Climate Change and Rural Livelihoods in the Lawra District of Ghana. A Qualitative Based Study

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Abstract

Climate change is a growing threat to the world's poorest and most vulnerable living in rural areas. The impacts of climate change challenge efforts to reducing poverty and hence, will require new approaches to focus development programming on the changing realities of the world. Understanding how the impacts of climate change affect the people, and their knowledge and experience in coping with it will assist in identifying appropriate strategies for adaptation to it. This paper thus examined the impacts of climate change on livelihoods of rural communities in the Upper West region of Ghana and the challenges posed to efforts at reducing poverty in the area. Discussions on vulnerability to climate variability and adaptation issues in this paper focused on evidence observed by 10 communities in the Lawra District. Adopting a qualitative approach, ten focused group discussions were organized to gather data. Specific issues discussed surrounded evidence of climate change in the communities, its impacts, underlying causes of vulnerability to climate and coping strategies employed by community members. Based on the discussions, the paper recommends the need to develop and intensify effective institutional mechanisms to facilitate community adaptation measures, awareness raising (creation) on anti-environments practices in communities, institution of bye and customary laws to regulate human anti-environmental activities, and the implementation of adaptation projects to aid communities cope with the major impacts of climate change in the district and world at large.

Keywords: Climate Change, Climate Variability, Adaptation, Effects, Rural Livelihood, Sustainability

Introduction

Climate plays a significant role in shaping natural ecosystems, human economies, and cultures in many ways. However, human activities and other natural occurrences influence climatic conditions over time (Moss, et al., 2010: Karl & Trenberth, 2003). According to Oppenheimer & Petsonk (2005), there is growing concern on how climatic conditions are being affected by human activities globally as evidence of abnormal behavior patterns of climatic conditions have become obvious. This has made it difficult for humans to predict future conditions using the past as the past is no longer a reliable predictor of the future, hence climatic conditions have become increasingly unpredictable (Department of Ecology, State of Washington, 2015).

Climate is rapidly changing with disruptive impacts in many ways in all parts of the world (Karl & Trenberth, 2003: International Panel on Climate Change (IPCC, 2007a: 2012). The changes being experienced appear faster than any seen in the last 2,000 years (Department of Ecology, State of Washington, 2015). Climate change and variability thus present additional obstacles to ending poverty and improving standards of living (Ministry of Environment, Science, Technology and Innovation, Republic of Ghana, 2013: Ayers & Huq, 2009; Boyd et al., 2009). Karl & Trenberth (2003) describe climate change as a global issue which may prove to be humanity's greatest challenge. This could be true considering its significant consequences to livelihoods of many people around the world (Badjeck, et al., 2010: Boyd et al., 2009: McMichael et al., 2007: Parry et. al., 2005).

Although climate change is a global phenomenon, its effects and impacts on people are varied across different parts of the world, with the developing world being much exposed (Adger et al., 2003). In developing countries, a greater proportion of people engages in livelihood activities pertaining to primary production, making the impact of climate change more intense than in developed areas where secondary activities dominate (IPCC, 2007: 2012). Besides, a greater proportion of peoples' livelihoods in the developing world is predominantly dependent on natural resources, which predisposes them to the negative impact of climate change (Mawunya and Adiku, 2013; Ministry of Environment, Science, Technology and Innovation, Republic of Ghana, 2013). In Africa, climate change is a major challenge and a threat to agricultural livelihoods (Aniah et al., 2014: Schlenker & Lobell, 2010: Nelson et al., 2009: Challinor et al., 2007) and food security of many rural people living in the region (Akudugu et al., 2012: Food and Agriculture Organization, 2008: Jones & Thornton, 2003). Agriculture is the

most vulnerable sector to climate change (Challinor et al., 2007: Dube and Phiri, 2013) due to the sensitivity of its activities to weather (Lyimo and Kangalawe, 2010) and because people engaged in it tend to be poorer compared with other sectors (De Janvry & Sadoulet, 2010: Bezemer & Headey, 2008).

Lyimo and Kangalawe, (2010) further stress that; climate change is making life more difficult for rural people as a result of the natural-resource dependent nature of their livelihoods. In fact, climate change has become a hindrance to the sustainability of many rural livelihoods (Akudugu et al., 2012: Gyampoh, 2009: Mertz, 2009). The declining amounts of rainfall, rising sea level, melting glaciers, the unpredictability of incidence and duration of agro-seasons and rains (IPCC, 2007a: 2012) resulting from rising temperatures and variation of rainfall patterns threaten rural livelihoods in many ways (Hulme et. al., 2001; Gyampoh, 2009). This is particularly true considering the fact that climate change alters the physical geography of areas leading to a disappearance of flora and fauna and other natural habitats that constitute the core supporting framework of rural livelihoods. The situation is worsened by the fact that the rural poor have limited capacity to adapt to the change (Smit and Pilifosova, 2003).

