Understanding the Causes and Threats of Climate Change in Rural Ghana: Perspectives of Smallholder Farmers

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Available at http://www.ssrn.com/link/OIDA-Intl-Journal-Sustainable-Dev.html
ISSN 1923-6654 (print) ISSN 1923-6662 (online).
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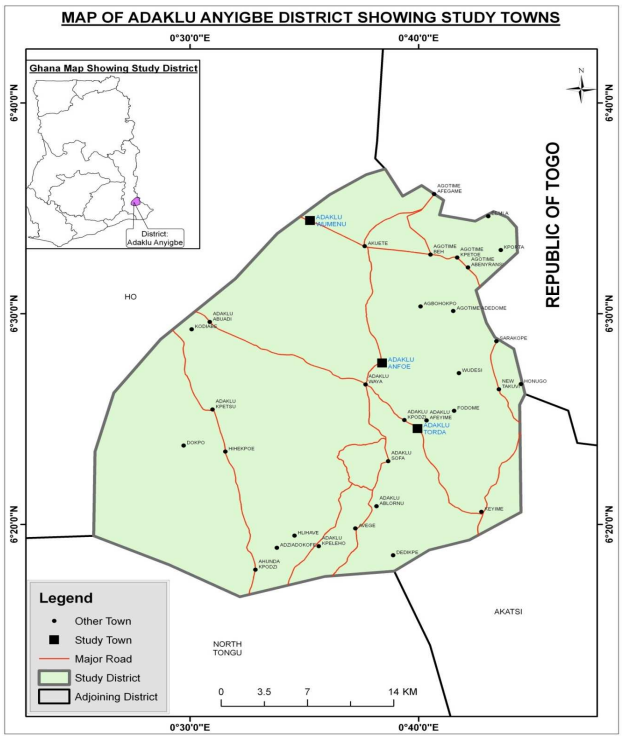
Abstract: This study examines the views of smallholder farmers about the causes of climate change, the effects of human activities on the climate and its implications for farming and livelihoods in three villages in the Adaklu District of the Volta region of rural Ghana. Data were collected from a purposively selected key informants who participated in a carefully organized focused group discussions and semi-structured in-depth interviews. The study participants were drawn from three case study villages of Anfoe, Torda and Wumenu in the Adaklu District. A total of nineteen (19) of smallholder farmers took part in the group interviews. The semi-structured in-depth interviews were conducted with two key informants who serve as agricultural extension services providers in the district. The study found that smallholder farmers are aware of warmer temperatures and rainfall patterns. The famer groups reported that activities of the farming communities are responsible in various ways for the observed weather changes especially regarding unreliability and unpredictability of the rainfall, intensity and prolonged duration of the dry season. Study participants (.i.e. smallholder farmers) identified charcoal burning, tree-felling, shifting cultivation, slash and burn farming method and indiscriminate bush burning for purposes of hunting and tradition as potential triggers of the changes in the weather conditions. Majority of interviewees believed that there is a link between the coping economic activities of farmers and the weather problem. According to them, embracing mixed-farming methods and livelihood diversification is helping to adapt and cope with the changing weather condition. The smallholder farmers reported that there has not been any education or support service from the local government and/or public institutions aimed to help them cope with the effects of climate change. The study findings support earlier studies which found that climate change and its causes are anthropogenic and directly linked to social and economic activities of humans wherever they live, including small holder farmers. National and local governments would have to device strategies to support farming communities in the form education, construction of dams for all year round farming and introduce them to sustainable alternative livelihood options to help improve adaptive and coping capacity of vulnerable smallholder farmers.
Keywords: climate change; causes; Ghana; perceptions; threats; smallholder rural farmers

Introduction

Since the 1990s, climate change has increasingly been recognized as one of the world's most threatening environmental issues. Poor communities and economies depending on climate sensitive resources such as agriculture are especially vulnerable to climate change (IPCC, 2007).Though Ghana has attained a lower middle level status, its future development is at risk. This is because greater part of the economy still depends on the climate induced sectors such as forestry and energy with the most affected being agriculture. Today, the increasing concern expressed in most literature focuses on how global climate change is introducing new conditions of life to people all over the world. The most fascinating thing to know is that climate change has the potential to bring new but varying events to people across space and time; they bring unequal effects to major ecosystems across the globe which in turn brings variations in the impact of climate change on the livelihood of the people that largely depend on these resources. Experts have predicted future consequences of the changing climate using climate models that reveal that climate change will affect agriculture mostly in Africa, which has a greater portion of its land as being arid and semi-arid and have suggested some adaptive strategies. In line with the environmental problems associated with developing countries, standardized solutions have been proposed. Proponents of these solutions believe that

