

LONDON
SCHOOL of
HYGIENE
& TROPICAL
MEDICINE



LSHTM Research Online

Saronga, Naomi Jones; Mosha, Idda Hubert; Kessy, Anna Tengia; Ezekiel, Mangi Job; Zizinga, Alex; Kweka, Opportuna; Onyango, Paul; Kovats, Sari; (2016) "I eat two meals per day" impact of climate variability on eating habits among households in Rufiji district, Tanzania: a qualitative study. *Agriculture & Food Security*, 5 (14). DOI: <https://doi.org/10.1186/s40066-016-0064-6>

Downloaded from: <http://researchonline.lshtm.ac.uk/4652605/>

DOI: <https://doi.org/10.1186/s40066-016-0064-6>

Usage Guidelines:

Please refer to usage guidelines at <https://researchonline.lshtm.ac.uk/policies.html> or alternatively contact researchonline@lshtm.ac.uk.

Available under license: <http://creativecommons.org/licenses/by/2.5/>

<https://researchonline.lshtm.ac.uk>

RESEARCH

Open Access



“I eat two meals per day” impact of climate variability on eating habits among households in Rufiji district, Tanzania: a qualitative study

Naomi Jones Saronga^{1*}, Idda Hubert Mosha¹, Anna Tengia Kessy¹, Mangi Job Ezekiel¹, Alex Zizinga⁴, Oportuna Kweka², Paul Onyango² and Sari Kovats³

Abstract

Background: Improved understanding of the influence of climate variability on eating habits is required to manage health outcomes that could be produced. Agriculture production is the main source of income to people in Rufiji district, where communities produce food for household and also for income. Effects of climate variability and weather extremes include occurrence of floods and prolonged dry seasons, which are recently reported to be very frequent in Africa continent, affecting food production. Prolonged dry seasons as well as frequent floods have been reported to destroy cultivated food crops in Rufiji district. However, there is little evidence on climate variability effects on household food security and their eating habits in Tanzania. Therefore, this study assessed the influence of climate variability impacts such as prolonged dry seasons and floods on the eating habits of Tanzanian rural households.

Results: Study findings showed that respondents recognized changes in seasonal trends such as rainfall pattern and increase in temperature in the area. Drought and floods reduce food production and cause shortages in households. Low and poor harvest of food crops is the major contributing factor in their farms of rice and maize, the main staple food crops grown amidst prolonged dry seasons. They reported existence of household food shortage which was not there 10 years ago. Participants developed adaptation mechanisms that included reducing food quantity, eating of new meals which were not eaten before as a main meal such as cooked unripe mangoes and stiff porridge. Household members decided to change eating habits as an adaptation strategy to the situation of food shortage. Some discussants acknowledged reducing number of meals, eating two meals a day instead of three or four as it was 10 years ago.

Conclusion: Climate variability has led to reduced amount of annual rainfall, thus affecting food productivity and consequently food shortages and changes in dietary habits among the people in Rufiji. Additional research is warranted to assess the impacts of climate variability on nutritional quality of meals.

Keywords: Climate variability, Eating habits, Rural households, Floods, Drought

Background

Climate variability affects adequate food availability in the households leading to feeding disparities. Eating habits refers to what and how people eat, their selection of

food items and their way of getting food. Climate variability refers to variations in the mean state and other climate statistics such as standard deviations and/or the occurrence of extremes, on all temporal and spatial scales beyond those of individual weather events [9]. Climate variability tends to alter the seasons from normal to unpredictable trends [21]; some years have rainfall below average, some above average and some average rainfall.

*Correspondence: nsaronga@gmail.com

¹ School of Public Health and Social Sciences, Muhimbili University of Health and Allied Sciences, Dar es Salaam, Tanzania
Full list of author information is available at the end of the article

The actual rainfall varying from the mean represents drought and flood conditions and might force changes in diets around the globe as certain staple foods become harder to produce [3].

