Local Adaptation Practices versus Introduced National Agricultural Programmes to Mitigate Climate Change Impacts in Northern Ghana- Guaging the Evidence

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Abstract

Climate change is widely recognised as a major threat to agricultural production and productivity in Ghana. There is some evidence to suggest that adaptation is occurring in response to climate variability both at local and national levels. This paper evaluated the adaptation strategies to climate change in the agricultural sector in northern Ghana. Firstly, the paper identifies and assessed the severity of climate change and variability impacts on the socioeconomic status of the local people and their adaptation strategies. Secondly, the paper evaluated the performance of the national agricultural adaptation programmes in the region. The Bolgatanga district in the Upper East Region (UER) was used as a case study area. Survey questionnaires were administered to 100 households in two rural communities (Yorogo and Gowrie) in the district from September to October, 2014. Focus group discussions with local people and interviews with key informants to validate the questionnaires were carried out. The results indicated that households in the study area are not only vulnerable to climate change impacts/effects but have more limited adaptation strategies. The results also revealed that only four of the six national adaptation programmes in the agricultural sector were implemented in the region for the period 2009-2013.

Keywords: adaptation strategies, climate change impacts, northern Ghana, agriculture productivity, National Adaptation Programmes

1. Introduction

Sub-Saharan Africa (SSA) is considered to be the most vulnerable region to current and future climate variability (Conway &Schipper, 2011; Siept*et al*., 2013). Particularly in Ghana, an increase in mean annual temperature of 1 degree Celsius per decade since1960 and a decrease of monthly rainfall by about 2.4% per decade was recorded (De Pinto *et al*., 2012). Moreover, an increase in future mean annual temperature with erratic rainfall distributions is expected (Lodoun*et al*., 2013). Such shifts in rainfall distribution and changes in temperature might therefore have an adverse consequence on agriculture in general and on food security and poverty level of rural communities in particular. The adverse effects are expected to be severersince agriculture is predominantly rain fed with minimal irrigation coverage (Oloukoi*et al*., 2013, Ghana Irrigation Development Authority, 2011). Agriculture forms the basis of the economy contributing roughly 30% to GDP and providing livelihood for 60% of the population (Sarpong&Anyidoho, 2012). According to the Environmental Protection Agency (EnviromentalProtection Agency, 2011), about 70% of the Ghanaian population depends directly or indirectly on agriculture and forest sector for both timber and non-timber forest products(NTFPs). Even though, climate variability threatens, [Wheeler & von Braun, 2013], there is some evidence to suggest that adaptation is occurring in response to climate variability (Wiggins &Leturque, 2011). In Ghana for example local and national level policy strategies, have under taken a mix of different adaptation strategies such asearly maturingcrop varieties, changing planting dates, growing drought resistance crop varieties, use of crop insurance mechanisms, use of irrigation, use of short term production credit and adoption of soil and water conservation practices to mention but a few (Tachie-Obeng*et al*., 2013).
Since agricultural production remains the main source of income for most rural communities in Ghana;its adaptation mechanisms are imperative to enhance the resilience of the agricultural sector, protect the livelihood of the poor and ensure food security. There are records of studieswithout adequate information to address the issue of performance of adaptation strategies to climate change, especially in the agricultural sector. Previous studies (Tachie-Obeng*et al*., 2013; Rodima-Taylor *et al*., 2012) only focussed on adaptation options for particular crops or enterprises rather than evaluating the performance of the strategies to climate change impacts. In addition, recent policy debates on climate variability have been focusing on the impacts of climate variability rather than on the role of adaptation (Di Falco *et al*., 2011; Laube*et al*, 2012).

According to Clement *et al*.(2011), innovative technologies and practices do exist, or have been developed in different parts of the world to help facilitate adaptation to climate change in the agricultural sector. These include improved weather prediction, water conservation, sustainable soil management, better livestock management and improved crop varieties among others. A challenge for agricultural researchers is to understand how and when these technologies are used by farmers and with what impacts (Doss, 2006). Evaluating the performance of these technologies and identifying the factors that influence the adoption of an innovation is therefore important in the process of technology development and dissemination (Al-Hassan &Jatoe, 2002). Assessing adaptation strategies in the context of national policies and local adaptation practices are not addressed adequately by the approaches taken so far in most studies (Brooks *et al*., 2005). This is particularly worrying since the presence of adaptive capacity is a necessary condition for designing effective adaptation strategies.

Reducing the adverse effects of climate variability therefore requires overcoming the existing climate variability deficits and responding to future climate variability through the appropriate adaptation and policy interventions (Milman&Arsano, 2013). This paper seeks to contribute to the climate change literature by evaluating climate change policies and local adaptation practices in the UER.

