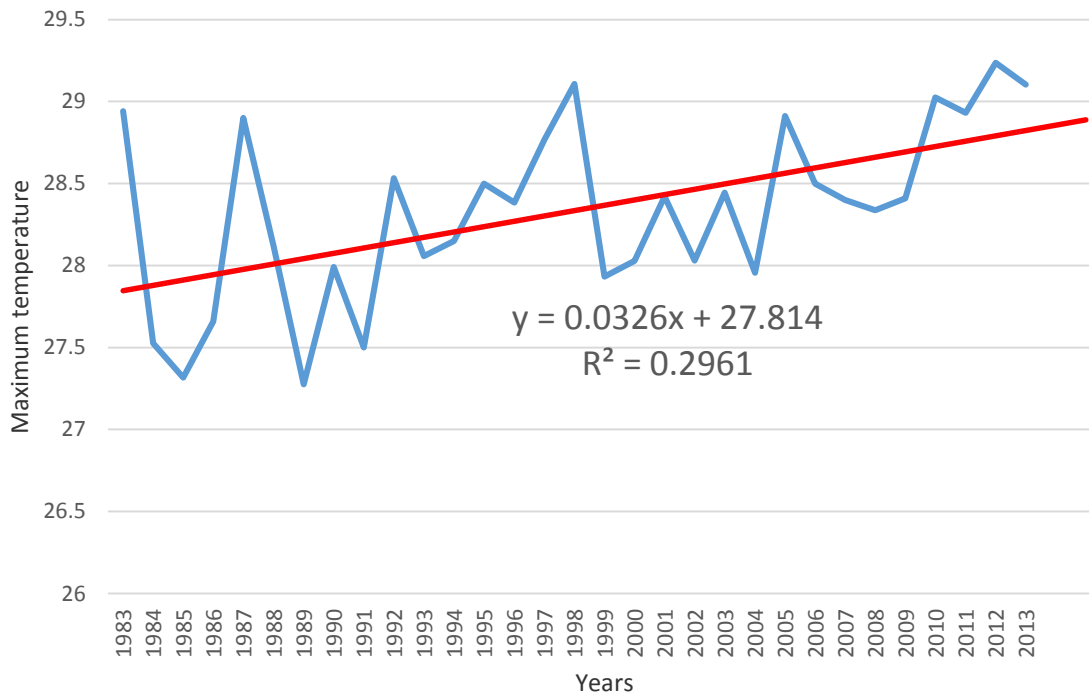


Figure 3. Bolero Mean Annual Maximum Temperature from 1983- 2013; Source: Department of Climate Change and Meteorological Services in Malawi.

