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Farmers' Knowledge and Perceptions to Climate Variability in North West Cameroon

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Abstract

Global climate variability exerts negative impacts especially on agriculture-dependent economies. Contemporary climate modelling suggests that farming households in developing countries will bear the greatest brunt from climate variability. However, information on farmers' knowledge and perceptions to climate variability and possible influence on household adaptation strategies especially in developing countries is scarce. This paper assesses farmers' knowledge and perceptions to climate variability, based on a case study from the North Western region of Cameroon.

A structured questionnaire was used in a cross sectional survey to collect data on knowledge and perceptions to climate variability, from 272 farmers in six randomly selected villages in the North West Region of Cameroon. Data was analyzed using the Statistical Package for Social Sciences (SPSS version 17.0) and Excel. Over 97% of respondents demonstrated contextual knowledge of climate variability. Perceptions to the causes of climate variability were quite diverse. While 20% of respondents had no idea, around 40% attributed climate variability to human activities, 20% to industrial activities and 20% to the anger of the gods.

We conclude with the need for climate variability research to increasingly pay attention to farmers' indigenous knowledge and perceptions as prerequisites to building resilience amongst farmers in Cameroon.

Keywords

climate variability, farmers, knowledge and perceptions, North West Cameroon

1. Introduction

Climate variability is a global phenomenon which does not obtain solely from natural processes. Human activities have been strongly accused for being responsible for climate oscillations. Such activities include for instance man's consistent increasing use of fossil fuels, deforestation and intensification of agricultural activities (IPCC, 2014; Innocent et al., 2016). Although the epistemology of climate variability seems to attract global concern, its effects are differently felt in developed and developing countries. In developed countries, the thematic discourse circulates around costs and responsibility towards future generations. In developing countries where state and market failures are more frequent, climate change and variability effects are expected to be huge, although they are essentially externalities to many of these countries (Edoun et al., 2015). The discourse in such countries is therefore about survival. In fact, variability in climatic factors is construed to affect livelihoods in such countries, by exerting negative pressure particularly on the agricultural sector, on which an overwhelming majority of inhabitants in these countries depend for food security and other aspects of livelihoods (Valdés et al., 2010; IPCC, 2014; Kimengsi & Lambi, 2015). Nevertheless, the literature from both developing and developed countries converge on at least two key issues: (1) that climate variability has negative impacts, and (2) that the effects of climate variability are currently exacerbated by rising humanly orchestrated disasters, with terrorism at the forefront (Hansen et al., 2004; Vedwan, 2006; Malmin, 2016).

A distinction must be made between climate variability and climate change. Climate variability on the one hand refers to temporal or yearly variations in climatic elements (rainfall, sunshine and temperature) above or below long-term average values. Climate variability therefore refers to short-term seasonal fluctuations. Climate change on the other hand refers to long-term mean changes, as calculated over many years (e.g., 35 years). Thus, while climate variability is frequent and of shorter duration, climate change is slow, gradual and accumulates over time (IPCC, 2007).

The importance of climate-dependent agriculture in Cameroon in general and its North Western Region in particular cannot be overemphasized. Around 70% of the population in the North Western Region in particular and Cameroon in general depends on climate-depended agriculture as a primary source of livelihoods. Agriculture as an economic sector contributes around 35% to the gross domestic product of Cameroon (Moloa & Lambi, 2006; Moloa, 2010; Kimengsi & Lambi, 2015). Rain-fed agriculture accounts for over 95% of the total agricultural production. Kimengsi and Lambi (2015) for instance hold that rainfall in Cameroon in recent years has largely become inconsistent, culminating in crop failure, post harvest losses and food insecurity. Not surprising therefore that climate variability is seen as a major factor exposing farmers to poor harvest risks and potential famine (Innocent et al., 2015; Yengoh et al., 2010).

The agricultural sector is currently highly vulnerable to climate related stresses, particularly variations in temperature and precipitation (Moloa & Lambi, 2006; Vedwan, 2006). Reduced rainfall and

increased temperatures reduce the availability of water needed by plants. Low or too much rainfall and increased temperature recorded in many parts of the country have been identified as key drivers for starvation and poverty (Innocent et al., 2015) and for the increased occurrence of floods and droughts in Cameroon (Balgah et al., 2015). At the moment, over three million people are estimated to be food insecure in Cameroon, as a result of climatic variability (Nzouankeu, 2012). This precarious situation has been worsened in recent years by the rise of cross border terrorist attacks, orchestrated by Boko Haram in some parts of the country.