these solutions are embedded in "developmental environmental narratives" (Roe, 1991) or what is termed "received wisdoms" (Leach & Mearns, 1996). Knowledge of this nature and of such origins are only based on assumptions aimed at formulating policies to intervene in a given situation and could even leave the situation worse than before. According to Roe (1991), developmental environmental narratives are like stories which has a beginning, a middle and an end and if cast in the form of an argument has premises and a conclusion. An important feature about them is their persistent nature even if their validity is in question and the ability of their listeners to do something about them or believe them is in doubt. Discussions still continues and as stated, Africa being a developing continent is predicted to suffer more from the changing climate. As it is, Africa's rural folk population, which has a preponderance of peasant farmers are going to become poorer should their crops fail due to prolonged drought and inconsistent or intense rainfall. Most farms in Africa are rain fed and the probability that the majority of these rural folk are unaware of the causes of the changing climate is rather high. According to the IPCC, (2001), climate change is mainly caused by anthropogenic activities such as bad farming practices, deforestation for the purpose of timber and biofuel such as charcoal production and firewood for domestic use as well as other land used changes and industrialization. It is argued that climate change is affecting rural livelihoods. However, only a little is known and documented about the way in which the socio-economic and cultural activity of rural people also contributes to the observed changes in the climate. Specifically, there has been a gap in the empirical literature about the effects of rural activities and its impacts on the variations in rainfall pattern most especially. Though developing countries contribute less, their emissions will gradually grow to meet their developmental and social needs, (UNFCCC, 1992). There is therefore the need to investigate local farmers' understanding of the environment and climate, and the relevance of natural resources like trees to climate and carbon dioxide sequestration so that prevents dangerous anthropogenic gases from interfering with the climate by stabilizing their emissions. A holistic approach therefore is needed in order to fill that gap in the literature hence looking at three case villages in the Adaklu District of the Volta Region. To do this the study tried to answer the following question from the perspectives of smallholder rural farmers: (a) what do smallholder farmers understand by climate change?; (b) what do smallholder farmers know about the causes of climate change (resulting from their activities) and its effects on their economic activities (farming)?; (c) what are the effects of climate change are on the livelihood of smallholder farmers?; and, (d) what are the coping strategies being adopted by small holder farmer in response to climate change?

Methodology and Area Map of the Study District and Towns



Methodology

Data was collected from three case villages in the Adaklu district of the Volta Region namely Adaklu-Anfoe, Adaklu-Torda and Adaklu-Wumenu. Thus the discussion of the key issues is done in three main sections which centered on the three case villages which have five broad themes under each. The themes are perceived knowledge and awareness of climate change, perceived causes of climate change, perceived effects of climate change, strategies to adapt and local level institutional support, livelihood diversification and alternative energy sources. The chapter again comprises of two exclusive interview sections with key personnel from the district agricultural office and a further discussion of the research findings in relation to the theoretical and empirical literature review. This discussion was grouped into two broad sections namely convergent and divergent views whiles the various sections were once more based on the themes that were used in the presentation the research findings. This chapter has a summary and conclusion. Below is the demographic data of nineteen respondents who took part in the discussions in the three case villages.

Table 1: Biographical characteristics of interviewees

Demographic Data			
Categories	**Anfoe Total No. of Respondents= 6**	**Torda Total No. of Respondents=6**	**Wumenu Total No. of Respondents=7**
Sex			
Male	3	5	5
Female	3	1	2
Total	**6**	**6**	**7**
Age	2	1	1
35-44	3	4	5
45-54	1	1	1
55-64	-	-	-
65-74	**6**	**6**	**7**
Total			
Religion	6	6	6
Christian	-	-	1
Muslim	-	-	-
Traditionalist	-	-	-
Others	-	-	-
Total	**6**	6	7
Marital Status			
Single	6	5	6
Married	-	1	1
Divorced	-	-	-
Widowed	-	-	-
Total	**6**	**6**	**7**
No. of Household Members	1	3	5
0-5	3	2	2
6-10	2	1	-
11-15	-	-	-
16-20	-	-	-
Total	**6**	**6**	**7**

Educational Status			
No education	-	1	-
Primary/Middle school	5	2	6
Secondary	-	2	-
Post-Secondary/Tertiary	1	1	1
Total	**6**	**6**	**7**
Years of Farming Experience			
20-30	1	3	3
31-40	4	3	3
41-50	1	-	1
51-60	-	-	-
Total	**6**	**6**	**7**

Source: Field Data, (2013)

Findings from three Smallholder Farmer Villages

Background Data Case Study Village 1: Adaklu-Anfoe

A background study of this community reveals that, they are a predominantly small scale farming community in the district. This community engages in mixed cropping, particularly maize, beans, groundnuts and yam, and off farming activities such as, rearing of household animals like poultry and goats, charcoal burning, firewood harvesting, small scale hunting, brewery of local gin called 'akpeteshie', palm-wine tapping and trading in food stuffs. They also crack stones and rear fish especially when the rains are over. The main source of water in the area is from a river body called Tordza.

Figure 1: Vegetation of the forest before deforestation

Source: Fieldwork, 2013

Figure: 2 A guinea corn farm in the area after slash and burn

Source: Fieldwork, 2013

The above photographs show the green vegetation and a guinea corn farm in the area. Plate 1 show how green and rich the forest is before it is destroyed for farming and other activities like charcoal burning while plate 2 too shows a photo of a guinea corn farm in the area.

Knowledge and awareness of climate change

The discussion started by probing whether they had heard about climate change before, and a respondent in the group answered

> "*Yes, there has been a change in climate but not much change has occurred, though there has been irregularity and variations in the temperature and rainfall pattern.*"

I then probed further to ask whether there were any indications to show that the climate had changed or was changing; a respondent in the group answered thus:

> "*There used to be rain holidays during rainy seasons due to the regularity of rainfall pattern during our school going days in the past but now there is irregularity in rainfall patterns and rainfall intensity has also increased. The rains now come in bits and this destroys our crops, for example the leaves of cassava turn yellow or if it is maize one yellow thing passes through the leaves (disease) which hinders its growth*"

A participant also observed that,

> "*It used to rain heavily in June and July in the past but now the rainfall pattern has become irregular*"

One interviewee in the group also added that,

> *"Sunshine is more intense now than in the past*"
>
> Interestingly, a majority of the discussants noted that there used to be forest savanna but it is no longer there, they conceded unanimously that:
>
> *the forest is gone and we are using savanna woodland for our farming activities.*

Perceived effects of climate change on economic activities

Correspondingly, when a question was asked on the observed effects and changes in their farming and daily activities, they responded by saying they have experienced the infestation and prevalence of new pest and diseases on their farms. One of the discussants said

> *"In the past there were no pest and diseases, but now they tend to affect our crops a lot*"

Participants said there has also been low yield on their farms and conversely attributed it to the over cultivation of the same piece of land and the use of herbicides and other chemicals as the cause of low yield and quality of the farm produce. On the contrary, another discussant argued that

> *"I cannot agree with the fact that chemicals are the causes of low yield, I do crop rotation and use less chemicals and yet get the same result"*.