Rural people, despite their limited capacities, usually strive to have sustainable and secure livelihoods by adopting various means to adapt (Paavola, 2008: Smit & Pilifosova, 2003). The common strategies related to rural agricultural livelihoods have been diversification of activities, intensification, delaying of planting time, early planting, and the use of resistant seeds in some areas among many others (Aniah et al., 2014: Kangalawe & Lyimo, 2013). However, literature has noted that not all strategies adopted to cope with climate change are friendly as some go further to worsen the livelihood situation of the people. This is evident in strategies such as intensification of “anti-environmental” practices including deforestation and bushfires, and other agricultural practices including slash-and-burn, shifting cultivation and chemical usage in many parts of the world (Adomako and Ampadu, 2015). These practices continue to threaten and worsen the condition of the environment, undermining sustainability; hence threatening the security of rural livelihoods. Adoption of bad practices worsens the situations as it contributes to factors which further induce climate change and worsen livelihood situation of rural people (Adomako and Ampadu, 2015: Akudugu et. al., 2012).

The complex relationship between climate change and rural livelihoods needs to be further explored. Literature in this regard is enormous; however, there is the need to continuously explore this area due to the diversity of relationships between the two in many parts of the world. Besides, how climate change manifests in nature vary in different parts of the

world (IPCC, 2007a: 2012) and the ways it affects livelihoods, as well as, how people cope with its impacts also vary in in different areas (Anniah et. al., 2014: Harley et al. 2008: Smit & Pilifosova, 2003) as they depend on many context-specific factors. This means that effects of climate change on the livelihood of people are not uniform, hence, are more diverse and context-specific in many parts of the world. Understanding these context-specific effects of climate change on rural livelihoods and how people cope with them is important in devising appropriate measures towards solving problems it poses to different groups of people and activities.

This paper, therefore, examines how climate change threatens the sustainability of rural livelihoods in the context of Lawra District in the Upper West region of Ghana. The study examines the context-specific manifestations of climate change in the District, how they affect livelihoods of rural people (communities), indigenous coping strategies being adopted and what makes people and livelihoods vulnerable to the effects of climate change in the area. The study moves in the direction of this inquiry with the aim of making inputs into local level decision making and policy that ensures rural livelihoods become secure amid climate change and variability.

Climate Change, Adaptation, and Coping in Local Context

In everyday life, climate plays important role in shaping natural ecosystems, human economies, and cultures which all depend on its elements in diverse ways. However, Department of Ecology, State of Washington (2015) notes that current state of various climatic elements is not what it used to be, and hence the past is no longer a reliable predictor of future occurrences. This points to change and variability in climatic elements. The climate of the world is changing as evident in the variability of various climatic elements in recent times. Climate change is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods (Smit and Pilifosova, 2003). Though efforts have been made to distinguish climate change and variability, this study uses the two terms interchangeable to describe both the long term and short term uncertainty of climatic elements induced naturally or through human interactions with nature.

Evidence of climate change and variability are rift in both global and local contexts around the world. Rising global temperatures by 2^0 C every decade (Hinzman, et al., 2005), rise in sea level of about 19 cm globally since the 1990s-continuous decline of artic ice of about 4% per decade since the 1970s and many other have been cited as evidence of climate change at the global scale (Parry, 2007). Similar evidence ranging from rising temperatures, unpredictable rainfall and wind patterns among others have

been cited in various local contexts including Ghana and Northern Ghana to be specific (See Ministry of Environment, Science, Technology and Innovation, Republic of Ghana, 2013). The issue of climate change and variability has become evident at both the global and local context that it is no more a question of its occurrence, but of its magnitude, effects, and ability of humanity to cope or adapt to it.

Climate change and variability have had devastating effects on local actors (IPCC, 2007b), prompting conscious efforts to adapt to this phenomenon. At the local level, responses depend very much on the kind of climate impacts to be expected. The responses can consist of reducing exposure to the hazards or raising the adaptive capacity and/or reducing climate vulnerability. In the context of land-use management, measures could include water-harvesting techniques and erosion protection such as dikes and water pans, but also improved irrigation systems or more drought- or salt-tolerant crop varieties (Agrawal et al., 2008). They could also include integrating trees into agricultural systems because trees have many features that can help reduce vulnerability to climate impacts. Summarizing local strategies, Agrawal et al., (2008), classified efforts identified in 118 case studies into seven main classes with diversification being the dominant one (See Table 1).

Table 1: Classes of Rural Adaptation Practices

Class of Adaptation	Strategies
Mobility	Agropastoral migration Wage labor migration Involuntary migration
Storage	Water storage Food storage Animal live storage Pest control
Diversification	Asset portfolio diversification Skills and occupational training Occupational diversification Crop choices Production technologies Consumption choices Animal breeding
Communal Pooling	Forestry Infrastructure development Information gathering Disaster preparation
Market Exchange	Improved market access Insurance provision New product sales Seeds, animal, and other input purchases

Source: Adapted from Agrawal et al., (2008)