Adaptation strategies to climate variability in the context of climate change are all those practices that are used by smallholder farmers to either get used to, or minimise the effects of climate change and variability. The Food and Agricultural Organisation (FAO) in a study (FAO, 2006) on the adaptation strategies adopted by farming households in Bangladesh categorized adaptation strategies into four types: thus traditional strategies, government-supported strategies, alternative and innovative automatic adaptation strategies, and technology driven strategies. This study categorizes the strategies adopted by smallholder farmers for dealing with the effects of climate change and variability into two, namely indigenous adaptation strategies and introduced agricultural adaptation strategies following the FAO classification. The traditional strategies are what are considered in this paper as community based strategies. Introduced agricultural adaptation strategies for this study are government policies and programmes in the agricultural sector. Community based or indigenous adaptation strategies are all those technologies and practices originated from the local people and used in their communities. The introduced agricultural adaptation strategies are those technologies or programmes introduced by the Ministry of Food and Agriculture (MoFA) and used by smallholder farmers in their communities. This paper analyses the mitigation performance of implemented introduced agricultural adaptation policies of climate change as against indigenous local practices in UERas agriculturebecame a significant part of climate change policy debates in Ghana in the last few decades.

The first Food and Agriculture Sector Development Policy (FASDEP I) was developed in 2002 by MoFA as a framework for the implementation of strategies to modernisation of the agricultural sector. After nearly four years of its implementation and the development of sub-sector policies and strategies to guide implementation, it became necessary to revise FASDEP I to reflect lessons learned and to respond to the changing needs of the sector (MoFA, 2007a). The revised policy (FASDEP II) emphasisedon the sustainable utilization of all resources and commercialisation of activities in the sector with market-driven growth in mind. It targeted fewer commodities for example, staple food such ascereals, legumes, root and tubers and livestock for food security and income diversification of resource poor farmers. This was to enhance the productivity of the commodity value chain, through the application of science and technology, with emphasis on environmental sustainability. Greater engagement of the private sector and collaboration with other partners was also emphasised to facilitate implementation of policies (MoFA, 2007a).

In line with improving the food security and enhancing the resilience of the agricultural sector to climate change impacts in Ghana, MoFA developed the Medium Term Agriculture Sector Investment Plan (METASIP) to be implemented from 2009-2015. METASIP was an action plan framework with set targets to be achieved within the specific period (2009-2015). The plan identifies various priority development issues which were categorized into various programmes that corresponded to FASDEP II objectives (MoFA, 2007b).

The six programmes were:

i. Food Security and Emergency Preparedness

ii. Increased growth in incomes
iii. increased competitiveness and enhanced integration into domestic and international markets
iv. Sustainable management of Land and the Environment
v. Science and Technology for Food and Agricultural Development
vi. Institutional co-ordination

In order to assess the performance of the agricultural sector underMETASIP, indicators were developed by MoFA to measure the progress of achievements in the sector as follows:

- Percentage change in the level of production of selected staple crops
- Percentage change in output/yield per unit area
- Access to production inputs (number of farmers)
- Access to improved technology and extension services (number of farmers)
- Cultivated areas under irrigation (number of hectares)
- Post-harvest losses management and food security (percentage change in losses)
- Promotion of livestock and poultry development (number of programmes, number of farmers)
- Promotion of selected crops development
- Improved institutional coordination

This study adopted these indicators in the analysis of the policies and programmes implemented in the case study region (UER) to measure their performance from 2009-2013. It goes further to evaluate the performance of agricultural adaptation policies from 2009-2013 and the synergies of local practices in the study region. More specifically, the paper examines whether adaptation policies in response to climate variability are meeting expected set targets and in reducing poverty and enhancing food security in the study region.

Aims of study

The aims of the research:

1. to provide a methodology for identifying some robust adaptation strategies and options at both the local and national level
2. to provide a basis for understanding how to structure adaptation intervention so as to benefit the most vulnerable households and communities within vulnerable regions;
3. to assess the performance of introduced adaptive strategies and programmes.

It could be argued that, successive agricultural adaptive strategies and policies to climate change implemented in Ghana may not have achieved their desired impacts because of failure to investigate their performance at the community level, the synergies of local practices and national policies among others.

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Objectives

The paper seeks to address three specific objectives:

1. To identify and analyse the performance of existing government adaptation policy and strategies to climate change impacts in the agricultural sector.
2. To capture and analyse local community's adaptation strategies and the severity of climate change impacts on local population in the study area.
3. To analyse the synergies between government adaptation policies and community based strategies in the study area.