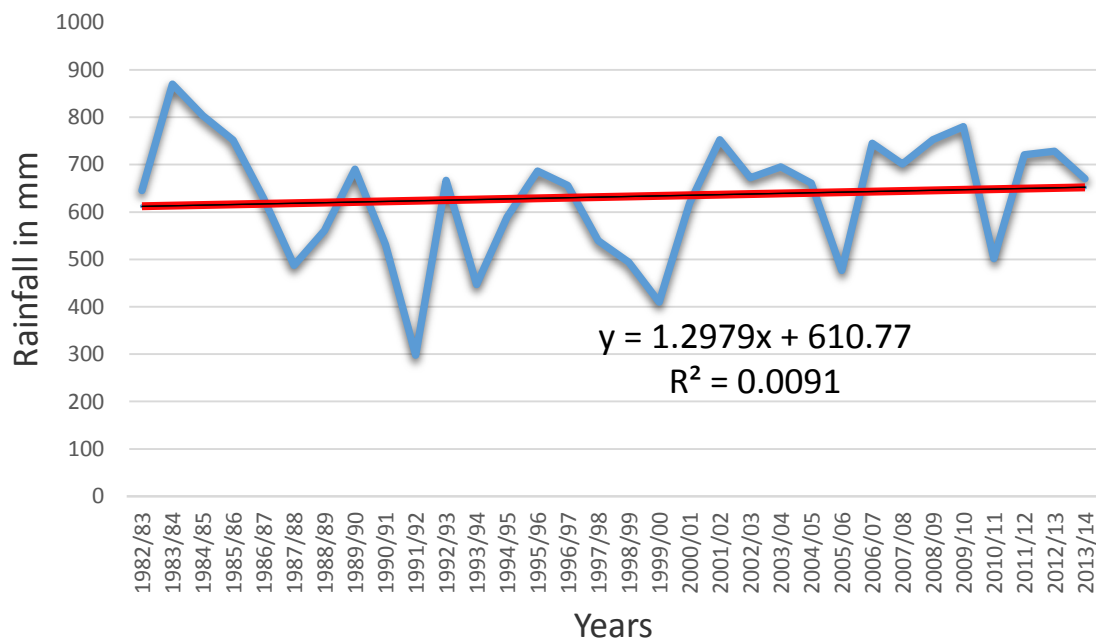


Figure 4. Seasonal rainfall for Bolero from 1999/2000- 2013/2014; Source: Department of Climate Change and Meteorological Services in Malawi.

reason that many smallholders opt to grow more tobacco as a 'cash-spinner' than maize.

Smallholder farmers may also perceive a decrease in rainfall due to the fact that the meteorological rainfall

data used in the study does not show the actual rainfall amount and rainy days within a month. From experience, most farmers know specific days or weeks within a critical crop growth period when a crop demand for water is highest and if it does not rain in those critical times, farmers might perceive it as decrease in rainfall amount (ATPS, 2013). In addition, the meteorological rainfall data does not capture the observed changes in rainfall patterns whereby the growing season is becoming shorter (Khamis, 2006; Tadross et al., 2007).

Overall, smallholder farmers perceptions of changes in both temperature and rainfall reveal that the perceptions are made based on local environment and are not linked to an understanding of climate change and variability in the national or global context. This brings some challenges. Basing perceptions of climate change to local events creates a challenge for climate change projects that take into consideration global or national view of climate change which is different from the local environment and perceptions. Such perceptions may have a bearing on adoption of international and national adaptation strategies in an area.

Smallholder farmers' Knowledge on Climate Change

Respondents were asked to indicate if they had ever heard of climate variability and change. Overall 96% of respondents indicated that they had some idea and had heard about climate variability and change. However, when the respondents were asked to describe the meaning of climate change and variability, they gave a variety of answers. The most common understanding for the majority of the respondents of climate change and variability was the change in rainfall (48%) while 21% indicated that it was a change in both rainfall and temperature. Only 5% of the respondents indicated that it was a change in temperature (Figure 5). Results from the study shows that smallholder farmers' knowledge about climate change and variability is not in the context of the theoretical definition of climate change and variability. It is not surprising to note that most farmers associate climate change to changes in rainfall patterns because of its direct effect on agricultural production and food security. This is supported by Maddison (2006) who observes that farmers' understanding of climate change is often linked to experiences of such events. Lack of knowledge in climate change and variability can equally affect adoption of adaptation strategies. Since the smallholder farmers in Bolero community do not understand the concept of climate change and variability fully, they need to be helped. It is important to ensure that smallholder farmers and other natural resource users in Bolero Community get the

right information on climate change that is most relevant to them which should include meteorological data and seasonal climate forecasts. This would improve their existing knowledge gaps and increase their adaptive capacity and resilience to the negative effects of climate change and variability.

Smallholder farmers' attitudes

In order to capture the farmers' attitude towards climate change, the respondents were asked about their level of agreement with the statement that there is nothing that the community could do about climate change. The study revealed that the majority of respondents (88%) disagreed with the statement and only 6% of respondents agreed with the statement. A Chi-square test showed that the differences in farmers' level of agreement is statistically significant ($\chi^2 = 241.100$; DF = 4; P-Value = 0.0001) implying that it is unlikely that the differences in attitude can be due to chance alone.