One of the farmers, recognized as the best in the area, intimated that there had not been in any change in terms of farm yield and quality apart from groundnut which had a low yield in recent times. He attributed the increase in yield to the improvement in agricultural services and the use of fertilizers. He said

> *"For example the Ministry of Food and Agriculture has thought us to plant maize in rows so even without fertilizer you are assured of getting good yield, the application of fertilizer even makes it better*." He added "*even though the rainfall pattern has not been consistent he can proudly say his yields are better now than in the past*"

However, some few respondents shared divergent views on this issue, they noted that in the past they could get good harvest from maize crop for example but now they could not get anything and sometimes even make losses. The yield for groundnut has been bad in recent times unlike in the past. They revealed that, their main river body, River Tordza, which was the main source of water in the area had not seen any major change in its state as they stated:

> *"It still overflows when there is a heavy rain like it has been in the past even though there has been inconsistency in rainfall."*

They have however not seen any strange disease among the community members yet.

Perceived causes of climate change

Interrogations were further made on their perceptions on the effects of their activities on climate change and surprisingly an overwhelming majority of the respondents answered in the affirmative and said

> "*we are aware of the fact that activities such as slash and burn, the use of chemicals in farming, cut down of trees are having effects on the climate and consequently on farm yield but we are also of the view that we do more of plantation farming in the area which could help neutralize the effects deforestation has on the environment"*.

Another interviewee said:

Though we clear the forest to farm, we are now into the cultivation of oil palm plantation which should counteract the effects of deforestation on the environment."

One other important question raised during the discussion was the causes of the weather condition; the discussants mentioned cutting down of tress as a major cause. One young man during the group discussions noted:

"the production and use of ammunitions by the white men coupled with the use of motorbikes destroys the ozone layer and increases the intensity of the sun rays reaching the earth resulting in climate change.".

One of the participants, in a very frank manner, conceded thus:

"I don't know the cause of the change in climate or weather"

Another respondent argued however that,

"there is more oil palm plantation farming in the area now than it used to be in the past. I do not agree with the fact that climate change is caused by cutting down of trees since they are replaced with plantation farming."

A follow up question probed more on the views of charcoal burning; firewood harvesting and the methods of hunting as well as cutting down of raffia palm tree as timber for roofing and how these activities contribute to the changes in the weather. The following answered that,

"*We do hunt but not on a large scale only on occasional basis which we have now resorted to the use of torch lights, the use of traps and local guns unlike the local lantern used in the past which could trigger bush fires. We are predominantly farmers and only engage in charcoal burning and firewood harvesting for domestic consumption"*.

A woman interviewee said:

"We do not sell wood from the raffia palm tree in this area"

However a view expressed by the extension officer, was both fascinating and illuminating. He said:

"There has been high level accusation of the issue of cutting down of all the trees in the area for business and for that matter, it is not openly accepted by a majority of them that they engage in such businesses, it is an 'open secret' he added".

From the researcher's own observations in the field, the existence of charcoal business in the area is undeniable since there were quite a significant number of bags that were packaged ready for the market; though the quantity was however not on a large scale as compared to what we saw in the other villages especially Wumenu, which is well noted as the 'charcoal capital' for the district.

Figure 3: Firewood displayed on the road side for sale

Source: Field Work, 2013

Figure 4: Firewood gathered for the roadside

Source: Field work, 2013

Figure 5: Raffia palm being processed for sale

Source: Field Work, 2013

The above depicts how firewood and raffia palm is displayed and marketed on the main road of Wumenu Township and its surroundings for sale.

Figure 6 and 7: Firewood being processed into charcoal

Source: Field Work, 2013

Source: Fieldwork, 2013

The above is a photograph depicting how firewood is processed into charcoal. Plate 6 shows how the firewood is arranged before it is covered with sand and plate 7 shows how the fire is set to it to begin the process of charcoal burning. This does not only destroy the forest but the soil quality as well as further emission of carbon dioxide into the atmosphere which is one of the leading emissions of GHGs. Plate 8 and 9 below shows how firewood is displayed and marketed.

Figure 8: Charcoal displayed by by the roadside

Source: Fieldwork, 2013

Figure 9: Charcoal packaged on the farm the roadside

Source: Fieldwork, 2013

Strategies to adapt to climate change

Interestingly, the question on adaptation strategies to climate change got responses like the engagement in mixed farming for example maize, yam, groundnut and beans, fish farming especially when the rains were over as well as small scale hunting, stone cracking and brewery of palm-wine and 'akpeteshie', a locally manufactured gin to sustain themselves. One woman respondent rightly said

> *"we only adapt by doing mixed farming or mixed cropping while some of us engage in the brewery of 'akpeteshie', stone cracking and fish farming when raining seasons are over"*

Institutional support, coping mechanisms, livelihood diversification and alternative energy sources

One question that was very vital to this discussion was the nature of institutional support from the district assembly on climate change and how they could cope. They answered

> *"No there has not been any help so far from the district assembly only that the Ministry of Food and Agriculture subsidizes the price of fertilizer for us."*

I inquired further whether there has been any education on climate change and agriculture in their area and they answered thus:

> *"Yes there has been one by the Ministry of Food and Agriculture by their water and water management unit came to talk to them about climate change on one occasion*"

I enquired further, whether there are some measures which they think could be done to mitigate and reduce their vulnerability and they reiterated that apart from mixed cropping and involving in other trading activities, there was little more they could do:
"There is no other way unless the government comes out with other solutions".