A critical step to reduce exposure to climate variability, considering the difficulty of prevention, is for farmers to adapt (Tingem & Ravington, 2008; Ngigi, 2009; Shemdoe et al., 2015). Adaptation demands a sound understanding of farmers' knowledge and perceptions to climate variability as crucial steps towards enhancing community based and farmer driven adaptability. We acknowledge the growing literature focusing on farmers' perceptions to climate variability (see for instance, Hansen et al., 2004; Vedwan, 2006; Deressa et al., 2009; Eiser et al., 2012; Innocent et al., 2016). This is however not commensurate with the severity of the problem, especially in developing countries. In addition, most research works examine knowledge and perceptions as independent variables, and often do not pay sufficient attention to their combined effects. Based on a case study from north western region of Cameroon, this article contributes to the state of art by assessing knowledge and perceptions as two interconnected variables, attempting to understand how they affect farmers' adaptation strategies to climate variability.

1.1 Problem Statement

Climate variability is neither rhetorical nor delusional. It is an unfortunate reality impacting many parts of the world today. Increasing temperatures and variations in rainfall for instance have been reported in many parts of the globe (Maddison, 2009; Yengoh et al., 2010; Dang et al., 2014; Kimengsi & Lambi, 2015; Innocent et al., 2016). In the Western highlands of Cameroon, Yengoh et al. (2010) for instance have reported high fluctuations in average rainfall and temperatures over the last 12 years, particularly in the North West Region of Cameroon, which is considered as one of the food baskets of the country. There is a growing literature on the impacts of climatic variability on livelihoods in general and on the agricultural sector in particular. However, research on farmers' knowledge and perceptions on climate variability is still scarce. Exceptions however include for instance the studies of Hansen et al. (2004) in Argentina and South Florida, Hageback et al. (2005) in China, Eakin (2005) for central Mexico, Vedwan (2009) for Apple growers in India and Dang et al. (2014) in the Mekong Delta of Vietnam. Research on such issues is crucial to unravel the mystery behind climate variability, in order reduce its negative effects, by developing appropriate preventive, mitigating or coping strategies and enhancing resilience, based on community processes.

This article aims at reducing the knowledge gap, by examining the knowledge and perceptions of smallholder farmers to climate variability based on a case study of smallholder farmers in the North

West region of Cameroon.

2. Concise Literature Review on Farmers' Knowledge and Perceptions to Climate Variability

Empirical evidence exists to support the fact that farmers' knowledge and perceptions to climate variability can be crucial in influencing their adaption strategies, reduce food insecurity and enhance their capacity to develop resilience (Hansen et al., 2004; Vedwan, 2006; Bryam, 2009; Maddison, 2009; Dang et al., 2014). Farmers' perceptions provide context specific frameworks and ideological suppositions under which they attribute meaning to the environmental changes and effects. In other words, knowledge and perceptions provide mental models on which individuals build human-environment relations (Vedwan, 2006). This, arguably, has a direct impact on how much effort they will be willing to indulge, in order to adopt endogenously or exogenously propagated measures to prevent, mitigate, cope or resist any consequences of climate related risks.

Maddison (2009) for instance in a study of farmers' perceptions spanning across ten African countries, shows that farmers' perceptions of climatic oscillations results in a plethora of actions such as less frequent visits to village shrines and mermaid palaces. Furthermore, perceptions to climate variability especially in the form of changing rainfall patterns was reported to stimulate the adoption of technologies such as improved seeds and irrigation practices.

Moyo et al. (2012) and Innocent et al. (2016) express similar observations amongst farmers in Zimbabwe and Cameroon respectively. However, while the Zimbabwean farmers mostly perceive changes as fallouts of increasing disrespect for ancestral spirits and traditional customs, their Cameroonian counterparts provide a very mixed scenario, ranging from natural processes to the work of God. Nevertheless, in both cases, farmers reported difficulties to effectively plan their agricultural activities as hitherto fore, mainly based on fluctuations in the onset and offset of the rainy season. Ishaya and Abaje (2008) and Mertz et al. (2009) suggest that Nigerian farmers attribute climate variability to diverse human activities such as cutting of trees and deliberate and increasing use of bush fires, contemporary emerging as faster means to clear farms. Consequently, and based on these perceptions, they applied soil management techniques such as planting of cover crops, fruit trees, alongside bush fire preventions to combat climate variability. Further work in Nigeria by Tunde (2011) reveals that almost 50% of sampled respondents identified climatic variability with delayed rainfall, 22% as increasing temperatures, 6% as more frequent floods, 3% as unusual rainfall and the rest as undefined commencement and closure of the rainy and dry seasons. In addition to many of these factors, Kenyan farmers identified extreme windy conditions and increasing pests and diseases (Sarah et al., 2012). The Kenyan farmers for instance hold rising Christianity and non-respect of traditional rites (such as rain mourning ceremonies) as jointly being responsible for climate variability. Moloa (2010) points out that 80% of farming households in the West region of Cameroon understand that changes in climate are real. Like their Kenyan counterparts, Cameroonian farmers hold declining