From the works of Neufeldt, H., et al., (2011), adaptation to climate change is conceptualized as a continuum with activities ranging from a

vulnerability focus that addresses the underlying drivers of vulnerability to a more impact-oriented focus that includes measures or actions that reduce the impacts of climate change (such as dikes or irrigation measures), (Neufeldt, et al., 2011). Adaptation also includes reducing and transferring risks, as well as building the capacity of people to make such changes in the future. Learning is an important aspect as it is required to respond to climate stimuli with the right measures or actions (Stern, 2006, Neufeldt, et al., 2011). While the need for adaptation is clear, implementing adaptation in practice is complex because there is disagreement on where, how and when to act as the incident varies in the local context (Hulme 2009). To be effective, adaptation strategies for rural livelihoods need to be robust in the face of considerable and often unquantifiable uncertainties (Fraser, 2007; Hulme 2009; Neufeldt, et al., 2011). In the local context, diversity can reduce vulnerability and can also enhance other aspects of adaptive capacity as it maintains options for change in livelihoods (Neufeldt, et al., 2011). The adaptive capacity and resource base for adaptation are influenced by human and social capital as well as peoples' assets in the community in which they live, the ecological resilience (or sensitivity) of the natural capital and the presence/absence of appropriate laws and institutions (Bryant et al., 2000; Reilly and Schimmelpfennig, 2000). Hence, involving all stakeholders, appropriate monitoring and enforcement are paramount to developing appropriate adaptation strategies at local level. Also, as climate impacts are mostly experienced locally, responses must also be tailored to match the needs at the scale and time of the impact and not to be designed in a 'one size fits all' manner (Agrawal et al., 2008). Effective adaptation also requires different approaches within a comprehensive and integrated framework, where bottom-up meets top-down at international, regional, national, sub-national and community levels and where public and private sectors collaborate to achieve emission reduction and economic growth (Smit & Pilifosova, 2003). This can also be realized when evidence of climate change and variability, effects on local activities, and local efforts to adapt in various contexts are examined. This will provide important inputs in designing context-specific strategies to promote rural development in the face of climate change induced adversities.

Study setting and methodology

The study is situated within the Lawra District of Upper West Region of Ghana (the poorest region of the country). The District forms one of the eleven Municipal and District Assemblies in the region. The District has a total land area of about 527.37 square kilometers, lying between Latitude 10^{o} 35^{o}- 10^{o} 40 North and 2^{o}50-2^{o}50-2^{o}53 West. Lawra district is bounded by Nandom District to the North, Lambussie-Karni District to the East, and to

the southwest and west by the Republic of Burkina Faso (Ghana Statistical Service, 2014) (See Figure 1). The strategic location of Lawra as a border district between Ghana and neighboring Burkina Faso makes it open to cross-country livelihood activities.

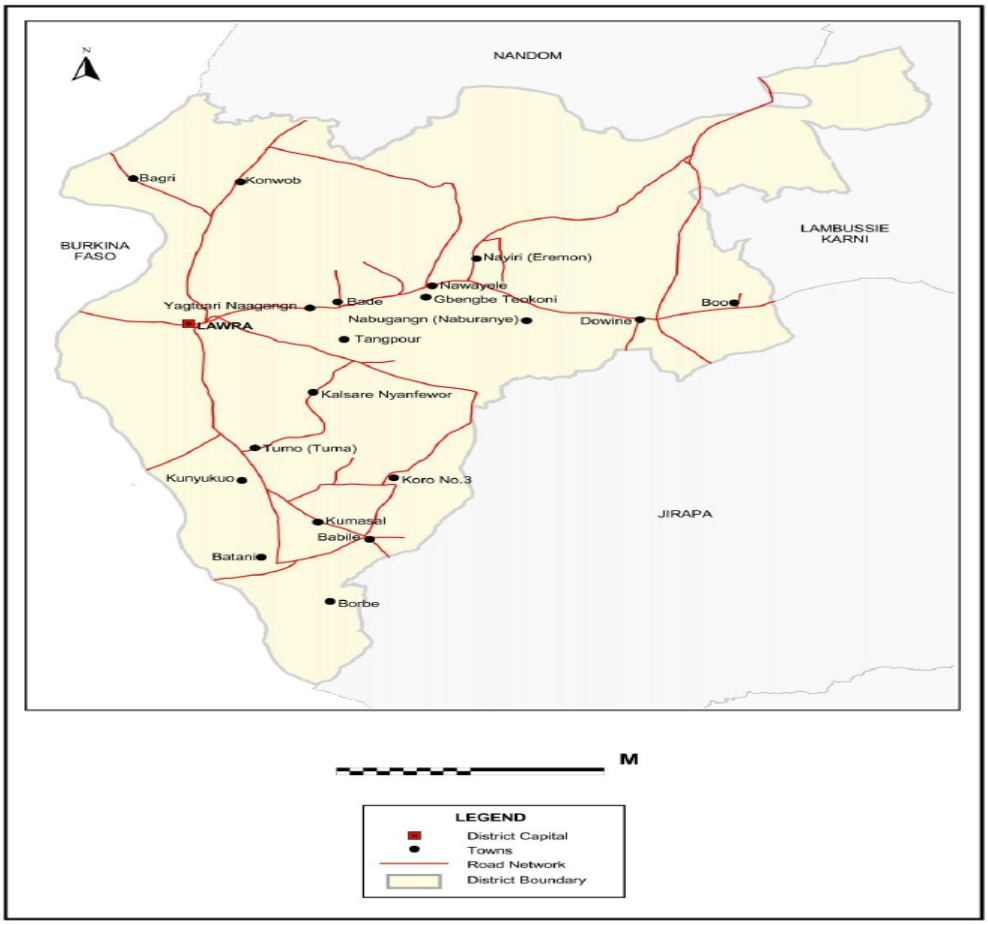

Figure 1 Map of Lawra District Source: Ghana Statistical Service, 2014

By the District's location, it experiences the tropical continental type of climate with mean annual temperature ranging between 27°C and 36°C. This makes the period between February and April the hottest in the area. According to Ghana Statistical Service (2014), there has been evidence of climate change in the area of late, affecting weather patterns. This makes the Tropical Maritime air mass now blowing over the area between April and October, which gives the only wet season in the year. In the aspect of vegetation, the district lies within the Guinea Savannah Zone characterized by short grasses and few woody plants which across in a scanty nature. The vegetation is also very congenial for agricultural activities including farming