Some effects of climate variability include occurrence of floods and droughts which are reported to be very frequent in African countries [10]. Previous studies found that floods and droughts have serious impacts on agricultural productivity [2, 11] whereby cultivated crops are destroyed by flood water or fail to grow due to drought. These cause reduced production of food crops [18] and sometimes completely lack of food in some areas [4, 25]. Climate variability has negative effects on agriculture production, thereby decreasing food production [1, 18, 23, 24] which then influences household food insecurity which means household fails to have enough food throughout the year [5, 16]. Climate variability as well was reported to have an effect in food price; because of low food production, the price goes higher, thus reducing food accessibility [1] and therefore causing household food insecurity. Due to this, households are influenced to change their eating habits when trying to cope with the situation of food insecurity [20].

Tanzania as for many sub-Saharan countries, agricultural production is predominately a rain-fed subsistence system [22, 23]. Agriculture is the main source of livelihood to people in Rufiji district, 93 % of households in Rufiji flood plain and delta areas are engaged in agricultural activities [14], and 78 % of households in whole district are engaged in agriculture [17]. This means majority produce their own foods as well as selling outside to earn income to cater for other necessary and basic needs [14]. Previously agricultural activity was characterized by three seasons: the short rain season, which involves planting of maize in November up to December and harvesting in February up to March; the long rain season, which involves planting of rice in December up to January and harvesting in June and July; and the flood recession season, which involves planting of maize and pulses in May and June and harvesting in August and September (maize) and October and November (pulses). Currently, the previous seasonal trends have been changing from time to time due to climate change and variability [13].

Rufiji district used to experience floods from long back in 1962 [13] but not as frequent as of current. Recently, they experience floods annually, and this affects negatively the livelihood in general. In recent years, it rains heavily in a very short time, affecting the cultivation season. When it rains and seeds are in the soil, some are taken away by water [7]. Sometimes it stops raining before seed germination, thereby affecting the whole

process. Prolonged dry season in Rufiji has been reported to reduce crop production significantly, while flood destroys crops by sweeping away and destructing cultivated food crops such as rice and maize [12, 21].

As a coping mechanism, qualitative research has shown that households can modify their eating habits in response to food shortages. Staple diets eaten when food was plenty are replaced by less preferred diets, others reduce feeding frequency, and some households reduce food quantity in order to enable food supplies to last longer [12, 13]. Studies that connect climate change and/or variability and food production are many. However, studies that connect climate change and/or variability and eating habits are lacking. Therefore, this paper assesses how climate variability influences the eating habits of Tanzanian rural households.

Methods

Study area

Rufiji is one of the six districts of the Coast Region in Tanzania. It is bordered to the north by Kisarawe and Mkuranga districts, to the east by the Indian Ocean, to the south by the Lindi Region and to the west by Morogoro Region. The Rufiji River runs through the district, and it forms one of the biggest river plains in the country. The district covers approximately 14,500 km², with a population of 217,274 (104,851 males and 112,423 females) [15].

Rufiji district has tropical climate with some variations in monthly temperature and day length [13]. Monsoon winds from Indian Ocean and Intertropical Convergence Zone control the rainfall pattern, which is long rain season from March to May and short rain season from October to December. The main food crops grown are maize, rice and some fruits and vegetables, and for cash crops, they grow cashew nuts and cotton [12]. Fishing is the second source of livelihood in this district but claimed to decline significantly due to climate variations [21].

Study design

This was a cross-sectional study which employed Focus Group Discussions (FGDs) to collect data among men and women 30–49 years of age residing in Rufiji. This age group was selected to participate in this study because they could recall what transpired in terms of climatic variability from 10 years ago. The FGDs approach was used in this study because it focuses on group dynamics in which interactions help to explore people's understanding of the phenomenon under study as well as of the norm system influencing their perceptions [6]. Furthermore, this approach takes advantage of in-depth information from the participants on the study subject.