respect for local traditions as strongly responsible for climate variability. A key question emerging from these case studies is: does knowledge and perceptions influence subsequent actions? Hansen et al. (2004) contend that the degree of climatic uncertainty is associated with the level of understanding and perceptions, which individually and cumulatively influence decision making. Dang et al. (2014) support this contention by showing that farmers in the Mekong Delta in Vietnam had limited knowledge on climate change, and their perceptions to climate variability constrained adaptation. A link between knowledge, perceptions and decision making is therefore suggested, even if the exact dynamics of such relations remain blurred.

The major contribution of this paper is therefore to examine if combining knowledge and perceptions can influence farmers' actions towards dealing with the consequences of climate variability in a developing country context. The article draws on an empirical case study of smallholder farmers in the North Western part of Cameroon.

3. Materials and Methods

3.1 Background of the Research Region

The North West Region is the third most populated region in Cameroon, with an estimated population of over 1.8 million. It has an urban growth rate of 7.95% and a rural growth rate of 1.16% (Ambagna et al., 2012). It is bordered to the north by Nigeria, to the south by the Western Region, to the east by the Adamawa region and to the west by the South West Region (Innocent et al., 2016). Over 80% of its inhabitants depend on smallholder agriculture for their livelihoods (Yengoh, 2012; Balgah & Buchenrieder, 2011). The region has a poverty rate of 51% and is home to 13% of the total number of rural poor in Cameroon (Ambagna et al., 2012).

The region has two seasons: the rainy season which traditionally lasts from Mid-March to October, and the dry season from November to Mid-March. Annual rainfall varies from 1300mm-3000mm, with a mean of around 2400mm. Mean monthly temperatures range from about 15˚C on the highlands to about 27˚C in low-lying regions (Yengoh, 2012; Innocent et al., 2016).

3.2 Sampling Procedures and Techniques

This research attempts to capture the diversity in the North West Region of Cameroon. To ensure this, its seven divisions were purposively grouped according to altitudes (high: above 2500mm, medium: 2000-2500mm and low: below 2000mm). This is important as climatic elements (such as rainfall and temperature) and knowledge and perceptions to climate variability are likely to vary according to altitudes. One division each was randomly selected from each rubric (Bui division in the high altitude, Donga Mantung division in the medium altitude and Ngoketunjia division in the low altitude respectively), to ensure adequate coverage across different micro-agro-ecological zones in the research region. One subdivision was randomly selected from each of the above mentioned divisions (Oku, Nkambe and Babessi respectively). In each subdivision, two villages were randomly selected (Bangola

and Mambim in Oku; Binka and Binshua in Nkambe; and Kesortin and Njenai in Babessi subdivisions respectively). Smallholder farmers were then systematically selected with the help of lists obtained from the agricultural delegations in the various subdivisions, and the agricultural officers in the respective villages. A smallholder farmer in our case study is one who cultivates an area of land under 5 hectares. Primary data was collected from individual farmers, using a standardized questionnaire. Previously used questionnaires (FAO, 2007; Johannes, 2012) were adapted and modified into a field questionnaire used in a cross sectional survey. A contact visit in all the subdivisions was carried out during which the targeted villages were sampled and stakeholders were informed prior to data collection. Questionnaire pretesting was carried out during such visits as prerequisite to validating and producing the final questionnaire.

45 farmers were randomly selected through random draws in each village to participate in the survey, which was carried out with the help of trained enumerators. Data collection took place from June 19th to July 18th 2015.

Collected data was entered and analysed using SPSS (Statistical Package for Social Sciences) version 17.0, adopting a 95% confidence interval ($\alpha = 0.5$). Descriptive statistics was performed to understand farmers' knowledge and perceptions to climate variability.