2. Methodology/Materials and Method

2.1 The Study Area

The study is conducted within the general context of the most affected by Climate Change and variability, but with a special focus on the northern dry savannah zone (EPA, 2009). The Upper East Region (UER) was randomly selected from the then three Regions of the north (Upper East, Upper West and Northern)to represent the savannah zone of the country due to its vulnerability to climate change and climate variability. The UER is located in the north-eastern corner of the country. The region has 13 administrative districts. In order to explore empirical community based adaptation practices and experiences on climate change and variability, two communities (Yorogo and Gowrie) in the Bolgatanga district in the regionwere randomly selected as the study sites (Fig.1).

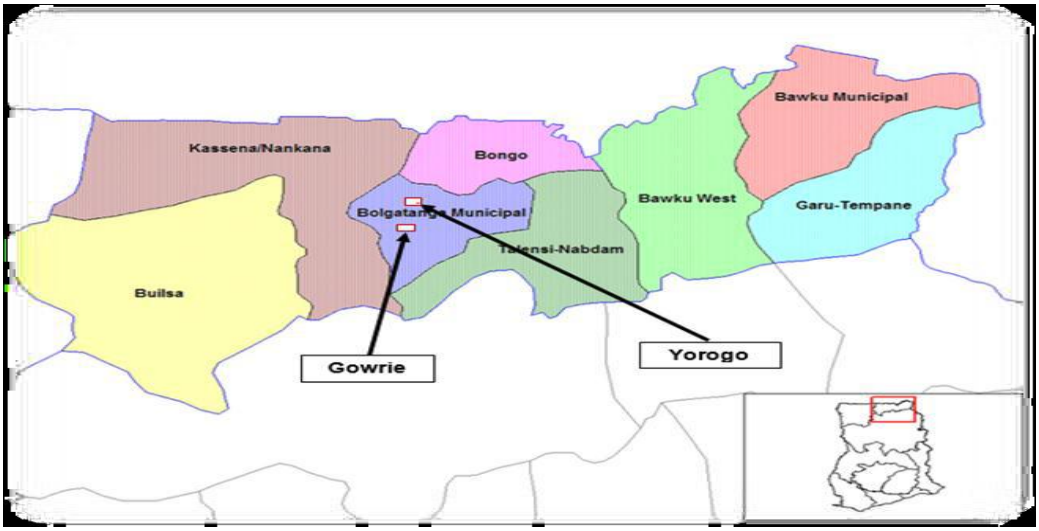

Figure 1: District map of the Upper East Region showing the Bolgatanga District and the study communities (GLSS, 2014).

The Bolgatanga district is located within the UER of Ghana with a land area of 1,620 km² and a population of 131,550 people and a population growth rate of 1.2%. The district has 26,706 households (GSS, 2012).

The climate is classified as tropical and has two distinct seasons a wet season that runs from May to October and a long dry season that stretches from October to April; with hardly any rains. Mean annual rainfall is 950mm while maximum temperature is 45°C in March and April with a minimum of 12°C in December (GLSS, 2014).
Agriculture is the main occupation of the people of the district, employing about 37.7% of the employed population (Bolgatanga District, 2013). However, production is at subsistence levels due to low soil fertility, erratic rainfall pattern,and limited capital, inadequate supply of agricultural inputs, skills and equipment. Major crops cultivated in the district include millet, sorghum, maize, rice, groundnuts, and cowpea, sweet potato, and soya beans. The climatic conditions in the area are also suitable for livestock (cattle and small ruminants), guinea fowls and poultry which are major agricultural activities in the district. More than 80% of the

farmers in the district are smallholders with an average farm size ranging between 0.4-1.2ha (MoFA, 2013a).

2.2 Conceptual Framework

The risk-hazard model framework (Fig. 2) was adopted from Turner *et al*. (2003) as the conceptual framework for the study. The model was chosen because it assesses the possible impacts due to climatic event (ibid). Since the study is into assessing the performance of adaptation strategies to climate change impacts, the model is appropriate because it draws and explains the linkages of climatic event factors (stage 1), the possible impacts (stage 2), the adaptation options (stage 3), strategies adopted (stage 4) and strategies performance (stage 5). The framework focuses on drawing linkages and explaining how climate change and variability affect smallholder farmers. Climate change and variability arises as a result of factors both internal and external to the smallholder farmer. The activities of the smallholder farmers in the UER of Ghana and to a large extent the activities of other individuals, as well as natural variations are the underlying causes of climate change and variability (MoFA, 2013a).