Sampling

Rufiji district was purposely selected for this study because it has been affected by both prolonged dry season and floods as an impact of climate variability [13]. Ikwiriri ward was purposively selected due to the fact that it is located in the Rufiji River flood plain and therefore affected most by the impacts of climate variability. Ikwiriri ward has three villages, and three FGDs were conducted in each village. With the help from local leaders, 90 discussants were purposively selected to participate in this study. Among them, 50 were females, while 40 were males, and they were residents of Rufiji district for more than 10 years. We used purposive sampling to get people who could provide the needed information on the subject area.

Data collection

A total of nine FGDs, each consisting of 10 participants, were conducted. The FGD guide focused on participants' perception of climate variability, food security, eating pattern and food source. The FGD discussion guide was prepared in English and translated into Kiswahili by the Principal Investigator (PI). FGDs were conducted in Kiswahili, as it is a *lingua franca* throughout Tanzania. The first author moderated the discussions with the help of a research assistant, who took notes and kept time. Each session lasted, on average, 1 h.

Data analysis

The digital-recorded discussions and FGDs were transcribed and translated into English and thereafter back-translated into Kiswahili. The first author supervised transcriptions from tapes and translations into English. Content analysis was carried out following the guidelines by Graneheim and Lundman [8]. The first author analyzed the data manually by initiating the coding and category assignments. Then the second and third authors went through the data identifying discrepancies. The discrepancies were discussed and consensus was reached among the authors after referring to the tapes. Codes and categories that emerged from data were later sorted out to form the main themes that emerged, as presented in the findings section.

Ethical consideration

We obtained a research permit from University of Dar es Salaam Institutional Review Board. We also obtained permission to conduct the study from the regional, district, wards and village authorities. Individual verbal consent was sought and obtained from the study participants prior to their participation in the FGDs. All information was kept confidential, with names excluded from the recorded materials to avoid giving away the identity of the participants.

Results

The main themes that emerged are as presented below.

Perception of climate variability

Majority of discussants gave out their perception of climate variability, which includes long rain season and long dry periods; heavy rains lead to floods. The droughts and floods destroy crops and lead to low yield and food insecurity. These respondents further pointed out that they started to experience some impacts of climate variability such as floods in Rufiji in 1998. Some participants described climate variability to include food insecurity, lack of electricity, and water and diseases outbreak in the communities. These diseases included diarrhea and malaria. For instance, one discussant had this to say:

[mmh] in 1998 we experienced great flood in Rufiji, however, prior 1998, we experienced severe drought in 1997, which led to low harvests to the farmers. After that, the following year (1998) was when we experienced severe floods, in such people got little harvests from their crops, even those people living in valleys were in suspense and moved from the valleys and lived somewhere else.

A discussant stated:

In my memory, I remember year 1998 when there were floods and all crops were drowned, people brought some items to us as aids including wheat flour, at that time I was a young boy. Again, in 1999 there was a drought and at the end of 1999 there were bigger floods compared to those of 1998.

Food availability

Majority of the participants confirmed that climate variability has affected food availability in Rufiji. They stated that because of climate variability and low yields they have reduced amount of food that they eat. They said that majority of them resort to doing small businesses so that they can get some money to buy food for their families because what they get from the farms is not enough. Some of them said that they resort to cultivating on valleys so that they can get some harvests. When asked to compare food availability at the current situation compared with 10 years ago, majority of them pointed out that they do not harvest enough crops to survive the whole year compared with past 10 years when foods were abundant due to good climate.

Furthermore, majority of them added that due to climate variability that have been started for about 10 years ago food prices like maize, rice and beans have gone up, thereby lowering the purchasing power among themselves, especially for maize, rice and beans, as they are

the main foods eaten by people in this place. They confirmed that sometimes when they experience floods or drought their crops are destroyed as they wither away or get destroyed by floods and result into no or little harvest, especially when they suffer from floods or prolonged drought due to climate variability. They stated that they manage to buy small amount of rice, maize flour and beans for their families. Majority of participants were of the view that nowadays they do not get enough food from their farms as compared to 10 years ago; they buy their foods from shops compared with previous years. Many residents of Ikwiriri are farmers, and a few of them do small businesses like retail shops and few engage in chopping woods. They argued that in previous years, climate was good and they got their foods from their farms.