and livestock production, which contributes significantly to household incomes in the area.

The thriving nature of agriculture in the district explains why about 82.4 percent are engaged in unskilled agricultural, forestry and fishery works. This is not surprising as the District is predominantly rural (88.2 percent), and agriculture forms the foundation of these people. Agriculture in the area is mostly on small scale basis; about 80.0 percent of the farmers are into subsistence agriculture, producing mainly maize, millet, groundnuts, soya bean and cowpea (Ghana Statistical Service, 2014). People also engage in animal production as a major agricultural activity to supplement other livelihood activities. Generally, livelihoods of rural people in the District revolve round agricultural related activities. The nexus of climate to these livelihood activities thus provided the foundations for this research.

The research adopted a qualitative case study approach. This approach allows researchers to investigate a contemporary phenomenon, such as climate change within its real-life context (Yin, 1994, 2003). In terms of its epistemological stance, qualitative design underpinned by interpretive paradigm is used. Data was collected mainly from key informants and community groups using key informant interviews and focused group discussions respectively. Ten focus group discussions were held in ten selected rural communities in the District. The groups included chiefs and elders, farmers, men, and leaders of women's groups. Each group was expected to identify and share their experiences on how climate change is affecting livelihoods in their respective communities and how vulnerable they are to it. The ten communities were selected because Care International (CI), Nandom Agricultural Project (NAP) and MOFA have identified climate change to be a critical challenge to livelihoods in them and hence, were intervening in these communities to mitigate the impact of the change. Information was also collected from government institutions like District Assembly and Ministry of Food and Agriculture to supplement community level responses. A total of 263 people participated in the ten communities selected. Data collected was collated and analyzed through drawing general themes from discussions after it was transcribed and uploaded into NVivo. Responses from communities were summarized into broad themes using NVivo and presented in tables to achieve the objectives of the study.

Results and discussion

Results are presented and discussed in line with general thematic objectives of the research. The results confer and explain evidence of climate change in the communities; how climate change affects livelihoods of the people; how they cope with the effects; and what makes them vulnerable to the effects of the change.

Evidence of Climate Change in Communities

The matter that the climate of the world is changing is no longer subject to debate as several studies conducted by researchers confirm the phenomenon (See Parry, 2007: Hinzman et al., 2005: Kaser et al., 2004: Walther et al., 2002). Climate change has, therefore, become an obvious phenomenon in all parts of the world as researches have revealed its manifestations in both the pure and applied sciences (IPCC, 2012). In fact, climate change has been proven by its various manifestations and accompanying effects and impacts on human activities. On the broader scale, growing abnormalities of various weather events have shown evidence of climate change and variability. This includes changes in rainfall, temperature, humidity and other consequential happenings like rising sea levels, melting ice and glaciers, flooding, droughts, the disappearance of plant and animal species and many others (Jones et al., 2007: Parmesan, 2006). Though studies have noted all these numerous evidences of climate change, the need for context-specific manifestations is still necessary considering the diversity of this contemporary phenomenon. Therefore, the research examined how climate change manifests to the rural people in the Lawra District. Local people were therefore asked to explain some of the evidence of climate change as observed in their daily lives and activities (See Table 1).

Table 1: Manifestations of Climate Change in the Lawra District of Ghana

Community	Evidence of climate change
Zedung and Walaateng	Changing patterns of rainfall, the shift in the seasons and early drying of open water sources were reported as evidence which points to the fact that the climate of the area is changing. In the view of the people, there is marked shift in the time that the rains use to start coming some time ago. The rains have not only become erratic but also very unpredictable for some years now. Water bodies in the area are drying up, indicating reduction in rainfall and high temperatures. Besides, intermittent droughts and flooding in the area and surrounding villages is becoming an annual ritual in recent times.
Taayaga	The community identified shortening of the rainy season, its variability in intensity and amount coupled with the drying up of surrounding water bodies, intermittent heat and cold, and the frequent floods and droughts as some evidence of a changing climate situation in the village. They argued that, though these occurrences have been with them for more than decade, the situation has become worse in the four years.
Segru	Respondents noted that, in recent times, temperatures have been very hot between February – April and very cold with heavy winds between November –January. Also, rainfall pattern is erratic and is observed between June – October. Community members noted that they never know when the rains come again as against previous times when they could predict and plan towards it.
Nabugangn and Betaglo	Like other communities, evidence of climate change is also rife in Nabugangn and Betaglo villages. From the discussions, it was clear that the rainy seasons have become not only shorter in duration, but also the pattern is erratic and continues to be less and less predictable. Water bodies dry up shortly after rainy season. There are intermittent droughts and flooding, with varying annual degrees experienced in the last four years.