They later came out with various ways the government could initiate to help them deal with climate change. An interviewee stated thus:

> "*to me I think I need credit facilities* while another said *I think irrigation dams would be very helpful"*.

To them their major problem is not with climate change but credit facilities and government fixing of prices and establishing ready markets for their produce since they had not noticed much change in their agricultural yield.
An important question which ended our discussion was whether they envisioned that providing them with other income generating activities and energy sources could help solve the issue of climate change but sadly they did not show much interest. Their answer was

> "*You are the most educated ones so we will appeal to you to come out with findings to support and promote agriculture so that it can help boost our crops"*. They added that

"We have engaged in farming for a long time and that is what we know, we feel that helping us to cope with our challenges, such as credit facilities and good market for our farm produce will help us a lot".

They seem not to have ideas about how they could help reduce their vulnerability apart from the main adaptation measure which is mixed cropping. They rather think that research should be done to bring in ideas that could help them with the situation. However, my own observation revealed that they were aware of other energy sources like the use of LP Gas since there were a few of them with the LP Gas cylinders.

Background data on Case Study Village 2: Adaklu-Torda

The background information of this community, point out that the village is a predominantly small scale farming community in the district with majority of them engaging in mixed cropping, with the most common one being groundnuts. The people also engage in off farm practices such as, rearing of household animals like poultry and goats, charcoal burning, firewood harvesting and small scale hunting. The main source of water in the area is from a river body called Tordza.

Knowledge and awareness of climate change

The first and foremost question asked was whether they had heard about climate change and surprisingly an overwhelming majority stated

"*Yes we have heard about climate change before"*

They came out again with certain indications as one discussant rightly said

*"there have been changes in the climate so much that we do not experience '**desado**' (a local seasonal name) which is from June to July and **'siamlom'** (a local seasonal name) is no longer there"* and another *when the wind blows it does not bring rainfall as was in the past, there is no longer harmattan and the winds become dried all of a sudden"*

Perceived effects of climate change on economic activities

The discussion continued with an important question that dealt with observable effects of the changing climate on their activities of which they mentioned low yields from their farms, dying of crops due to less rainfall as some of the effects of climate change they had experienced so far. They added that the leaves of their crops no longer grow green as one participant rightly observed

"*if you do not start planting early for example after first and second rains, your crops may fail, In the major season the rains become heavy at the beginning so when you start early your crops may do well, rains stop early and it makes it difficult to plant and get good harvest"* he added, *"There has been the manifestation of new pest and diseases on their farms which has not been there in the past".*

They now start planting early in the major season since the minor season no longer exists. As one interviewee explained

"previously we start planting in the minor season around September but now we do not know when the rains will start because before, when we plant in August pests would destroy all our crops but now we plant anytime and no longer wait for the onset of the rains.

The people in the area no longer plant only one type of crop but now do mix cropping since they believe that the weather might favour one or two of them out of a lot. These strategies constituted some of their adaptive measures.

Perceived causes of climate change

They went further to mention bad farming practices such as slash and burn, and the use of chemicals, cutting of trees for charcoal burning, and ploughing of the land with machines instead of using the hand as some of the causes. A participant said

"*Previously there has been a large area of forest land in the past but now everything is gone*.

One other participant was very superstitious, he said,

"*My grandmother told me that when an airplane flies through the sky, it causes rains to fall, now there are no airplanes that pass through their area. This holds the clouds down."*

However, they acknowledged the fact that, the major cause of climate change was deforestation because they believed when trees were left to grow, they stored up water and always made the environment wet.

Figure 10: Vegetation destroyed by slash and burn for farming activities

Source: Fieldwork, 2013

The photograph shows how the land is depleted through slash and burn during land preparation for farming activities.

One key issue inquired was their sensitivity to the effects of their own actions as a contribution to the causes of climate change, they responded that they were aware of the fact that climate change was also caused by the continual degradation of the environment and deforestation but they were not able to link it to the causes of climate change, while some expressed the conviction that it was the will of God for it to happen which they believed could be rectified if they change from their bad ways. A discussant in the group said;

> *"We think God is angry with us"*

I enquired further whether activities like charcoal burning and firewood harvesting did not cause climate change and they stated categorically that,

> *"we do not engage in charcoal burning and firewood harvesting on commercial basis in the area but only for our domestic use."* They also added that *"we are no longer doing shifting cultivation which destroys the virgin forest but continue to cultivate the same piece of land because it is now costly to plough a new area rather we now apply a lot of fertilizer due to the continuous ploughing of the same land."*

Some also think these activities only leads to infertility of the soil which is necessary for plants growth.

When queried whether their way of hunting did not lead to burning of the bush and contributing to climate change, this was what they had to say,

> *"we use traps and guns to hunt for animals rather the Fulani herdsmen are the major cause of bush burning since they always want green grass for their animals to feed on"*.

The others were rather in contention that they also engage in bush burning. They added

> *"bush burning has led to the extinction of grasscutter species in the area and they no longer get it as it used to be in the past. We no longer get bush meat as it was in the past because all the forest is gone."*

Strategies to adapt to climate change

A crucial question was asked on whether they had some ways of coping to the changing climate and one respondent answered thus:

"we only adapt by planting early during the major season and may or may not do anything during the minor season because the rains are very low for plant survival. Another discussant indicated that some of the women engaged in petty trading. He further said *our youths have turn to migrate to the urban centres since they cannot get good yield from their harvest. They also buy motorbikes popularly known as* ***'Okada'*** *for transportation business in the town to sustain themselves*."