For instance, one discussant commented:

Climate variability has affected us because food prices are going up; for instance rice nowadays is Tshs 2400 per kilogram ... and also price of maize flour has gone up due to climate variability; the drought has affected the crops- like the maize and rice has dried up, therefore we have nothing to depend on now.

Another discussant said:

Last year we faced drought, we didn't harvest rice and maize due to that drought, all crops withered away, likewise this year we have severe sun.

Assessing food availability

Participants were asked whether they had enough food to sustain them for the whole year. All participants said that they do not have enough food to sustain for the whole year at their households due to prolonged dry season. They stressed that in this year (2015) they do not have enough to eat because crops were affected by drought last year (2014). They all further mentioned that in the past 10 years, they were getting a lot of food from their farms to enable them to survive for the whole year because the rainfall was enough at that time and they did not suffer from climate variability. For example, one discussant stated:

Availability of meals is difficult because I remember we used to eat three meals per day in the past 10 years; but nowadays you can have your meal in the morning, have porridge as your lunch and little meal in the evening that is our life now, we don't have enough to eat.

Another discussant commented:

This year we don't have foods at our households because of last year's floods, so we didn't get any-

thing to store in our households, all crops were drowned. Very few people harvested little crops of which is not enough for whole year, we are buying foods from shops.

Type of food available

Participants stated that foods that were available in the past 10 years are also available nowadays, but not abundantly as it is used to be due to climate variability. Crops like rice, maize, cassava, vegetables and pumpkins are available even now but not abundantly as used to be 10 years ago, and the price has gone up. They mentioned also the coming of nomadic people (*Wamang'ati*) and their cattle as one factor that caused food shortage in Rufiji. They claimed that these pastoralists sometimes feed their cattle on their farms, hence destroying their crops. In addition, discussants mentioned reduced amount of rainfall, floods, droughts, late rains and short rain has reduced the crop harvests due to crop failure and destruction. Even those cultivating in valleys around water sources get low yields as they face shortage of water because some rivers and wells have dried up due to climate variability in Rufiji. They pointed out that water quality and quantity is low. For example, some of the discussants said:

The kinds of foods that are available in plenty in Rufiji are maize and rice and people used to harvest abundantly in past 10 years but now due to drought these crops are not available, (mhhh) floods and a lot of rain especially along the valley destroys crops. Crops get drowned by floods, and we cannot farm until floods disappear.

Another participant added on:

Some foods that were available in the past 10 years ago are also available nowadays. However, not in abundance as it used to be. The prices of foods have gone up. For instance, a kilogram of rice for the past years was sold around 1200 or 1000 Tshs. On the other hand, nowadays, it is sold at 2000/ or 2400/ Tshs per kilogram. Maize flour was sold at 600/ or 800/Tshs per kilogram while nowadays it is sold at around 1000–1200 Tshs per kilo. Likewise, cassava price has gone up. So foods are available in the shops but the price is high probably due to the reason that, they are coming from other regions not from our area.

For instance, one discussant confirmed:

Formerly we used to get these crops like millet, maize, rice, cassava even nowadays we get them. But we don't get them abundantly like we used to get

in the past 10 years. Formerly we used to get them abundantly and store them in pantries and we ate them till the next harvest next year. Nowadays crops are little in farms and this year for instance we have not cultivated rice due to lack of rain.

Another one opined:

Previously we used to get abundance pumpkins, watermelons bananas, and sugar cane farms in abundance...but as of now these foods are scanty compared to previous 10 years.

For instance, one participant had this to say:

For the past 10 years food situation was better compared to this time. Crops were plentiful and food prices were low. During those days it was even easy to have small business get money and succeed because people had money from selling their crops. Now, it is not easy to do businesses because it's hard to get money. Life is hard nowadays as it is very difficult to get our meals.