The impact of climate change and variability in the region however depends on the level of vulnerability of the smallholder farmers, which is a function of the level of exposure, sensitivity and adaptation capacity as depicted in Fig. 2. The extent of exposure depends on the frequency and intensity of the climatic impacts sensitivity which depends on the prevailing human and ecological conditions; and the ability to adapt is based on the economic and natural resources at the disposal of the smallholder farmer. The Intergovernmental Panel on Climate Change (IPCC) definition of vulnerability takes into account exposure, sensitivity and capacity to adapt and is therefore considered in this study in estimating the level of vulnerability of smallholder farmers in the UER of Ghana to climate change and variability. In order to reduce the impacts of climate change and increase their resilience, smallholder farmers usually adopt indigenous strategies (local traditional practices) as a first adaptation measure. These traditional strategies are however not usually sufficient for dealing with long-term climatic impacts.

The agricultural adaptation strategies are national policyinterventions meant to complement the efforts of the smallholder farmers in the form of projects and/or programs in this case METASIP that aid in adaptation to climate change and variability. The study identifies and evaluates the METASIP programmes implemented in the UER of Ghana between 2009 and 2013. The study also identifies local indigenous strategies used by smallholder farmers in the study area in adapting to climate change and variability. The performances of implemented programmes in the region based on the set targets are evaluated. The synergies of these implemented programmes and the indigenous practices are investigated to determine whether they complement each other or are in conflict. The decision of smallholder farmers to adjust their behaviours in order to adopt an indigenous or introduced adaptation strategy depends on several factors that are both internal and external to the smallholder farmer.

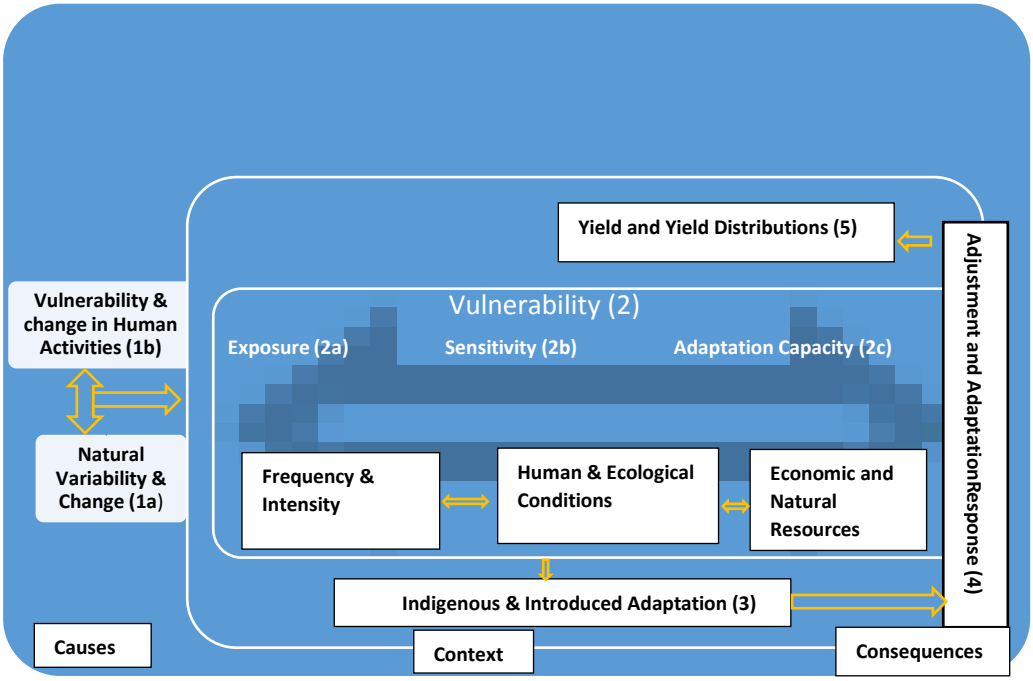

Figure 2: Risk-Hazard Model(Modified and Adopted from Turner *et al*., 2003)

2.3 Tools Employed, Data Type and Sources

Data were collected from two main sources, secondary and primary. The secondary sources were existing quantitative and qualitative data, this includes; MoFA reports on the implemented programmes and policies on climate change impacts in the agricultural sector, MoFA policy framework on climate change, and documented impacts of climate change of the study region and livelihood profiles of local people of the area.Primary data collected includes socioeconomic status of local people of the study area, frequency of occurrence of floods, droughts, storms and their severity (climatic events), the corresponding coping and adaptation strategies the people of the study area use and the reliability in sustaining their livelihoods.