Institutional support and coping mechanisms, livelihood diversification and alternative energy sources

I enquired whether they think diverting to other forms of livelihood activities could help in adapting to the situation, they said

> *"it is good but if farmers do not have money from their farm produce they may not be able to purchase other products or engage the services of artisans."* They said *"if we don't have money we cannot purchase gas stoves and cylinders or solar energy and that might not only be the solution to the problems".*

There was another important question on whether there were other measures to mitigate and reduce vulnerability and they stated

> *"we have little knowledge of what to do and the only thing we know is changing planting time and doing mixed cropping."*

Another key but inspiring question was whether there had been any intervention by the district Assembly and the Ministry of Food and Agriculture for them and their response showed a unanimous discontent with the Ministry's efforts at supporting them. They indicated thus:

> *"Even the extension officers do not visit our area; this is our first meeting of such kind"*

This answered the follow-up question on whether there had been any education or training on climate change and adaptation strategies. They reiterated that they sometimes did not do anything at all but only wait for God's intervention.

The respondents mentioned building of an irrigation dam for an all year round cultivation, credit facilities, and agricultural inputs such as drought resistant seedlings as well as capacity building and training of farmers in climate change adaptation as some of the help they expected from the local government. They expressed their worries thus:

> *"The white man has deceived us from abandoning our traditional seedlings which were drought resistant and could do well even in the dry seasons"*

The respondents also suggested an interesting idea; that is engagement in plantation farming as a way of introducing new farming methods and also as a way of mitigating and adapting to climate change.

Background Information Case Study Village 3: Adaklu Wumenu

A background study of community, indicates that it is a predominantly small scale farming community in the district with majority of them engaging in mixed cropping, particularly cereals such as maize and beans, cassava and vegetables such as okra and pepper, they also engage in off farm practices such as, rearing of household animals like poultry and goats, charcoal burning, firewood harvesting for commercial purposes and small scale hunting and petty trading. The main source of water is from a major dam since no river passes through their community.

Knowledge and Awareness of climate change

The most fundamental question about their knowledge of climate change issues received a unanimous response as they answered thus:

> *"Yes we have heard about it before"*

Another key question was the ways by which they have identified that the climate has changed and one participant who happened to be the best farmer for the area observed that;

> *"Previously, during our forefathers' time, the first month was used to weed the land, in the tenth day of the third month the weeds were gathered and burnt and in the twenty-fifth day of the third month, they start planting maize till the fourth month.* According to the interview, *when planting is done after that time, it would be eaten by worms. Now you can plant even from March to October and when you apply fertilizer, the maize grows well. It is obvious now that even in the third month of the year, there would not be any rain, only in the fourth month to the sixth month. She said that the first rains was called '**menye tsi'**. All these had changed and the atmospheric temperature in the area continued to increase causing their plants to die"*

While some interviewees argued that the timing for the rains had changed, others argued that there were no variations in the timing of rains so they still plant in March. A discussant went on to add to the first comment that,

> *"There is a change in rainfall patterns and its intensity, sometimes clouds gather but does not rain at all".*

They explained that previously it used to rain regularly and in controlled proportions but now it rained even the whole day. Such erratic rainfall may not enable one to work on the farm. Another respondent added

> *"For example June/July this year it did not rain, these rains help our crops to grow"*

To him, he had realized a change, another respondent indicated thus:

"previously it used to rain in the eleventh month so that they could cultivate maize in the minor season but now that didn't happen much. To them, there is no longer a season called harmattan."

In Ghana, there are two main seasons of the year, the wet or rainy season and the dry or the harmattan season, the wet season is a period between March to June and August to November while the dry season is a period between December and February. During the wet season there is cultivation of farm lands for crop production, in the dry season farmers rest from their labour while they fall on some stored food produced in the wet season since they can no longer plant during this season.

Perceived effects of climate change on economic activities

I asked a vital question on some of the observed effects and changes in their farming and daily activities and surprisingly they were quick to answer that they had observed some significant changes such as pest and diseases infestation which take over their crops such as tomatoes and okra. They stated unanimously that without pesticides and fertilizers their crops do not yield anything. They indicated thus:

"We have realized postharvest losses in especially maize production due to weevil manifestation so they now turn to the use of chemicals to preserve the produce which was not there in the past".

A woman interviewee stated emphatically that;

"The maize could be there for over a year without adding any chemical to preserve it in the past but now pest takes over when you do not preserve it with chemicals".

The respondents were of the view that, climate change had affected their yield and production seriously because they used to get better yields previously than they did now. They explained that there could be a whole season without one getting anything from the farm due to low or erratic rainfall patterns as they further explained. However, there had not been much change in the nature of the main river body apart from the fact that there had been siltation at its banks which caused the river to over flow into individual houses anytime there was a heavy down pour of rain which usually took a long time to percolate into the soil. A discussant made a remarkable conclusion here that;

"The ecological services rendered by the trees around the river banks have been destroyed by human activities."

Perceived causes of climate change

I queried further whether respondents were aware of the causes of the changing climate and one of the discussants explained that the deforestation of virgin forests for farming activities in order to accommodate the increase in human population and bush fires were some of the causes of the changing climate. He asserted that

"Now our population has increased so we now destroy the forest which we used to maintain for farming to be able to survive"

They stated emphatically that

engagement in charcoal burning and firewood harvesting have been a long time activity in the area and is not exactly as a result of climate change rather it has been a usual means of sustenance in the dry season.