4. Results and Discussions

This section commences with a discussion of the socioeconomic characteristics of the sampled farmers in the north western region of Cameroon, before proceeding to an empirical discourse on farmers' perceptions and knowledge on climate variability in the North West Region of Cameroon.

4.1 Socioeconomic Characteristics of Sampled Farmers

Table 1. Sample Distribution by Gender

	Frequency	Percentage
Male	100	36.8%
Female	172	63.2%
Total	272	100%

The sample distribution by gender is presented on Table 1 above. 63% of all farmers interviewed were females (172) while 37% (100) were males. Considering that farmer selection was random, the sample analysis suggests that women are the backbone of subsistence agriculture in the research region. The results support previous contentions (e.g., Balgah & Buchenrieder, 2011; Yengoh, 2012) that subsistence farming is mostly carried out by women, while cash crop production is done by the men.

Almost 90% of interviewed farmers are married. This indicates the importance attributed to the family

as an institution and a source of labour that is characteristic of subsistence agriculture (Balgah & Buchenrieder, 2011). Subsistence Agriculture is the main source of livelihoods in the research area (about 92% of all sampled households), with a meagre 8% employed in non-farm enterprises.

Also, more than 50% of the sample population have no formal education or have only completed primary school (Figure 1). However, 23% of the sample population have secondary and above educational levels. More so, about 60% of the sampled farmers were found to be literate based on their ability to use the English language. That this is 10 percentage points higher than those with former education suggests that there are farmers who did not complete primary school, but who are capable of reading and writing in English. The results are consistent with recent findings in the research region (see for instance Innocent et al., 2016). The literacy rate is however 8 percentage points lower than the national average (World Bank, 2013).

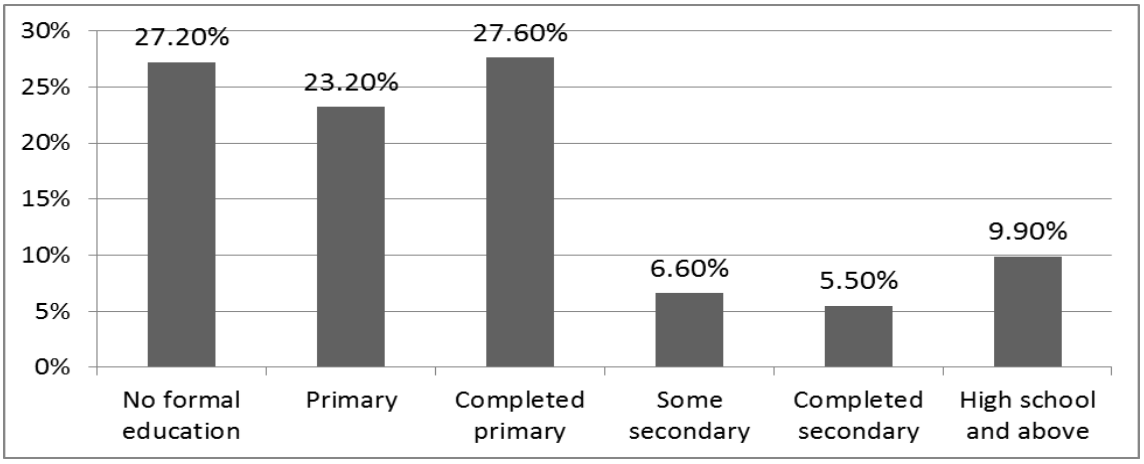

Figure 1. Educational Attainment in the Sample

As presented in Table 2 below, the mean age of the respondents was about 44 years, 10 years short of the life expectancy rate in Cameroon (World Bank Report, 2013).

The lower statistic has frequently been associated with inadequate social amenities (see for instance Rourke, 2008).

The mean household size of above 8 is higher than the average household size reported for the country (World Bank Report, 2013) and for the research region (Innocent et al., 2016; Balgah & Buchenrieder, 2011). Innocent et al. (2016) for instance report an average household size of seven. The difference is probably explained by the fact that the research covers a wider agro-ecological zone in the region than the previous ones. The mean monthly household income was found to be about FCFA 35,800 (US $60) and around FCFA 4,475 (US $7.5) per capita. This is less than 16% of the minimum wage in Cameroon of about 28.500 (US $47.5) by the 2013 standards (World Bank, 2013), and slightly above 12% of the newly established minimum wage rates of FCFA 36,270 (US $60.5) adopted by the Cameroonian

parliament in 2016 (Business in Cameroon, 2016). This means that on average, the farmers in the North West Region are poorer than the average individuals in the country.