The respondents were also asked about their level of agreement with the statement that climate change is occurring in this community because of sins and failure to respect certain cultural and religious beliefs and practices. The results show that 60% of the respondents disagreed and 39% agreed. A Chi-square test showed that the differences in farmers' level of agreement is statistically significant ($\chi^2 = 94.700$; DF = 4; P-Value = 0.0001) implying that it is unlikely that the differences in responses could be due to chance alone. This revelation shows that there still exist some smallholder farmers who believe that climate change requires divine intervention. This agrees with results from several studies from other places in Africa and Asia about ancestral beliefs and values such as Kondo district in Tanzania (Sleger, 2008), Zambia (Nyanga et al., 2011) and Balochistan province in Pakistan (Ashraf and Routray, 2013). These beliefs cannot be taken for granted because it can lead to under-investment by some smallholder farmers in rain-fed agriculture, failure to adopt modern farming methods which are adaptive to climate change or the entire adoption of coping and adaptability mechanisms to climate change and variability. There is need to ensure that climate change education awareness is conducted in the community with the aim of re-orienting the community towards climate change issues and changing their negative mind-set.

Smallholder farmers' practices related to climate change

The smallholder farmers were asked to state the major activities undertaken in their community that might have contributed to climate change and variability. These

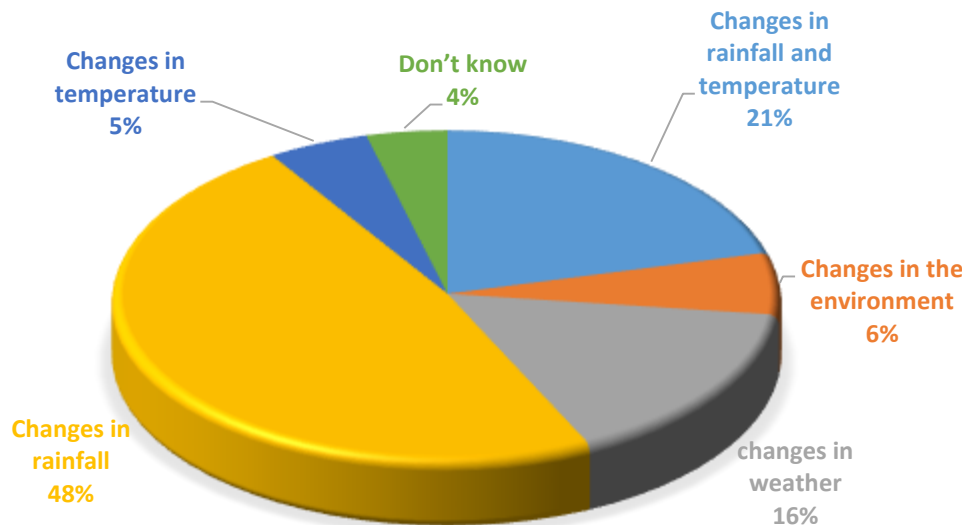


Figure 5. Respondents understanding of climate change and variability.