Hunting is also predominant in the area but as a result of the activities of Fulani Cattle herdsmen in the area, there has been an extinction of those species and they are no longer in abundance. The Fulani herdsmen are predominantly cattle farmers from northern and Sahara Deserts of Africa who have become settlers in the community as a result of the search of greener pastures to feed their animals. Most of these Fulani Herdsmen have been hired to raise these animals. However, their quest for feed for their animals leads to bush fires because they set fire to the dry grass in order for green ones to grow fast. They also tend to destroy other people's farmlands and crops when the animals walk through these farms. One of the women participants noticeably said

"The Fulani herdsmen have destroyed the forest to enable their animals to feed on fresh grass; this has caused reduction in the breeding and extinction of grasscutter species"

Perhaps one of the most intriguing questions was investigated to find out their views on the result of the peoples own activities on climate change. The answers the respondents gave were in line with the fact that some of their activities contribute to climate change but were very minimal. The discussants felt that charcoal burning and firewood business was not contributing to climate change as an interviewee explained

"To us we do not grow the trees but it grows back by itself, this includes the raffia palm tree because we do not plant them, this means it's a gift from God to us, just as the Sea is a gift for the people of Keta, the trees grow back by itself. So when we cut it grows back by itself."

Figure 11: Uncultivated vegetation

Source: Fieldwork, 2013

Figure 12: deforested vegetation

Source: Fieldwork, 2013

The above shows the difference in vegetation in the area that has occurred as result of deforestation for the purposes of farming. Plate 11 shows the green nature of the forest in the area before it is destroyed for farming activities, while plate 12 shows how the forest is degraded for farming activities.

When a question was asked on their hunting activities and bush burning, a discussant in the group said

> *"there is a belief that we, the people of Adaklu burn the bush for hunting activities but it is not true, we do not burn the bush for grasscutter but it is rather the Fulani herdsmen who burn the bush."*

The respondents seemed to express the conviction that the ability of trees to regenerate, was a symbolic gesture by God to bless them. A woman participant reistated with a smile:

> *"We do not grow the tress, they grow by themselves and we think it is a blessing to us"*

Strategies and adaptation to climate change

Adaptation measures were mentioned in the form of mixed farming so that if one crop failed another may do well. Another interviewee said that

> *"We engage in the rearing of some domestic animals which we sometimes use to supplement daily income as well as petty trading."*

They suggested plantation farming as an option even though they could not come out with a clear implication of plantation farming on the environment but were only using it to adapt to their new environment that climate change had brought to them. Some are however practicing it currently though not on large scale.

Institutional support to cope with climate change, alternative livelihood activities and energy sources

An equally important enquiry made was whether there was support and assistance from the local government to enable them cope with the situation. It was rather disappointing to know that there had not been any support as they all answered *"no"*. One discussant explained

> *"the only assistance is the provision of fertilizers by the office of Ministry of Food and Agriculture office which it has not been consistent"*.

I further probed to find out whether there had been any education on climate change which they again declined.

Alternative forms of livelihood can be in the form of trading in provisions, hairdressing, tailoring, bead and soap making. The community can also resort to the use of solar and LP Gas for cooking which tend to be more environmentally friendly. On the question of diverting to other forms of livelihood activities and energy sources which could help in adaptation and mitigation of climate change, they did not come out so clearly as to what should be done since burning of charcoal and firewood selling was a source of supplementary income for them. They believe when they cut the trees they will grow back by itself.

The interviewee however came out with some possible assistance that government could offer them. They mentioned construction of irrigation dam to help them farm all year round since, they explained

> *"the topography of the land in the area is hilly the soil is not able to hold much water as the topography of the lands in another towns called Waya and other towns"*.

They also called for capacity building in plantation farming such as mangoes and oranges as well as assistance to learn other trades like soap making. An interviewee who also happened to be the woman best farmer stated

"When we are thought other forms of trade we will depend on them if the farm fails us"

The people urged that government to put institutional measures to control the activities of Fulani herdsmen as this worsened their plight.

Further interrogations on one-on-one basis with some interviewees threw more light on the laws of acquiring land in the area. From the three groups they stated that acquisition of land in the area is based on family relations and communal basis. The discussants added that anybody who wants to farm on a land goes through the family head and the custodian to those lands to acquire a place. They said there are no harsh rules from the local government relating to land acquisitions issues in the area.

Perceived knowledge and awareness of climate change

On the issue of knowledge about climate change, the discussants expressed similar views and characteristics of climate change its causes. From the three groups, they attested to the fact that they were aware that the climate was changing; they mentioned some evidences such as Irregularity and erratic rainfall patterns, prevalence of droughts and increase in atmospheric temperatures as the most common features. They also mentioned the introduction of pest and diseases as an indication of climate change and have proved that the climate which used to be there has actually changed. This relates with other findings on climate change studies done by Penaranda et al, (2012), Kalinda, (2011), Ekpoh, (2010), Dahal, 2011, Ogella et all, (2012), Legesse et al. (2012) and Gwimbi, (2009). The authors mentioned irregular and erratic rainfall patterns, droughts and increase in temperatures as the most common features identified with climate change.

Strategies to adapt to climate change

Adaptation measures were another basic issue on which the interviewees in all the three villages held a consensual view. The three groups mentioned mixed and early planting times as well as mixed cropping as strategies or their main adaptation measures. They also shared similar views on engaging in small scale hunting and petty trading to supplement their daily income especially as their crops have started failing them due to climate change. Again this finding supports other studies done by Ogella et al, (2012), Legesse et al, (2012) and Ekpoh, (2012). They mentioned change in planting times, livelihood diversification, mixed and inte-rcropping, and petty trading as some of the coping strategies

Perceived causes of climate change

Perhaps the most crucial topics of all the issues discussed were on the causes of climate change. The three case villages mentioned major causes of climate change as deforestation, land degradation and bush burning as causes of climate change. The causes are crucial because the trees help in carbon dioxide sequestration and reduce its concentration in the atmosphere and also serve as soft grounds for precipitation to occur. Carbon dioxide has become one of the main greenhouse gases responsible for global warming and consequently climate change. One major cause of climate change is the depletion of the forest for agriculture and biofuels. According to IPCC, 2007, agriculture accounts for 14% while 3% of the total contribution to climate change is due to deforestation and forest degradation. The interesting thing revealed by these farmers is the acknowledgement of the facts that human

population has increased terrifically causing the over usage of the forest for sustenance. "Now our population has increased so we now destroy the forest which we used to maintain for farming to be able to survive" as one of the respondent noted. The United Nations Framework Convention on Climate Change (UNFCC), (1992) also acknowledges the fact that a change in the earth's climate and its adverse consequences are mutual to humans and as such human activities are causing an increase in the atmospheric concentration of greenhouse gases which results in increasing global temperatures and subsequently having negative effects on humankind and ecosystems. The people of Adaklu District are predominantly farmers and also engage in other economic activities such as firewood harvesting, charcoal burning and into animal husbandry; these activities are mostly done in an unsustainable manner in that it leaves negative impacts on our environment.