Table 2. Socioeconomic Characteristics of Sample

Variable	Minimum	Maximum	Mean	Std. Deviation
Age of respondent	20	100	44	30
Household size	1	30	8	4
Estimated monthly household income of respondent/FCFA	10,000	500,000	35,585	55,810
Years of experience as a farmer	1	85	25	13

Notes. 1) Figures have been rounded up to the nearest whole number and Income to the nearest FCFA.
2) 1 US $ = FCFA 600.

4.2 Farmers' and Knowledge Perception of Climate Variability

The mean years of farming experience in the sample is almost 25 years as seen in Table 2 above. A quarter of a century in our opinion provides sufficient time and experience for the farmers to have developed knowledge and established more or less permanent perceptions towards climate variability. This probably explains why 97.4% of the sampled farmers confirmed having basic knowledge of climate variability (Figure 2 below). However, contextual conceptualization of climate variability remains diverse. Only around 31% of the total sample attributed climate variability to general changes in weather conditions. This dynamic however changes at the level of individual climatic factors. When presented with individual climate oscillation variables, changes in rainfall pattern (58%), increases in temperature (50%), poor harvest (30%) and longer dry seasons (14%) were cumulatively identified as key indicators for climate variability. These results are generally in line with other case studies from the African continent in particular (Innocent et al., 2016; Bose et al., 2014; Sarah et al., 2012; Tunde, 2011) and from the developing world in general (Eakin, 2005; Hageback et al., 2005; Dang et al., 2014). Farmers generally seem to attribute climate variability to specific factors than to the total sum of these factors across different developing countries. As demonstrated in our case study, such perceptions may be context specific, and could have far reaching effects on adaptation or resilience building strategies.

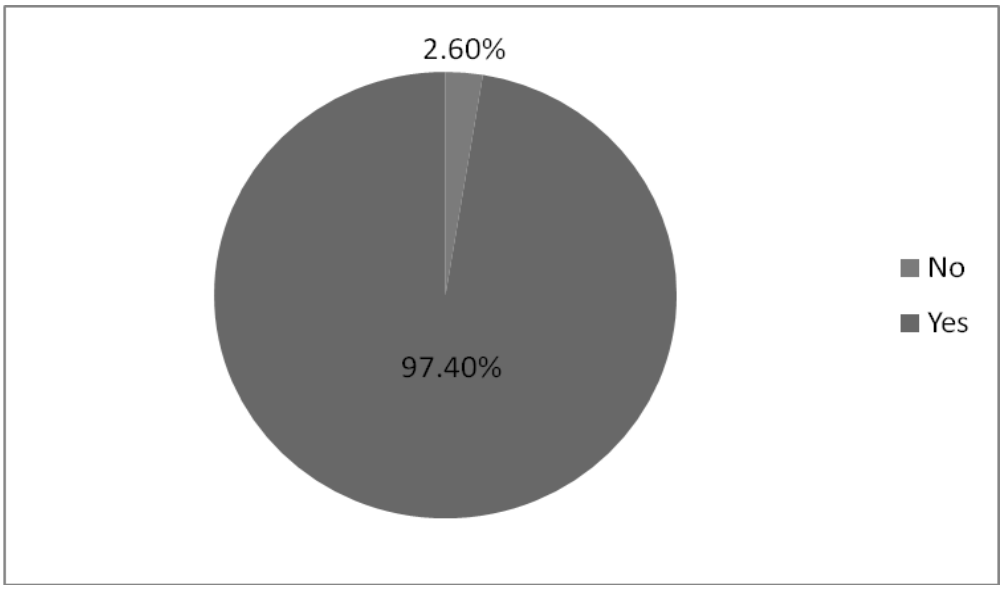

Figure 2. Farmers' Knowledge on Climate Variability

Table 3. Identification of Climate Variability Indicators by Farmers

Indicators of climate variability	**Number (percentage) Respondents**		**Total**
	No	Yes	
Changes in weather conditions	189 (69.5%)	83 (30.5%)	272 (100%)
Increase in temperature	139 (51.1%)	133 (48.9%)	272 100%
Changes in rainfall patterns	114 (41.9%)	158 (58.1%)	272 100%
Long dry seasons	233 (85.7%)	39 (14.3%)	272 100%
Poor harvest	190 (69.9%)	82 (30.1%)	272 100%