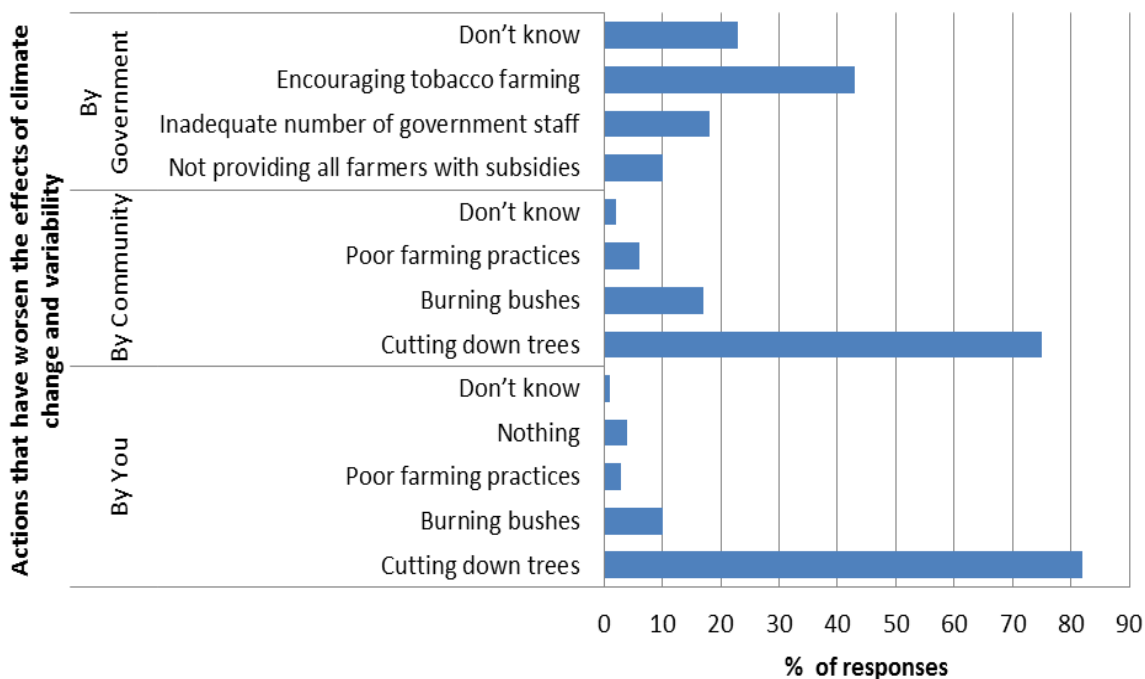


Figure 6. Farmers perceived factors contributing to climate change.

activities were categorized into Government, community and households. As for households and community, the majority of the respondents (82 and 76% respectively) reported cutting down of trees as the major activity contributing to worsening effects of climate change. About 45% of the respondents indicated that encouragement of tobacco farming by Government was the major activity that was worsening the climate

change and variability situation in the community (Figure 6). Thus, smallholder farmers need to be encouraged to diversify their income generating activities through crop diversification in order to reduce over dependency on tobacco farming.

Finally, the respondents were asked to rank the major factors that they believe motivate them to adopt adaptation strategies to climate change and variability.

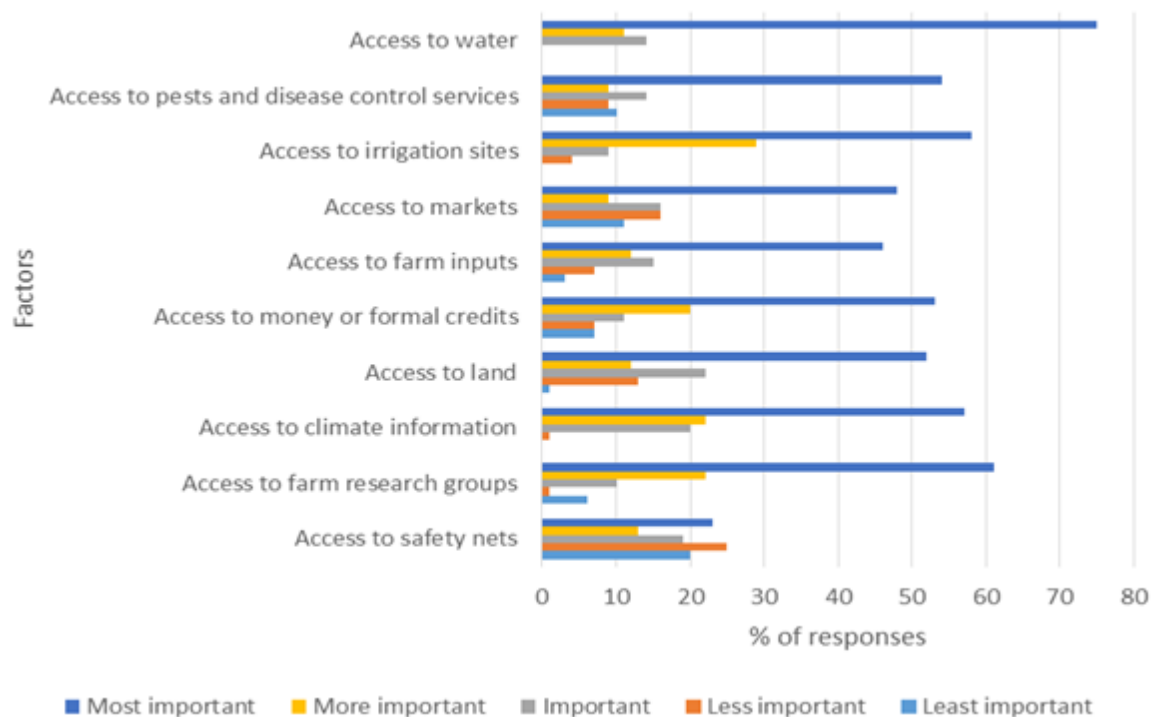


Figure 7. Ranking of motivating factors for adoption of adaptation strategies to climate change and variability.