Institutional support to adapt to climate change

A correspondingly important matter is the local institutional support. This is important because the people need some level of capacity to be able to cope with the new developments that climate change is bringing. Here, the three focus groups all agreed on the fact that there had not been any institutional support in any form which would enable them to cope with the climate change situation.

Varied views on key issues identified by the various smallholder farmwr groups

Causes of climate change

There were divergent views on the perception of their own activities to be some of the causes of climate change even though some discussants agree on the impact of human activities on the environment as causing climate change; some discussants at Adaklu- Anfoe, stated that even though they have cut down trees to farm on the land they are now engaged in oil palm plantation than before so they are assured that the plantation farming will offset the services that the forest would have provided. In Adaklu-Torda which is one of the farming communities in the area, they stated that they are aware of the implications that bushfire, charcoal burning, deforestation and bad farming practices such as the use of chemicals render to the environment but they do not engage in those activities but for domestic purpose and not as being publicized. They only harvest firewood and burn charcoal for their own use. They also disputed the fact that they set fire to the bush to hunt for wild meat. They explained, they have rather refrained from shifting cultivation since it had become expensive. However, they could only relate their diversion from shifting cultivation to ploughing of same land over and over to the financial burdens that it places on them and not its implication on the environment. To the people of Adaklu-Wumenu, they perceived the trees as a source of blessing unto them because it supplemented their income and the trees always grew back when it was cut thus could not contribute to climate change. To them, trees possess values of local and financial relevance as well as its ecological benefits they render and have recognized it as God's blessing to them

From the discussions it can be deduced that local folks also undertake activities that increase the concentration of GHGs, albeit at very minimal levels which cannot be quantified. Activities like deforestation slash and burn, application of chemicals and charcoal burning all constitutes activities that release GHGs in the atmosphere. These practices however, have been part of their means of sustenance and in some way embedded in their socio-economic and cultural activities for many years thus, understanding their way of life is crucial in formulating tailor made policies to enhance mitigation strategies and adaptation programs.

Effects of climate change on economic activities

On the views of the effects of climate change on their livelihood, there were diverse effects stories from the three villages, the respondents in Adaklu-Anfoe were of the view that even though the climate had changed, to them they get more yields from their farms, for example maize yield had rather increased in the past few years and therefore there was no change. Some of the interviewees in that group rather held views which were contrary to the earlier one. To them, there has been an inconsistency in their farm yields; they added that when the rains favour them, they get more yields, this they related to the improvement in agriculture services. In Adaklu-Torda and Adaklu-Wumenu the discussants were of the opposing view that there was a decline in their farm yields since the climate was no longer reliable as it was in the past. Climate change is expected to bring changes in many areas of life including agriculture. However; the vulnerability of these communities depends on factors such as the topography and geographical location of the land and the water retention ability of the soil among other things including capacity to adapt. The varied differences in the effects of climate change on their farm yield could also be as a result of these differences and also improvement in farming practices by extension services. According to Adaklu- Anfoe, they have adopted certain farming practices which have helped in the improvement in farm yield and produce. They contended that even though some of these practices such as chemical application also released GHGs into the atmosphere in the form of nitrous oxide, its concentration was however low as compared to carbon dioxide but grew

to higher concentrations which tend to have negative effects on the ecosystems and the global environment. According to the IPCC's report, climate change will impact on societies and groups in different ways based on their geographical locations and ability to adapt.

Institutional support to adapt to climate change

Discussants were of different views on this subject of climate change education; they stated that there had not been any education on climate change apart from Adaklu-Anfoe where, water management department of MoFA came to talk to them about climate change and water. The other two communities namely Adaklu-Torda and Adaklu-Wumenu, have not been educated in any way or had any institutional support of any kind on climate change so far.

This chapter has presented the research findings based on the five main themes stated at its beginning. The themes were the awareness of climate change, the causes and effects on their economic activities, the strategies adapted in response to climate change and the institutional support they have gotten so far. It also presented two exclusive interviews with officers from the ministry of food and agriculture. The chapter further deliberated on the findings based on the data presentation themes. Indeed there are indications of climate change happenings in all the three villages as rightly stated by the respondents and though there were differences in some of their views on the observed effects of climate change, they are aware that environmental degradation and forest depletion forms major causes of global environmental changes and climate change and it is of no doubt that climate change exists and African communities are vulnerable and must be sensitized and encouraged to commit to mitigation measures as they are also equipped to adapt to the changes. My next chapter will focus on the summary, conclusion and some recommendations relating to the study.

Summary

This final section of this paper presents a summary of the findings drawn from the field, a conclusion and recommendation based on the views of the interviewees, and grouped under two themes. The findings from the field reveals that smallholder farmers in the study area have been faced with unpredictable climatic conditions, they identified changes in climatic patterns in the area as irregular and erratic rainfall patterns with low records of rainfall and the increase in atmospheric temperature as some indications. They also identified the manifestation of new and increased pest and diseases infestation on their farm and farm harvest. This is in support of some of the major characteristics of climate change.