From the discussions, it emerged that men are the bread winners to their households. Most of the households' activities are carried out by women in Rufiji, and they are likely to be affected by the effects of climate variability and also food insecurity as they are the ones preparing foods at and taking care of their families.

Eating habits change

Majority of study participants confirmed that their eating habits had changed due to prolonged dry season that affects the district recently. Majority stated out that they have two meals nowadays instead of three meals, and few of them said they eat one meal per day depending on the availability of food at that particular day. They further explained that they sometimes have porridge as a meal when they do not have enough food. New diets were discovered in the study sites such as *ugali* (stiff porridge) and cooked unripe mangoes. This food was mentioned to be consumed nowadays due to lack of enough legumes and fish that were consumed in the past years. They pointed out all these are caused by little harvest of crops as a result of climate variability and inflation of food prices at the markets and shops.

For example, one participant had this to say:

Eating pattern here has changed a lot because formerly we used to eat three times per day. Nowadays we eat two meals per day so that we can get something to eat in the evening because crops are not abundant so life is hard.

Another one had this to comment:

Eating habit has changed greatly because previously we used to harvest enough food crops and store them and so we prepare any amount of food we like... but as for now we harvest little crops which are not enough throughout the year due to this we are forced to buy food from shops and if you have a large family and have low purchase power you can end up buying little which won't be enough for your family.

Another discussant said:

Eeh I mean like one kilogram of maize flour I divide it into two parts – one part I cook porridge in the morning as breakfast and the other half I prepare it as dinner so as to satisfy my children.

Another one commented:

*As for me it depends I can eat twice or thrice per day. In the morning I can have my breakfast, in the afternoon I don't eat and in the evening I get dinner like stiff porridge (*ugali*) and beans. It depends on what you get on that particular day.*

Another discussant had this to say:

My meals depend on that day, because there are other days that are better off and I eat thrice per day, and where the situation does not allow me to have three meals I usually have breakfast and dinner only.

A discussant said:

Eating habit has changed because floods and droughts destroys our crops, and you prepare farms again for planting new crops not sure if they will be destroyed again...So eating pattern changes because we rely on farming to get our foods, now it's different because we have to look for other ways to get our foods something different from what we used to rely on our farms for foods.

Food sources

Majority of the discussants mentioned that they buy food from the shops most of the time since they do not have enough food from their farms due to floods and droughts.

One discussant commented:

Some people do piece works like farming and selling logs and timbers so that they get some money to buy some foods, so that is the situation we are living in now in Rufiji.

Discussion

The aim of this study was to explore how climate variability affects people's eating behavior in Rufiji. We have presented direct quotes from women and men to allow the reader to ascertain the validity and dependability of the study findings. As such this seems to be first study in Tanzania on climate variability and eating habits.

Our study findings revealed a couple of changes that were brought about by climate variability in Rufiji. First of all, climate variability is reported to have affected food availability in Rufiji, hence affecting peoples eating habits with a notable change in the reduction in number of meals consumed per day due to food shortages. The study findings showed that eating habit among people in Rufiji has changed. In this study, majority of discussants confirmed to have two meals per day—mostly breakfast and dinner—due to food shortage caused by prolonged dry season. Reducing number of meals was recognized as the strategy to cope with the food shortage, and this is similar to what Shariff and Khor [20] found in their study. As such eating two meals per day instead of three meals can affect the health of vulnerable groups such as children and pregnant mothers and lead to undernourishment. In fact, this also can lead to poor attendance of children to school. Present study also found strategy to reduce portion size and food varieties was adopted to cope with the situation.

On food security, this study revealed that households do not get enough food to eat throughout the year due to droughts, floods and insufficient rains in Rufiji. This is similar to what Shaghude found in his study that was conducted in the same district. He reported food insecurity to the household in Rufiji district due to seasonal change [19]. Climate variability causes many changes to people; first crops get drowned or dry out due to variability of climate and lead to shortage of food and food insecurity in the households. They stressed that 10 years ago, they had had enough to eat and store and even selling outside the district was a means to increase income. The women discussants explained the difficulties they faced in budgeting food to last longer. They also mentioned the rise in food price as the hindrance to food access which is very different to how they access food in the past years.