From the findings, access to water (75%), access to farm research groups (61%), access to irrigation sites (58%), access to climate information (57%), access to pests and disease control services (54%) and access to formal credits (53%) were most frequently ranked by the respondents as the most important motivating factors while access to safety net was reported as the least important (Figure 7).

It is important to improve smallholder farmers' access to affordable credits which will increase their financial resources and ability to meet transactional costs associated with the various adaptations options they might want to take and also have the means to access to markets. In addition, with more financial resources and access to markets, small holder farmers will be able to buy new crop varieties, new irrigation technologies, invest in livestock farming, which are among the motivating factors to their adoption of climate change adaptation strategies.

Conclusion

The paper presented smallholder farmers perception on changes in climate in Bolero Extension Planning Area in Rumph District, northern Malawi. Majority of smallholder farmers are aware of climate change but debate continues on actual causes of this change. Among the few who believe their own human activity

contributes to the situation, they feel there are some factors which can motivate them to adopt coping and adaptation mechanisms to climate change and variability. Some of the motivation factors cited include access to market, access to credit/loan facilities, access to water resources, access to irrigation services, access to information on climate, provision of farm inputs, small stocks, polythene tubes and tree seedlings. Programmes that can take into account these suggestions may help to motivate many farmers to adopt coping and adaptation mechanisms in dealing with climate change and variability in Malawi and beyond. It is also important to increase awareness about the current trends and causes of climate change and variability in the area and the impact human activity may have on climate change. In addition, scientists and development experts should consider the cultural and traditional beliefs of smallholder farmers when designing climate change projects.

Conflict of Interests

The authors have not declared any conflict of interests.