Discussants in the various groups expressed divergent views on the impact of these changes on their farms. They mention the use of chemicals such as weedicides and fertilizers coupled with new and improved ways of planting crops like maize have helped to boost their production. Some farmers on the other hand rather expressed the opposite of those views as they mention pest and irregular rainfall to have affected their crops leading to low yield.

The farmers in the area have been able to identify some environmental changes as a result of their own activities such as slash and burn, firewood harvesting, charcoal burning, hunting and grazing of animals of having great impact on the environment. Though some were not able to attribute it directly to climate change, they were aware of the fact that trees serve an important role in the distribution of rainfall and other ecosystem services. Some still expressed the view that some of these practices have been with them for a very long time perhaps the population kept increasing and they would have to survive by making a living through the services of nature hence could not do away with it. The issue of charcoal burning and firewood harvesting for example was noted as a gift of God which they saw as being renewable by itself. They also see the introduction of plantation farming as a means of counteracting the effects of deforestation in the area. One other interesting thing is that, the use of chemicals is now taking hold of these farmers and they see it as a means of reducing the burden of controlling weeds and increasing yield quality and quantity through the use of fertilizers and pesticides.

There was a poor response to the issue of institutional support; they said there has not been any tangible support from the government in terms of capacity building, financial and equipment base to adapt to their new environment. Agricultural officers have also not been trained in this direction to help farmers, their main adaptation is an autonomous one, mix cropping and change in planting times has become virtually the only way of adaptation and they sometimes leave it to the mercy of the climate to decide. They however share the opinion that diverting to other livelihood activities could help reduce their vulnerability. However, they need money to be able to engage other services hence the need for proper capacity building to cope with the new climate. Improper institutional arrangements to the use of forest products and services by government has led to unsustainable use of it, as they said land acquisition is so flexible through the clan and family heads and therefore they all tend to benefit from its proceeds.

Conclusions

The overall research objective looked at the perception of smallholder famers in the Adaklu District on climate change issues and how it has impacted on them and how they have also impacted the climate with their activities. The results from the studies shows that climate change has actually occurred thus the people's inability to cope well with the situation makes them more vulnerable since there has not been any help or education on climate change. Vulnerability can be measured in terms of how prepared a people are and also the type of capacity relating to social, financial, political, human and physical capitals that they have. The people of Adaklu District unfortunately lack most of these capitals that will make them resilient to climate change thus making it very difficult to cope, their only way of coping is mix farming and mix cropping as well as changing planting times to suit the new climate.. Climate change however is not the only factor making them vulnerable but also their own relationship with the environment, their own activities such as slash and burn for the purpose of farming, charcoal burning and firewood harvesting for both domestic and commercial purposes further makes them vulnerable. The destruction of the ecosystem reduces their resilience to absorb shocks and perturbations that climate change is bringing, for example trees serve as biological pumps for rains to fall in a particular locality but they cut them down. The intensification of the use of the forest for commercial purposes however has always been a practice of these people and an economic activity for that matter a means of adaptation; nonetheless it helps in supplementing seasonal incomes.

According to climate change theories and research findings, anthropogenic causes are increasing the concentration of GHGs in the atmosphere; this has led to global warming and climate change. GHGs concentrations can be attributed to land use and land use change and desertification as well as the burning of fossil fuel due to industrialization and transportation, population growth, the development of settlements and energy use. The UNFCCC, (1992) stated that though developing countries have contributed insignificantly to emission rates, their developmental needs will cause their emission level to grow eventually.

Sustainable livelihood comprises of so many factors, these factors are not only climate related but other means of sustenance such as natural, social, financial, physical and political capitals, when all these factors come together; they help a community to achieve its goals and aspirations. In the Adaklu district, livelihood is not only affected by the threatening climate change conditions, but lack of financial, physical and social capitals and since their main economy depends on agriculture, they tend to be at higher risk to climate change. Their situation is further aggravated by their reliance on the natural capital for domestic fuel as well as commercial business purpose because it makes them more vulnerable. This continues to destroy virgin forest in the area leading to deforestation and degradation of the land through slash and burn and charcoal production. The issue continues to pose a serious challenge to Africa and other developing countries in meeting the millennium development goals by 2015. Nevertheless, in order to develop a more pragmatic and holistic approach to remedying the situation, the factors that account for this intensive use of the forest would have to be looked at. The need to understand the socio-cultural and economic factors that underpin our development to be able to address the issue becomes a relevant issue of great concern. Local folks continue to have a direct relationship with the environment through their activities and exacerbate vulnerability hence the need for them to understand these issues as well as the need for capacity building in other areas as well as evolving coping strategies in order to help deal with the situation.

Recommendations

This section presents the recommendations made by the discussants themselves. It is grouped under two themes namely institutional support to improve agricultural production and livelihood diversification

Institutional support to improve agricultural production

The farmers suggested the need for government help build the needed capacity so that they would be able to cope with the changing climate; they mentioned such areas like financial capital through the provision of credit facilities, the introduction of drought resistance seedlings and the provision of equipment and machines to help them on the farm.

They appealed to government to help them involve in the promotion of plantation farming through financial support so that it may help in reducing vulnerability while developing sustainably.

To some, the most important thing is for government to help provide irrigation dams so that there can be all year round cultivation of crops, this will go a long way for them to cope with the new climatic conditions which has become unpredictable for them to know when to start planting.

They pleaded with the government help control the activities of Fulani herdsmen who have become a major threat to their farms since most of them allow their cattle to destroy the topography of the land and their crops

Livelihood diversification strategies

Some also suggested that government should help them diversify to alternative livelihood strategies like the learning of different trades such as soap making to supplement their income when the weather fails them.

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