Kokoligu and Bulegangn	The communities experience climate variability issues which include shorter rainfall from May to October, long periods of droughts in between rains, and floods follow sudden torrential rains in almost all years in recent times. Respondents also noted that temperatures in the area have been extremely high in the past five years and people find it difficult living in the communities during the dry season.
Goziir and Danko	In these communities, respondents noted changes in the weather and rainfall pattern over the years. The main changes observed include shorter and erratic rainfall pattern in the rainy season, sudden torrential rains which normally result in flooding, droughts, and drying up of ponds and streams during the dry season. To them, these occurrences have shown clearly that the present has been different from the past, indicating evidence of changes in the climate.

Changing patterns of rainfall, shift in the seasons and early drying up of open water sources were reported by communities as some of the evidence which to them point to the fact that the climate of the area is changing. In the views of the people, there is marked shift in the time that the rains used to start coming some time ago. Respondents noted that the rains have not only become erratic but also very unpredictable for agricultural planning purposes. Also, drying up of water sources soon after the rainy season imposes a big challenge to households and on the prospects of livestock development. The study also revealed that, in recent times, the intermittent droughts and flooding in the area and surrounding villages is becoming an annual ritual. In addition, community members in Segru complained that the weather is very hot between February – April and very cold with heavy winds between November – January. To these people, that was not the case when they were growing up as children. Hence, there is evidence that the climate of the area is changing with time.

Generally, the study revealed various evidence of climate change as noted by local people including changing rainfall patterns, early drying up of water bodies, intermittent droughts, annual flooding, hot temperatures and cold winds at certain times of the year. This confirms earlier findings of evidence of climate change from the perspectives of local people as noted by others writers (See Anniah, et. al., 2014: Lyimo and Kangalawe, 2010: Gyampoh, 2009). This shows that climate change is obvious to everybody right from the global scale to the very root of society where the poor farmer can easily see it from his/her daily life. This also reveals that there is much difference in terms of how climate change has been explained at the global and national scales (See IPCC, 2003: 2007: 2012), and how it manifests at the local level.

Climate Change Impact on Communities

Climate change affects people in many ways. This is particularly true for rural people who are more vulnerable to its manifestations due to their conditions. The study thus assessed how climate change has been impacting on the lives of rural people in the Lawra District. The study revealed that

climate change affects rural livelihoods from various dimensions. Participants in the study lamented how their lives have been made difficult in so many ways by changing elements of climate. Some respondents noted that climate change has dealt a blow at the very roots which support their livelihoods, leaving them with no option but to adjust in hard ways. Though different focused groups were conducted, responses from communities all pointed to the damming effect of climate change on rural communities which affects livelihoods in diverse ways (See Table 2).

Table 2: Effects of Climate Change on Rural Communities

Community	Climate Change Impact
Zedung and Betaglo,	Drying up of water sources and vegetation soon after the rainy season imposes a big challenge on the prospects of livestock development in these communities. Also, intermittent droughts and flooding in the areas and surrounding villages hamper farming activities by reducing crop yields. According to some, their farm yields have almost reduced by more than half in the last seven years. The soils have become infertile and high temperatures usually kill crops. The situation is worsening by the long droughts experienced between rains which sometimes necessitate some replanting.
Walaateng and Bulegangn	In these communities, the effects of the frequently changing weather conditions, sometimes very severe, are being felt in the health conditions of the people as people find it difficult to cope with sudden and extreme condition. This leads to diseases like CSM which respondents noted have become common in the area. Respondent also noted that frequently changing weather affects livestock in the area and have made that livelihood activity unattractive. To them, climate change has taken a toll in general farming activities as crops continue to fail years in year out.
Taayaga	Cumulatively, climate change manifestation in the community results in low farm output and hence farmers incur huge debts. Extreme hot weather condition and floods (stagnant water) in the community increase cost of health care due to high prevalence of diseases such as malaria, diarrhea, pneumonia, CSM, etc. The occasional floods and stormy weather sometimes result in destruction of housing property and the already poor road network.
Segru	The community experiences disasters such as drought and floods, contributing to the destruction of farm lands and crops, and also the collapse of human dwellings. These events have impacted on the community's livelihoods activities by leading to poor yields, food insecurity (hunger), loss of property and infrastructure etc.
Nabugangn	In this community, food production has generally suffered the impacts of climate variability. Most farmers lose their crops due to intermittent rainfalls within the rainy season. There are accompanying health threats like extremely high daily temperatures and cold condition at night and early morning which have been a worry for the people. Malaria cases and cholera outbreak continue to remain a challenge, for which they attribute to stagnation of water resulting from climate change (floods). Sometimes, houses and property are destroyed by heavy rains and storms which have greeted the community in the past eight years.
Kokoligu	Community members noted that climate change events have impacted on their livelihoods activities. Changes in rainfall patterns have resulted in poor/ or low yields resulting in food insecurity (hunger) during the long dry period. Torrential rains also flood in community leading to loss of property and infrastructure etc. Vegetation completely dries up and burnt during the dry season, hampering livestock production in the area.
Goiir and Danko	Food crop yields are dwindling in these communities. Women, livestock producers, and some animals travel long distances in search of water during droughts. This usually results in some animals either being stolen or dies out of thirst and starvation. Floods also wash away crops, roads, and culverts. During the floods, outbreaks of diseases such as cholera, malaria, pneumonia etc are common.