Also the findings showed that people struggle to get their needs by resorting to income generating activities other than farming and relying on food purchased from retail shops at high prices instead of getting them from farms as they used to.

Furthermore, the study findings showed that people in Rufiji experience prolonged drought and very heavy rains. Discussants stated that they started experiencing climate variability impacts in recent years compared with past 10 years. They further claimed that increased floods intensity destroys maize and rice which is one of the main

food staples in the area. The discussions stressed out the low production of food crops cultivated in the area in the recent years compared with 10 years ago. This is in the same line with a study by Shemdoe and Kihila [21] who reported prolonged drought and very heavy rains as the impact of climate variability and change in Rufiji district.

Carbohydrates were the main nutrients composed in a diet mentioned to be consumed by most of the participants in this study. Little amount of protein foods was mentioned to accompany the staple meals. Vegetables were not consumed frequently as in the past 10 years, and the main reason was dryness of the land. Irrigation scheme could be better option to reduce this situation as the Rufiji River is situated nearby, but they fail as the system is not in place.

This study reveals that people in Rufiji get their food through different ways due to climate variability as compared to 10 years ago. These include doing small businesses and cultivating on the valleys.

Conclusion

Climate variability has led to reduced amount of annual rainfall, thus affecting food productivity and consequently food shortages and changes in dietary habits among the people in Rufiji. Therefore, government should look for strategies which will help people produce and have enough foods in their households. The strategies can include using modern irrigation methods among farmers in Rufiji as of now they depend on rainfall which fails them due to climate variability. Also we recommend studies to be conducted which will assess the impacts of climate variability on nutrition quality of meals.

Authors' contributions

NJS designed study, coordinated the implementation of the study, did sequence alignment and drafted the manuscript. IHM supervised data collection, analyzed data, participated in the sequence alignment and drafted the manuscript. MJE mentored the implementation of the study and writing process and reviewed the manuscript. AZ revised the manuscript. OK supervised the design of the study and revised the manuscript. PO supervised the design of the study and revised the manuscript. ATK revised the manuscript. SK is a Research Specialist Advisor and helped to revise the manuscript. All authors read and approved the final manuscript.

Author details

¹ School of Public Health and Social Sciences, Muhimbili University of Health and Allied Sciences, Dar es Salaam, Tanzania. ² University of Dar es Salaam, Dar es Salaam, Tanzania. ³ London School of Hygiene and Tropical Medicine, London, UK. ⁴ College of Agriculture and Environment Sciences, Kampala, Uganda.

Acknowledgements

This research is supported by funding from the Department for International Development (DfID) under the Climate Impact Research Capacity and Leadership Enhancement (CIRCLE) programme.

Competing interests

The authors declare that they have no competing interests.