The tools employed for the primary data involves household questionnaire interview, participatory methods such as community/civil society focus group discussions (FGDs), ranking/scoring, seasonal diagramming, timelines, well-being categorization, as well as semi-structured interviews and key informant interviews with households.

2.4 Sampling Technique

A multi-stage sampling technique was employed in this study. It is a technique that selectsa group (s) within groups and finally members of the selected group (s). All the then three regions of the north (Upper East, Upper West and Northern) were purposively sampled since they represent the savannah zone of the country. The UER was randomly selected from the then three regions. The Bolgatanga district was also randomly picked from the 13 administrative districts (Fig. 1). Two communities (Yorogo and Gowrie) were also randomly selected from the 18 communities in the district for the study. Finally, 100 households were randomly selected from the two communities for the questionnaire interviews. 54 households

were selected from Yorogo and 46 households from Gowrie. There is no particular reason for the different sample sizes for the two communities, it was basically based on those available and ready for the questionnaire interview. Four focus group discussions were organized (in September and October, 2014) in each of the two selected communities (Yorogo and Gowrie) differentiated by gender and age. Between 10 and 15 members in a group were randomly selected in each community. Two female groups and two male groups in each community: one age group was 30 years and below, while another was above 30 years. This was to allow participants to objectively share their experiences and perception about climate variability and impacts and their adaptation practices.

2.5 Analytical Methods

The use of quantitative and qualitative methods (mixed methods) is adopted for the data analysis but with more emphasis on the qualitative approach. The data was analysed using SPSS software. The responses from the household questionnaire interviews are presented using simple percentages in tables. Furthermore, the data derived from the interviews and focus group discussions were reported and analysed qualitatively using tables, content analysis, key words in context where necessary.

As seen in the conceptual framework (Fig. 2) above, the analysis of the paper focuses more on stages 3, 4 and 5 of the framework. The stage 3, is the adaptation strategies been practiced or adopted. Through the group discussions, questionnaire and interviews, the type of adaptation strategies practiced were identified. At stage 4, the paper analyses these identified practices that originated from the local people and how this is sustainable to their livelihood. With the introduced (METASIP) programmes, the study identifies the programmes been adopted by the local people at stage 4. The paper at stage 4 of the framework analyses how these two different strategies complement or conflict each other. At the stage 5 (strategies performance), the paper through MoFA reports assesses the performance of the introduced programmes through the evaluation of the reported output of the programmes as against their expected set targets. The paper adopts the pre-determined indicators in the agricultural sector developed by MoFA (performance indicators) to measure the progress made towards achieving the set targets of the implemented programmes.

2.6 Study Limitations

The study's primary data as mentioned earlier is obtained from only two communities in one district from the study region. Although the environmental characteristics of the study district (Bolgatanga) are quite homogeneous with the other 12 districts in the region, there are important differences among the districts, and across communities, with respects to population density, land cover and elevation. These differences can have a non-negligible impact on the resources people can rely upon, and on the livelihood strategies that they pursue in order to cope and adapt with climate variability and impacts that occurred in the study region. The study analysis of the adaptation policies and programmes are solely based on MoFA technical reports. Programmes that do not have any reported data were left out in the analysis. The reports outputs are therefore averages across communities, districts, and regions. One could argue that average figures does not give accurate picture of specific areas, however, this study seeks to assess the performance of national adaptation policies for the agricultural sector and specificity in context does not in any way affect the objectives of the study. Despite these limitations, the study succeeded in eliciting most of the needed data for the research study.

3. Results and Discussions

3.1 Socio-Demographic Characteristics of Respondents

Sex, age, marital status, formal education, occupation and respondent knowledge of climate change are the socio-demographic factors considered for this study. Demographic information provides data regarding research participants and is necessary for the determination of whether the individuals in a particular study are a representative sample of the target population for generalization purposes.

66 male (66 %) and 34 female (34 %) respondents were interviewed. Most of them (62 %) were above 30 years, representing active part of the population, engaged in farming. Persons younger than 30 years of age were 38%. Almost all the respondents (98%) mentioned that farming is their primary occupation, while 22 % mentioned trading as a secondary job. Majority (74%) of the respondents are married with only 20% been single and 4% are divorced and widowed respectively. The importance of formal education to overall socio economic development of households cannot be over-emphasised. About 42% of the respondents were found to have had no formal education while 50% attained basic education. Formal education improves literacy and subsequently the ability to read and understand concepts especially agricultural related instructions, technologies, changing trends among others.