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REFERENCES

- Arbuckle Jr JG, Prokopy LS, Haigh T, Hobbs J, Knoop T, Knutson C, Loy A, Mase AS, McGuire J, Morton LW, Tyndall J (2013). Climate change beliefs, concerns, and attitudes toward adaptation and mitigation among farmers in the Midwestern United States. *Climatic Change*, 117(4):943-950.
- Ashraf M, Routray JK (2013). Perception and understanding of drought and coping strategies of farming households in North West Balochistan. *Rev. Inter. J Dis. Red.* 5:49-60.
- African Technology Policy Studies Network, (ATPS) (2013). Farmers' perception and adaptive capacity to climate change and variability in the upper catchment of Blue Nile, Ethiopia [Bewket Amdu, Azemeraw Ayehu, Andent Deressa], ATPS WORKING PAPER No. 77
- Brody S, Grover H, Vedlitz A (2012). Examining the willingness of Americans to alter behaviour to mitigate climate change. *Clim. Pol.* 12(1):1-22.
- Bruinders V, Canavan K, Johnstone S, Mabuza M, Mattushek P, Spencer J (2009). Global warming: An assessment of knowledge, attitudes and practices at Rhodes University. University of Rhodes, Environmental Science Project, Group 3 Final Report.
- Caribbean Institute of Media and Communication (CIMC) (2012). Report on climate change knowledge, attitudes and behavioral practice survey. The Planning Institute of Jamaica. https://www-cif.climateinvestmentfunds.org/sites/default/files/knowledge-documents/cckapsurvey2012_rep.
- Chambers CM, Smith (2007). Environmental awareness in the OECS. OECS Protected Areas and Associated Livelihoods (OPAAL) Project Report of a KAP (Knowledge, Attitudes and Practices) survey conducted in six OECS member states, Castries, St. Lucia.
- Fosu-Mensah BY, Vlek PL, MacCarthy DS (2012). Farmers' perception and adaptation to climate change: a case study of Sekyedumase district in Ghana. *Environ. Dev. Sustain.* 14(4):495-505.
- Gbetibouo GA (2009). Understanding farmers' perception and adaptation to climate change and variability: The case of the Limpopo Basin, South Africa International Food Policy Research (IFPRI). Discussion Paper 00849. Environment and Production Technology Division, IFPRI. http://www.fao.org/fileadmin/user_upload/rome2007/docs/ifpri_limpopo_dp00849.pdf.
- Hulme M (2009). Why we disagree about climate change: Understanding controversy, inaction and opportunity. Cambridge University Press, Cambridge.
- IPCC (2007). Climate Change 2007: Climate Impacts, Adaptation and vulnerability. Working Group II to Intergovernmental Panel on Climate Change Fourth Assessment Report, Geneva: Intergovernmental panel on Climate Change. https://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4_wg2_full_report.pdf.
- Jamaica Climate Change Enabling Activity (JCCEA) (2005). Jamaica Climate Change KAP Study, Meteorological Services of Jamaica, BRAC Limited. http://research.fit.edu/sealevelriselibrary/documents/doc_mgr/473/Jamaica_Public_&_Climate_Change_JCCEA_2005.pdf
- Khamis M (2006). Climate change and smallholders in Malawi: Understanding poor people's experiences in climate change adaptation. A report by Action Aid International. https://www.actionaid.org.uk/sites/default/files/doc_lib/malawi_climate_change_report.pdf.
- Lorup JK, Hansen E (1997). Effect of land use on the streamflow in the southwestern highlands of Tanzania. In Sustainability of Water Resources under Increasing Uncertainty (Proceedings of the Rabat Symposium SI, April 1997). IAHS Publ. 240:227-236.
- Maddison D (2006). The perception of and adaptation to climate change in Africa. CEEPA Discussion paper no. 10 Center for Environmental, Economic and Policy in Africa, University of Pretoria. <http://www.ceepa.co.za/uploads/files/CDP10.pdf>.
- Mings L (2008). Determination of Knowledge, Attitudes and Practices on Climate Change Issue. *Environ. Tour. Consulting* 1-12.
- Moyo M, Mvumi BM, Kunzekweguta M, Grufard P, Dorward P (2012). Farmers' perception on climate change and variability in Semi-Arid Zimbabwe in relation to climatology evidence. *Afr. Crop Sci. J.* 20(2):317-335.
- Nyanga PH, Johnsen FH, Aune JB (2011). Smallholder farmers' perceptions of climate change and conservation agriculture: Evidence from Zambia. *Rev. J. Sust. Dev.* 4(4):73-85.
- Ojomo E, Elliott M, Amjad U, Bartram J (2015). Climate change preparedness: A knowledge and attitudes study in southern Nigeria. *Environ. Dev. Sustain.* 17:435-448.
- Olsen KH (2006). National ownership in the implementation of global climate policy in Uganda. *Clim. Pol.* 5(6):599-612.
- Oopen M (2012). Knowledge attitude and practices surveying Lao PDR related to environmental protection, biodiversity, conservation and climate change adaptation. KAP survey report. www.laos-proceed.com/la/.../surveys/kap-survey-report_v19_final-final_small.pdf.
- Shankara MH, Shivamurthy M, Kumar K (2013). Farmers' perception on climate change and its impact on agriculture in eastern dry zone of Karnataka. *Int. J. Farm Sc.* 3(2):100-107.
- Sleger MF (2008). Exploring farmers' perceptions of drought in Tanzania and Ethiopia, PhD Thesis, Wageningen University ISBN: 978-90-8585-240-7.
- Tadross M, Suarez P, Lotsch A, Hachigonta S, Mdoka M, Unganai L, Lucio F, Kamdonyo D, Muchinda M (2007). Changes in growing-season rainfall characteristics and downscaled scenarios of change over southern Africa: implications for growing maize, IPCC regional Expert Meeting on Regional Impacts, Adaptation, Vulnerability, and Mitigation, Nadi, Fiji, June 20-22. Meeting Report Papers, pp. 193-204.
- United Nations (1992). United Nations Framework Convention on Climate Change. FCCC/INFORMAL/84. <https://unfccc.int/resource/docs/convkp/conveng.pdf>.
- Vandamme E (2009). Concepts and challenges in the use of Knowledge- Attitude- Practice Surveys: Literature review. Department of Animal Health, Institute of Tropical Medicine, Antwerp, Belgium.