In many communities, intermittent droughts and flooding were reported. Local people noted that these occurrences continue to hamper the prospects of agriculture and food security in the area (Akudugu et al., 2012: Jones & Thornton, 2003). Explaining this, local people mentioned that, intermittent droughts hamper output levels as this sometimes happens after the first rains arrive and they plant. To them, the first rains now come like a deceiver or to fraudster farmers to plant only for long periods of droughts to follow, killing their crops which barely mature before then. To worsen the situation, the rains arrive heavily afterward in some years, thereby destroying their crops. Local people lamented that what they experience now has become a great disincentive for them to farm. This confirms the assertion that climate change is a challenge to agriculture (Aniah et al., 2014: Schlenker & Lobell, 2010), especially in the developing world where there is limited capacity to cope (Smit and Pilifosova., 2003).

Respondents also noted that the effects of the frequently changing weather conditions, sometimes very severe, are also being felt in the health conditions of the people as reported in Wantagh, Bulegangn, Goziir, Danko, Nabugangn, and most of the communities. This is because people find it difficult to cope with sudden change and extreme weather conditions. Cumulatively, this leads to increasing cost of health care due to high prevalence of diseases such as malaria, diarrhea, and CSM in the rural communities. This means that climate change does not affect the core of rural livelihoods by altering weather, but also impacts negatively on the health status of the people. Hence, climate change poses a threat to health conditions of people (Roser-Renouf et al., 2016: Lugsdin & Hook, 2016: Costello et al., 2009: McMichael, et al., 2007) Therefore, climate change not only affects livelihoods of rural people, but also a detrimental effect on their health. The inference to draw from this finding is that climate change does not only affect livelihood assets and activities of rural people but also short-chains their capability to actively participate and a have sustainable livelihood.

The study also revealed that stormy rains (due to bareness nature of vegetation to act as windbreak) and occasional floods sometimes result in destruction of property and the already poor road network. Not only does climate change affect household livelihoods, it also causes damage to public goods at the expense of authorities. The resources which could have been used for other development activities are used to provide aid to evictions of the rigors of climate change and to replace damaged public properties in the area. From this revelation, climate change hinders development of rural communities by negatively impacting on households, communities and even institution at both local and regional level. In explaining how climate change haunts almost all aspects of rural livelihoods and hinders development, a key

informant at Goziir summarized the impact of climate change as in a stamen captured as:

> *Because of climatic variations, food crop yields are dwindling in this community and in some areas, there are total crop failures. During the droughts, animals and women travel long distances in search of water. These usually result in animals either being stolen or die out of thirst and starvation. The floods also wash away crops, roads, and culverts. During floods outbreaks, diseases such as cholera, malaria, pneumonia etc. are common and during the hot season, we have CSM to contend with.*

Underlying Causes of Vulnerability to Climate Change

Communities in the Lawra District believed many factors underpinned their continuous vulnerability to climate change. Discussions with local people revealed that anti-environmental actions of people in the past and present are some of the underlying causes to their vulnerability. Community members believe that climate change is a result of the cumulative impacts of bad human activities towards the environment (See Table 3). To them, these actions make them more vulnerable to the rigors of climate change.

Table 3 Drivers of Vulnerability to Climate Change in Rural Area

Community	Drivers of Vulnerability to Climate Change
Zedung, Bulegangn, and Goiir	The people of Zedung Bulegangn and Goiir believe that climate change is a result of the cumulative impacts of bad human activities towards the environment such as cutting of trees for charcoal production and burning of the vegetation (bush fires). Consequently, the people are taking measures to mitigate the effects of climate change by planting trees and passing by-laws against bush burning, felling of trees and other environmentally harmful practices.
Walaateng, Betaglo, and Danko	In these communities, frequent bushfires, cutting down of trees and bad farming practices were identified as some of the causes of their livelihood vulnerability. They identified the lack of access to seedlings or plantlets for afforestation as a hindrance to the adaptive measures. People living near valleys are also being encouraged to build on hilly or highland areas. Also, fire volunteers serve as mouth piece for them in times of such crisis to sensitize people to stop burning.
Taayaga and Segru	Though Taayaga and Segru values include non-burning and felling of trees, the people blamed bushfires and deforestation as the underlying causes of their vulnerable to climate change.
Nabugangn, Kokoligu,	The communities disclosed that the underlying causes of their vulnerable were bush-burning and deforestation. Therefore, through CBEA concept, farmers were sensitized on the best practices that help in restoring the environment and ensure sustainability of agricultural systems. With assistance from partners such as Care International, NAP and MOFA, the communities hope to improve the conditions of the natural environment to reduce their vulnerability to climate change.