Received: 11 January 2016 Accepted: 18 July 2016

Published online: 08 August 2016

References

1. Badolo F, Somlanare R. Climatic variability and food security in developing countries. *Etudes et Documents* 2014;05.
2. Banerjee L. Effect of flood on agricultural wages in Bangladesh: an empirical analysis. *World Dev.* 2007;35:1989–2009.
3. Biello D. Farmed out: how will climate change impact world food supplies. *Scientific American.* 2009. <http://www.scientificamerican.com/article/how-will-climate-change-impact-world-food-supplies/>.
4. Brida A, Owiyo T, Sokona Y. Loss and damage from the double blow of flood and drought in Mozambique. *Int J Global Warm.* 2013;5(4):514–31.
5. Codjoe SNA, Owusu G. Climate change/variability and food systems: evidence from the Afram Plains, Ghana. *Reg Environ Change.* 2011;11(4):753–65. doi:10.1007/s10113-011-0211-3.
6. Dahlgren L, Emmelin M, Winkvist A. Qualitative methodology for international public health. Umea: Umea University Press; 2007.
7. Donovan D. The continental observer. 2014. <http://thecontinentobserver.com/africa/05/15/floods-leave-rural-tanzania-under-water/>.
8. Graneheim U, Lundman B. Qualitative content analysis in nursing research: concepts, procedures and measures to achieve trustworthiness. *Nurse Educ Today.* 2004;24:105–12.
9. IPCC. Climate change 2001: impacts, adaptation, and vulnerability. 2001;1–30. <http://www.ipcc.ch/ipccreports/tar/wg2/index.php?idp=4>.
10. IPCC. Climate change, adaptation, and vulnerability. *Organ Environ.* 2014;24:1–44. http://ipcc-wg2.gov/AR5/images/uploads/IPCC_WG2AR5_SPM_Approved.pdf.
11. Kangalawe RYM, Lyimo JG. Climate change, adaptive strategies and rural livelihoods in semiarid Tanzania. *Nat Resour.* 2013;04:266–78. doi:10.4236/nr.2013.43034.
12. Lugenja M, Meena H, Mwakifwamba S. Analysis of technical and policy options for adaptation to consequences of climate change for Tanzania water supply features in relation to the climate change impacts and adaptation. Dar es Salaam; 2008.
13. Meena H, Lugenja M, Stephenson M. Climate change impacts on livelihoods in Tanzania and adaptation options: experience of floods and drought in Rufiji. 2006.
14. Mkindi AR, Meena HE. Rufiji district residents and adaptation to environmental changes over time. 2005.
15. NBS. 2012 Population and housing census population distribution by administrative areas. Dar es Salaam; 2013.
16. Ray DK, Gerber JS, Macdonald GK, West PC. Yield variability. *Nat Commun.* 2015;6:1–9. doi:10.1038/ncomms6989.
17. RCO. Regional website. 2015. http://www.pwani.go.tz/rufiji/d_acl.php. Accessed 20 May 2011.
18. Rowhani P, Lobell DB, Linderman M, Ramankutty N. Agricultural and forest meteorology climate variability and crop production in Tanzania. *Agric For Meteorol.* 2011;151(4):449–60. doi:10.1016/j.agrformet.2010.12.002.
19. Shaghude YW. Costal impacts of water abstraction and impoundment in Africa: the case of Rufiji River. Repository of Ocean Publications; 2005.
20. Shariff ZM, Khor GL. Household food insecurity and coping strategies in a poor rural community in Malaysia. *Nutr Res Pract.* 2008;2(1):26–34.
21. Shemdoe R, Kihila J. Understanding community based adaptation strategies to climate variability in fishing communities of Rufiji River basin in Tanzania. *Afr J Hist Cult.* 2012;4(2):17–26. doi:10.5897/AJHC11.041.
22. Stige LC, Stave J, Chan K-S, Ciannelli L, Pettorelli N, Glantz M, et al. The effect of climate variation on agro-pastoral production in Africa. *Proc Natl Acad Sci USA.* 2006;103(9):3049–53. doi:10.1073/pnas.0600057103.
23. Tadross M, Hewitson B. The interannual variability of the onset of the maize growing season over South Africa and Zimbabwe. *Climate.* 2005;18:3356–72.
24. Tingem M, Rivington M, Colls J. Climate variability and maize production in Cameroon: simulating the effects of extreme dry and wet years. *Trop Geogr.* 2008;29(29):357–70. doi:10.1111/j.1467-9493.2008.00344.x.
25. Wight E. Droughts, flooding, disease: the reality of a Cambodia that has been hit by climate change. *The Phnom Penh Post.* 2014. <http://www.phnompenhpost.com/7days/droughts-flooding-disease-reality-cambodia-has-been-hit-climate-change>.

Submit your next manuscript to BioMed Central and we will help you at every step:

- We accept pre-submission inquiries
- Our selector tool helps you to find the most relevant journal
- We provide round the clock customer support
- Convenient online submission
- Thorough peer review
- Inclusion in PubMed and all major indexing services
- Maximum visibility for your research

Submit your manuscript at
www.biomedcentral.com/submit