3.2 Farmers' Perception about Climate Change

Surveyed households were asked about their perceptions of long term climatic changes. Specifically, farmers were asked "Have you noticed any long term changes in the average temperatures, rainfall and rainfall variability over the last 20 years?" Farmers that responded positively reported the changes they have observed. The results show that an overwhelming majority of farmers perceived an increase in average temperature (96%), and a decrease in average precipitation (50%) over the last two decades. When asked whether they had perceived any changes in weather pattern, farmers specified which changes they noticed (Table 1)

Table 1: Respondents perception of climatic changes they have observed

Climatic changes perceived by farmers	**Number of respondents in percentage: N=100**
Noticed weather pattern has changed but not significant	**2%**
Noticed weather pattern has changed significantly	**56%**
Noticed weather pattern has changed very significantly	**42%**
Noticed decreased temperatures	**4%**
Noticed increased temperatures	**96%**
Noticed decreased rainfall	**50%**
Noticed increased rainfall	**14%**
Noticed erratic rainfall	**36%**

Source: From field survey, 2014

3.3 Household Vulnerability and Adaptation Strategies in the Study Area

The results showed that farmers adopted a range of practices in response to perceived climate change (Table 2). The most common practice adopted by the respondents is changing crop varieties (100%) and practicing this strategy ranges from less than a year and more than 5 years. Changing livestock breeds (96%), practicing irrigation farming (98%), local traditional practice (98%) and land management (98%) are adopted strategies by respondents from the area. They have been practicing these adopted strategies, ranging from less than one year to more than 5 years as presented in Table 2.

Table 2: Adaptations farmers adopt in response to perceived climate change

Adaptation strategy	**Do you practice any adaptation? N=100**				**% of strategies adopted**
	Adaptation not practised	**Yes adaptation and duration**			
		<1 year	**1-5 years**	**>5 years**	
Improved livestock breeds	4	34	58	4	96%
Irrigation farming	2	-	28	70	98%
Migration	78	2	10	10	22%
Livelihood diversification	2	20	52	26	98
Improved Crop Variety	-	24	76	-	100%
Local traditional practice	2	-	26	72	98%
Land management	2	2	28	68	98%

Source: From field survey, 2014

The results indicated that households in the Bolgatanga district in the UER are not only dealing with tougher (or severe) climate conditions but also have more limited range of adaptation options available to them.

During the focus group discussions (FGDs) participants discussed potential strategies to climate change. These included both actual and desired adaptation. The discussions revealed that livelihood diversification is the most common adaptation strategy. Migration as a strategy received less attention (22%) during the household survey. Other strategies mentioned during the FGDs especially by the women groups, include planting more drought resistant crops, early maturing varieties as well as improved hybrid seeds. Farmers are also reported shifting towards livestock production and adopting resistant livestock breeds [MoFA, 2013a]. Irrigation farming and water harvesting schemes were ranked at the top among the priority adaptation during the FGDs regardless of gender and age. FGDs also stressed soil and water conservation as a strategy.

3.4 Introduced Agricultural Adaptation Programmes Adopted by Farmers

When farmers were asked to assess government's introduced programmes to climate change adaptation, farmers were to identify which programmes they have adopted and their benefit to them as shown in Table 3.

Table 3: Benefits and Significance of Introduced Adaptation Programmes

Introduced Agricultural adaptation programmes and policies	**Respondents' benefits and significance level of policy: N=100**			
	Not	Beneficial	Beneficial	Beneficial

	beneficial	but not significant	and Significant	and very significant
Income growth policy programmes	-	26	60	14
Land Management and Irrigation	-	10	62	28
Food Security programmes	2	24	30	44
Science and Technology policies	-	26	25	24
Market Access Policy Programmes	58	20	10	4

Source: From Field Survey, 2014

The study showed that the farmers (respondents) adopted some of the introduced agricultural adaptation programmes in their communities as presented in Table 3 above. The most adopted programme and also perceived to be beneficial and significant was the land management programme (62%), and 28% of respondents perceived this programme to be very significant and beneficial. Market access programmes were given the least attention (10%) to be beneficial and significant by surveyed farmers.

During the FGDs it was revealed that farmers in the study area are not faced strictly with the choice of either adopting an indigenous or introduced agricultural adaptation strategy in dealing with the effects of climate change and variability. Whereas the adoption of specific introduced strategies (for example improved crop varieties and livestock breed) was found to lead to the abandonment of certain indigenous strategies (like local crop varieties and breeds), some indigenous and introduced strategies were however used complementarily (irrigation practices and local composting).