To capture farmers' endogenous perceptions and construction of knowledge of the reality, farmers were questioned on the causes of climate variability. Figure 3 below presents the results. Only 20% of all the sampled farmers had no concrete idea of the cause of climate variability. A majority of them (close to 40%), reported that climate variability was the fallout of unsustainable human activities such as deforestation and bush burning practices. 20% attributed changes in climatic factors to industrial

activities, while slightly above 20% explained it as a demonstration of the "anger of the gods". Our results are similar to the findings of previous research on this issue in Cameroon (Innocent et al., 2016; Moloa, 2010), elsewhere in Africa (Moyo et al., 2012; Maddison, 2009) and from other developing countries (Dang et al., 2014; Vedwan, 2006; Hageback et al., 2005).

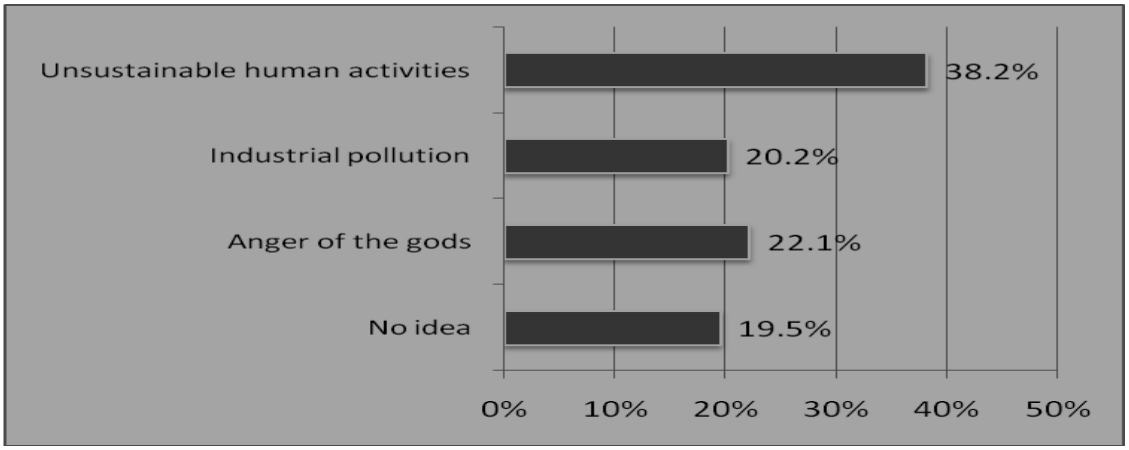

Figure 3. Farmers' Perceptions on the Causes of Climate Variability

5. Conclusions and Recommendations

This paper intends understand farmers' knowledge and perceptions to climate variability in the Northwest Region of Cameroon. Data was collected from randomly selected individual farmers across different altitudes, using a structured questionnaire. Analysis of field data leads us to a number of conclusions. Firstly, there is clear evidence that farmers in the Northwest have some knowledge, perceive and are experiencing climate variability. This conclusion stems from the fact that almost all sampled farmers reported to have heard of the word climate variability, acknowledging its existence generally in the form of decreasing rainfall and increasing temperatures. However, their perceptions as to the causes of climate variability were mixed. While most of the farmers (about 40%) hold that climate variability has emerged from unsustainable human activities like deforestation, bush fires, the rest attribute it to other factors such as industrial pollution and supernatural demonstration of the anger of the gods.

While there is ample scientific information on the causes of climate variability and change, adaptation strategies will be more sustainable if local knowledge and perceptions are understood and embedded in such strategies. It is true that perceptions are not always factual or correct, and can lead to false assumptions (Malmin, 2016). Nevertheless, they are crucial ingredients in developing mental models, and parading subsequent actions and reactions of actors.

On the basis of our results we therefore recommend that future strategies to deal with alterations in climatic factors especially in developing countries should build on the already existing local knowledge

and perceptions. However, research should continue to assess to what extent community based knowledge and processes could contribute meaningfully in building adaptation or resilience in such communities, rather than considering local knowledge and perceptions as irrevocable panaceas for dealing with climate variability effects in developing countries. Knowledge and perceptions to climate variability should be applied for prevention, mitigation, adaptation and resilience building against climate oscillations on a case by case basis.

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