According to the communities, the difficulties they face now are as a result of anti-environmental actions of their ancestors and which the current generation is also doing. In all communities, deforestation was noted as one

of the underlying cause of vulnerability to climate change. Same could be said for bush burning which was mentioned in all communities. Respondents attributed these acts to the desperate need of the rural folks to protect and sustain their livelihoods at the time of climate change. Hence, resorting in all kind of activities which will help them have their livelihoods even in times environmental conditions have changed. This finding confirms the assertion by Adomako and Ampadu (2015) and Appiah, et al. (2014) that, climate change intensifies anti-environmental practices in many rural communities, which in turn make them more vulnerable to its effects. This also explains why human actions form an integral cause of climate change and variability, and even now seen as large enough to exceed natural induced variability (Parry, 2007). The relationship between human activities and climate change needs more attention from stakeholders. This explains why some rural communities like Zedung, Goiir, and others in the District have enacted by-laws to control deforestation and bush fires in the area.

Coping Strategies Employed by Community Members

The effects of climate change have been evident and damming to livelihoods of rural people. Considering the continuous effects, and the fact that climate change has come to stay with society, communities (rural people) must adapt to it. Rural people, therefore, use various mechanisms to cope with the changes in their livelihood activities and assets. In doing so, rural people in the Lawra District uses indigenous knowledge and practices as well modern technologies. The study revealed that, during adverse effects of climate change such as floods, drought, pest and disease outbreaks as well as destruction of shelter and infrastructure, affected people usually rely on available social networks systems indigenous to them to accommodate and cope with the effects (See Table 4).

Table 4 Coping Strategies Adopted in Rural Communities in the Lawra District

Community	Coping Strategies
Zedung and Walaateng	During adverse effects of climate change such as droughts, floods, crop failure, pest and disease outbreaks as well as destruction of shelter and infrastructure, they rely on available social networks systems indigenous to them to be able to accommodate and cope with the effects. In times of drought and crop failure, they reduce the number of meals per day to only one. Some migrate down south to labor for money to buy food. Sometimes, remittances from migrant relatives in salaried jobs come to assist overcome the situation.
Segru	The people adapt various methods to cope with the effects of climate change. These include relocating to higher lands within the community to avoid effects of floods which are common in the area. Some diversify their activities (from farming) to dawadawa processing, pito brewing, and extraction of shea butter whilst others migrate to the southern sector for jobs.
Nabugangn and Betaglo	Over the years, the people of Nabugang and Betaglo have lived and survived with the impacts of climate variability through various means. Generally, family support systems are still quite strong in the community. They aid each other in times of disaster and need. Some of the strategies that the people use to cope with climate change

	impacts include; Migration (both seasonal and long-term); Limiting the number of household meals per day; Non-agricultural activities to diversify livelihoods; Animal rearing and Remittance from migrant relatives.
Kokoligu	Farmers adopt coping mechanisms and strategies such as the planting of drought-resistant crops, early maturing crops and the diversification of livelihood activities including petty trading, pito brewing, processing of dawadawa and shea butter and dry season gardening using water from the dam.
Goiir	Farmers in Goziir through the support of Nandom Agricultural Project (NAP) and other stakeholders adapt the following strategies to cope with the situation. They plant early maturing crops, keep animals (including rabbit rearing) and birds as support systems. The youth also migrate down south to work and support family back home.
Danko and Taayaga	Because of the precarious food situation in Danko and Taayaga, certain coping strategies are employed to mitigate the impact, particularly during the lean season. These are Women harvest and process wild plant leaves and fruits for vegetables and food. Women engage in other non–farm income generating activities such as pito brewing, making cake (Koose), shea butter extraction, dawadawa processing among others to earn cash to buy food for the family Young men and women migrate down south to work and send food home. Sometimes, adult members of the household skip meals to allow only children to eat.
Bulegangn	Households in Bulegangn also employ several strategies to mitigate the impact of the lean season when their food stocks run out. Some of these strategies include engaging in non-agricultural livelihood activities such as dawadawa processing, pito brewing, and extraction of shea butter among others; harvesting and eating of wild fruits and leaves; out-migration by the youth to the South to work and send food and cash back home and skipping of some meals by adult members of households

Agrawal (2008) opines that the basic coping and adaptation strategies used by rural people can correspondingly be classified into a set of four analytical types: mobility, storage, diversification, and communal pooling. The study confirms this assertion as various coping strategies noted by respondents fell in line with the classifications. Respondents mentioned diverse strategies which are all aimed at ensuring livelihoods in rural areas are secure and sustainable.

In the aspect of mobility, respondents noted that, in the dry seasons, the youth usually move to other areas especially southern Ghana to engage in other activities. This is done to raise money to support families back home at the time of the climate change-induced long and intermittent droughts. In all ten communities studied mobility either in short or long terms formed an integral coping strategy adopted to ensure security and sustainability of the livelihoods in the period of climate change. This means that rural people use migration, by moving to areas of greener opportunities to reduce the effect of climate change on their lives (Lyimo and Kangalawe, 2010: Agrawal, 2008: Paavola, 2008). Respondents, however, noted that, even though this coping strategy have worked over years, those who migrate down south many at times return home with strange diseases only to die.