During the group discussions it was revealed that no particular individual or group was found to be using only one strategy, they were found to be using a combination of strategies. Common combinations mentioned at the discussions included the use of two or more different indigenous strategies; the use of two or more introduced strategies; and finally the use of two or more indigenous and introduced strategies together. Across all the group discussions it was revealed that combination of several indigenous strategies appears to be more popular as compared to the use of multiple introduced strategies together. Participants at the FGDs were found to be using different combination of indigenous strategies such as crop and livestock related, soil related, cultural practice and other indigenous strategies. Combination of different introduced strategies appeared not to be widespread. According to the participants, across gender and age, the introduced programmes were used by farmers to complement indigenous strategies.

3.5 Introduced Agricultural Programmes' Performances (2009-2013)

The performances of introduced agricultural programmes were based on the technical reports output of MoFA in the UER. Four programmes had data reported on them, and the analyses of the performance are based on these programmes. The four programmes include food security and emergency preparedness, income growth, sustainable land management, irrigation and technology and science programmes. Each of these programmes has measurable indicators to assess their progress in achieving their set targets.

Food Security and Emergency preparedness Programmes

The measurable indicators for this programme are:

- The percentage change in output per hectare of selected staple food in the study region
- Post-harvest losses to be reduced by at least 30% every year
- Land under irrigation to increase

The Ministry of Food and Agriculture (MOFA)recognises that increasing productivity of small scale farmers will ultimately increase food security. To be able to evaluate the performance of the indicators, targets were set. Yields of staple foods are to be increased by 50% by the year 2015 or at least increase by 10% every year from 2009-2015. The yields over the five-year period (2009-2013) as indicate in Table 4 experienced fluctuation and fell below the expected targets set. For example comparing 2013 and 2012 yields of millet, soybean, groundnuts and rice recorded a decrease of – 10.0%, –12.0%, –10.0%, and –27.0% respectively. However, maize, sorghum, and cowpea recorded an increase of 8.7%, 7.9% and 5.6% respectively, but these increases were all below the 10% increase target. The productivity targets for staple crops in the study region were not met for the period (2009-2013).

Table 4; Percentage change in output/yield per unit area (Mt/Ha)

Crop indicator	**2009**	**2010**	**2011**	**2012**	**2013**	**Progress towards target**
Maize	1.5	1.54 (2.7%)	1.60 (3.9%)	1.38 (–14.0%,)	1.5 (8.7%)	Target not met
Rice	2.8	2.81 (0.4%)	1.95 (–31.0%,)	2.69 (38%)	2.00 (–27.0%,)	Target not met
Millet	1.14	0.97 (–15.0%,)	0.82 (–15.0%,)	0.90 (9.8%)	0.81 (–10.0%,)	Target not met
Sorghum	1.27	1.14 (–10.0%,)	1.10 (–3.5%,)	1.01 (–8.2%,)	1.09 (7.9%)	Target not met
Soybean	0.91	1.00 (9.9%)	0.76 (–24.0%,)	0.97 (28%)	0.85 (–12.0%,)	Target not met
Groundnuts	0.77	0.90 (17%)	0.76 (–16.0%,)	0.87 (14%)	0.78 (–10.0%,)	Target not met
Cowpea	0.88	0.80 (–9.0%,)	0.60 (–25.0%,)	0.71 (18%)	0.75 (5.6%)	Target not met

Source:MoFA Reports output, (MoFA, 2013a; MoFA, 2013b; MoFA, 2011)

*Yield/Ha is the ratio of total output per unit area cultivated. Figures in brackets are percentage change from previous year.

One of the main objectives of MoFA was to improve food storage and distribution by reducing post-harvest losses by at least 30% along the value chain of the staple foods (MoFA, 2013b). According to the regional report (MoFA, 2013a) there is a reduction of post-harvest losses from 2009-2013 for the staple foods in the study region. Thus, an average post-harvest

loses reduction of 23% for 2009, 30% for 2010, 31% for 2012 and 33% for 2013.This suggest a significant steady progress towards achieving the set target of 35% reduction in post-harvest losses by the end of 2015.

The third indicator under the food security programme is the increase land area under irrigation. Increasing land area under irrigation is expected to boost food production and reduce the overdependence of the country's agriculture on rain-fed farming. The target for this indicator was to increase land area under irrigation by 22,590ha by the year 2015 country wide. As at end of 2013, a combined area cropped under both formal (11,136.2ha) and informal (10,541.7ha) irrigation was 21,677.9ha, an increase of 8.1% increase over 2012 country wide (Sarpong&Anyidoho, 2012).Land area under irrigation for the UER, were 916ha in 2010, 905ha in 2011, 1849ha in 2012 and 2990ha in 2013, suggesting a steady progress on land increase under irrigation for both the country and the region respectively.

Increased Growth in Income Programme

This programme was expected to increase farmers' disposable income. The indicators to measure were value of crop production and the development of farmer based organisations (FBOs) for the period (2009-2013).The other indicators like value of livestock, fish and cash crops data is not reported. As seen in Table 5, there is mixed performance in terms of the value of production for the selected major staples in the region. Steady increase in the value (price) of all food items from 2010 to 2012, but decrease in value for maize, rice and groundnuts in 2013. However, there had been modest gains in value of production for the other food items, suggesting modest increase in income of farmers who cultivate these crops.

Table 5:Average unit production value of major staples from 2010 to 2013

Staple Item	**Average Unit Value of Production: GHC/MT**			
	2010	**2011**	**2012**	**2013**
Maize	400	525 (31%)	665 (27%)	550 (–17.0%,)
Rice	900	1134 (26%)	1476 (30%)	1460 (–1.1%)
Millet	510	616 (21%)	905 (47%)	1043 (15%)
Sorghum	470	523 (11%)	660 (26%)	725 (9.8%)
Soybean	No data	No data	675	1050 (56%)
Groundnuts	1010	1730 (71%)	2635 (52%)	2274 (–14.0%)
Cowpea	960	1100 (15%)	1660 (51%)	1752 (5.5%)

**Source: (MoFA, 2013a) ***There were no reports on 2009

Farmer Based Organisations(FBOs) offer smallholder farmers the opportunity to reap all the benefits that accrue from working in groups. The number of FBOs formed in the region were 1733 in 2009, 1671 in 2010, 1195 in 2011, 1525 in 2012 and 871 in 2013. The progress has been fluctuating from year to year and far below the set target of 2500 FBOs expected in a

year as at end of 2013.
Sustainable Management of Land and Environment

This programme was expected to enhance production, improve food security, income and livestock through sustainable land management practices such as crop management, erosion control, bush fire control, adoption of sustainable land management technologies among others. Measurable indicators include awareness creation on these activities that will address climate change vulnerability within the food and agricultural sector. In the region as seen in Table 6, the sustainable land management activities have gained some steady progress from 2010-2012, with slight reduction in 2013. There was also significant progress with the number of beneficiaries of these implemented activities as shown in Table 6.

Table 6: Activities on Sustainable Land Management (SLM) Practices (2010-2013)

Indicator	**2010**	**2011**	**2012**	**2013**
SLM activities carried out	40 activities	65 activities	82 activities	75 activities
Number of beneficiaries	4, 017 farmers	10, 936 farmers	7, 800 farmers	11, 475 farmers

**Source: (MoFA, 2013a) ***There were no data reports for 2009

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Research and technology development, its application and adoption are important for agricultural production and productivity. The measurable indicators for this programme include access to improved technology and extension services. The number of farmers that have access to improved technology in the region were 8420 farmers in 2010. It went up to 11,066 in 2011, 11,334 in 2012 and shot up to 21,200 (2013), suggesting a significant progress toward achieving the target of 25000 farmers by year 2015. With a target of extension officer farmer ratio of 1:1000 by 2015, the reported output indicated 1:1500 in 2010, 1:1300 for the years 2011, 2012 and 2013 respectively, suggesting a 61% progress towards the set target. The reported output showed thatthe number of communities with access to extension services in the region improved progressively as; 740 in 2011, 989 in 2012 and 989 in 2013. This brings to the conclusion that, the yearly target of 1083 communities to access extension services in the region could not be achieved as at end of 2013.

4. Summary and Conclusions

The paper has assessed the performance of local indigenous adaptation strategies and national adaptation policy programmes in the agricultural sector to climate change impacts in the Upper East region of Ghana. The results showed that many households in the study area have made significant adjustments to their farming practices in response to climate change. It is revealed that the range of adaptation strategies employed were more limited, suggesting the precarious situation people in the region face.

The results of introduced agricultural programmes implemented at the community level were less applied as compared to community based programmes, suggesting the need to combine the two where feasible to improve the limited adaptation programmes available to the people in the region. During the FGDs, participants placed considerable emphasis on adaptation strategies that will lift them out of rain fed agricultural challenges. The analysis showed that

farmers in the study area are largely aware of government introduced adaptation programmes but are yet to benefit immensely from these programmes. This means more efforts need to be done to make these programmes beneficial to the target population. The outcomes of the introduced agricultural programmes from the analysis suggest mixed performance in terms of progress towards achieving the programme targets. From the analysis, yields targets for staple food did not meet targets, while post-harvest losses reduction and land area irrigation made significant gains toward achieving the programme targets. The income growth, science and technology programmes have recorded steady progress towards targets, but still fall short of the yearly programme targets as at end of the evaluation period 2009-2013.

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