Rural people in the Lawra District also use diversification as a major coping strategy. This involved diversifying livelihood activities, assets, and

household diets. The study revealed that rural people in the area diversify by moving into non-farm activities like trading, pito brewing, processing of "dawadawa" and shea butter among others as ways of sustaining their lives. Diversification of rural livelihoods, especially moving into non-farm activities has become common in almost all parts of the world (See Van Aelst & Holvoet, 2016: Dumenu & Obeng, 2016: Shisanya & Mafongoya, 2016: Lei et al., 2016). This is a viable option of sustaining rural livelihoods, reducing poverty, and propelling general development in remote areas. Also, households diversify their diets by relying on wild fruits and leaves. Respondents, however, noted that relying on wild fruits have not been a viable strategy in recent times since most of these trees are going extinct.

Other strategies like communal pooling and agriculture-related changes such as early planting, use of resistant varieties and others were recorded. What was also evident among rural people in the area is sacrifice. In all communities, sacrifice formed an integral coping strategy in times of climate change. Sacrifice manifest in adult members skipping meals and reducing amount of food consumed just to sustain households. To the rural person, climate change has come to stay with them, and they have to use all means possible to cope even to the point of sacrifices.

Conclusion and way forward

The climate of the world is changing, and this is happening at a fast pace today. The phenomenon has become part of the human society and must be accepted as so. What must be noted is the fact that climate change is a continuous process that will forever impact on human societies. Though measures needed to reduce its rate are evident everywhere, the phenomenon will continue to exist. Studies have shown that the phenomenon is no friend, and must be treated as so. This is because; climate change is a hindrance and a challenge to the sustainability and security of human livelihoods, especially among rural people. Its impacts are very much unfriendly to rural livelihoods as it destroys the very core supporting frameworks upon which these livelihoods are built upon. More so, the study has revealed that rural people in their quest to survive contribute to their own vulnerability. Efforts must, therefore, be made to minimize its effects on rural people, and by so doing, sustainable and secure livelihoods will be built. Measures must span from the macro to micro levels of society where the household and the individual also have roles to play. Minimizing the effects of climate change on rural livelihoods can be achieved through implementation of comprehensive mechanism that acknowledges the complexities of both rural livelihoods and climate change. This can be realized through the following mechanisms.

Integrating Education into Climate Change and Variability Interventions

Awareness and knowledge are critical in dealing with any problem. This explains why capacity building has received much attention in international development efforts in the last decade. It is therefore recommended that rural education is an integral component of climate change interventions. This should go beyond the usual school building and supply of learning materials to rural school. Interventions in this direction must target the both old and the young, with education programs organized for adults in rural areas to help improve knowledge and awareness about climate change. In this regard, NGOs, government, and philanthropists should design adult literacy programs as sub-components of broader interventions to help cope with climate change. This can be done in collaboration with various non-formal education units usually found at the local level. Particularly, education programs should include basic numeracy, reading, and writing skills which could help rural people, especially adults, better understand modern technologies to facilitate livelihood activities. When such education programs are organized and adults gain literacy skills, they will be able to cope well by learning to practice modern farming practices through reading instructions. Improving numeracy and other management skills of rural people will also help rural people better manage livelihood activities in ways that would make them sustainable. Education of rural people should, therefore, be given attention by all stakeholders of climate change.

Rural Livelihood Supports

The need to support rural livelihoods activities is more urgent now than ever. Limited access to material support for largely agricultural dependent rural livelihood activities makes it difficult for livelihoods to survive rigors of climate change. Livelihood assets and capabilities of rural people need an uplift through external support, that should include help with fertilizers, tractors, harvesters, pesticides, and other modern technological advancement which could enhance productivity among rural people. Providing these important inputs will go a long way to help facilitate the ability of rural households to have secured livelihoods. Thus, governments, NGOs and other actors interested in rural livelihoods must take conscious efforts to build capacity for sustainable livelihoods by either directly providing supports or facilitating access to both agricultural and non-agricultural livelihood inputs among rural people. When livelihood supports in the form of livelihood inputs are made accessible, in both physical and financial terms, rural people will be able to make use of that to offset negative impacts of climate change on livelihoods. This also has the potential to

facilitate diversification of rural livelihoods because it could help facilitate preparedness towards non-farm rural livelihood activities.

Control of Anti-Environmental Practices of Rural People

The study revealed that practices adopted by rural people to cope with climate change tends to undermine environment, thus further worsening the situation which threatens rural livelihoods. It is therefore recommended that conscious efforts be made control some of these practices that tend to worsen the situation. This should be a responsibility taken by actors from the grassroots to higher levels climate change action. At the community level, rural households must themselves be cautious of the kind of practices and methods they use in their efforts to cope with climate change. This will help reduce destruction of the environment which further threatens their ability to cope with climate change. Communities and local authorities must also institute by-laws aimed at curbing these bad practices. With this, deterrent fines and sanctions must be kept in place to punish culprits of bad practices within rural communities. Various NGOs working to sustain rural livelihoods should also educate rural people on the effects of such bad practices and alternative ways to which they can achieve higher outputs in the face of climate change. When all these measures are kept in place, the effects of climate change on the environment on which rural agricultural livelihoods depend on will be protected. This will go a long way to minimizing the effects of climate change on rural livelihoods, hence, ensuring security of rural people.

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