

# The Role of Formal and Informal Institutions in Smallholder Agricultural Adaptation: The Case of Lawra and Nandom Districts, Ghana

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## Abstract

As the current frequency of climate impacts is expected to increase in semi-arid regions of Ghana, smallholder farmers will require access to new and relevant information to adapt successfully. Institutional support is increasingly gaining attention for effective and successful adaptation; however, there is limited knowledge on the specific roles of both formal and informal organizations in implementing adaptation strategies in semi-arid regions. Using the Lawra and Nandom Districts as case studies, the various roles of existing institutions in adaptation strategies were examined. A total of 135 household questionnaires, six focus group discussions (FGDs), 20 in-depth interviews with farmers, and seven key informant interviews from institutions evaluated climate risks and impacts, adaptation responses of farmers and the functions of the different institutions in supporting these adaptation strategies. Majority of respondents observed that irregular and unpredictable rainfall (77%), high temperature and extreme heat (56%) and rainfall irregularities during growing season (55%) as the main changes in the past 10 years. Major agricultural adaptation strategies identified were changing of planting dates (100%), planting of different varieties of the same crop (51%), planting of trees (35%) and seasonal migration by the local farmers (21%). There is high dependence by the smallholder farmers on formal institutions' resources to adapt, especially for developing/building the local capacity, rather than on local innovations within the communities. This is mainly due to the lack of knowledge about climate change risks and adaptation strategies and limited or no access to financial resources. Government-led adaptation is considered to be more sustainable than NGO-led programmes although it comparatively lacks specific mandates and financial resources. Continued support by formal institutions will therefore enable the development of more effective agricultural adaptation initiatives.

## Introduction

Increasing global warming has led to a change in the magnitude and frequency of some extreme weather events in sub-Saharan Africa that has impacted on its social and economic development (IPCC, 2014). These countries are more vulnerable due to their high dependence on climate sensitive sectors which reduces their capacity to adequately adapt to the changing climate (Nordhaus, 1991; Stern, 2006; Akram and Hamid, 2015). The agricultural sector employs majority of the rural population and as a result has the potential to exacerbate their vulnerabilities as their "... livelihoods depend on already overstrained climate-sensitive resources as their social welfare systems are weak" (Chalise and Naranpanwa, 2016:1). Recent reductions in agricultural production in these regions have been attributed to late rains,

increased drought, and decreased soil fertility among, others (Yengoh et al., 2010; Stanturf et al., 2011). This situation is likely to worsen under future climate change as adaptation by the local community is restricted as a consequence of increasing poverty (Nelson and Agbey, 2005).

Adaptation to climate change can occur at local, regional and national levels across that time-scale, from short, medium and long term (Adger et al. 2005; IPCC 2001). According to IISD, IUCN and SEI (2003), addressing future climate change impacts will need to be based on collaboration and adaptive capacity of society and the country at large, which must be locally initiated by the people and supported by the government and other institutions. The successful implementation of adaptation strategies therefore requires both local and national mandates (Corfee-Morlot

et al., 2009). National mandates are critical in ensuring the implementation of climate change adaptation as they mobilize political will, support research institutions, establish networks that promote information sharing and also facilitate and finance mechanisms (Noble et al., 2014). On the other hand, local mandates foster intergovernmental coordination and facilitate the implementation of climate change adaptation through individual and collective actions at all levels (Agrawal and Perrin, 2008; Noble et al., 2014). As a result, national policies and development projects must reflect the local communities' interests and experiences in order to effectively assist communities' full potential to engage in a successful climate change adaptation (Savane, 2013; Komba and Muchapondwa, 2015). Thus, for successful adaptation strategies targeted towards smallholder farmers, the compliance and devotion of formal and informal institutions at local, regional, national and global actors are indispensable.

#### *Climate change and Adaptation in the Upper West Region, Ghana*

The Upper West Region of Ghana, located in the drier semi-arid areas of the country, face high poverty levels, extreme temperature, low rainfall and poor soil fertility which augment their vulnerability under climate change (Nelson and Agbey, 2005). In addition, unsustainable land management practices relating to poor soil organic matter management, increased deforestation and bush burning contribute to drought risks and high soil temperatures in the area (Padgham et al., 2015).

Agriculture is the main economic activity, with crop cultivation and livestock production

being the main farming practices. Subsistence farming is common practice among the rural smallholder farmers who mainly grow groundnuts, millet, sorghum and cowpea (Blench, 2006; GSS, 2010). Some farmers raise livestock such as sheep, goats, pigs and poultry for both household consumption and for sale (GSS, 2010). Livestock farming is also used done to complement crop production by farmers. The agriculture sector is rainfall dependent and as such highly sensitive to climate variability in the region (ALP, 2015). Changes in temperature and rainfall have significant impacts on soil organic matter, affecting agricultural production (Brevik, 2013). The impacts of climate change are already evident in the region. It is experienced as water stress, challenges for food security and extreme weather events (Yaro et al., 2015). For example, as the leading producers of cereals in the country, northern Ghana faced an abrupt decrease in the average yield from 1200 kg in 1996 to less than 900 kg in 2000 due to extreme rainfall variations during that period, coupled with inadequate irrigation systems (Braimoh and Vlek, 2006; Stanturf et al., 2011).

Studies have shown that farmers have long been adapting to the seasonal and annual variability in climate through the sharing of indigenous knowledge on better crop varieties, permanent and seasonal migration and other farming systems, including irrigation practices (Fussel et al., 2006; FAO, 2009; Bishaw et al., 2013; Komba and Muchapondw, 2015; Tambo, 2016). The traditional authorities at the local level have supported these initiatives by playing key roles in managing and conserving access and use of the natural resources in the community (ALP, 2015).

The shift from the Millennium Development Goals (MDGs) to Sustainable Development Goals required the inclusion of climate change adaptation in countries' development policies (Schipper and Pelling, 2006; Smucker et al., 2015). Thus at the national level, efforts towards climate change adaptation were also outlined in various national development policy frameworks. Platforms such as the Ghana Climate Adaptation Network (G-CAN) and the Ghana Climate Change Agriculture and Food Security Platform aim to promote climate change advocacy and integration in to development planning. Support such as subsidized agricultural inputs in the Northern Regions were provided to overcome the barriers of climate change adaptation; although this eventually created risks of maladaptation for farmers who had limited or no access to this support (ALP, 2015).

Although adaptation strategies are generally location specific, the influence/assistance and cooperation of both formal and informal

institutions is required for successful implementation of adaptation strategies (Agrawal et al., 2013) as depicted by the Adaptation Institutions and Livelihoods (AIL) framework (Figure 1). Formal institutions are defined as tangible governance and organizational structures whilst informal institutions are cultural norms and traditions which shape the behaviour and nature of human interactions (Jones et al., 2010; Mubaya and Mafongoya, 2017). There is a high risk of failure at local scale in the absence of support from the national governments, resulting in unsustainable adaptation (Juhola and Waterloo, 2011). In addition, the ability of farmers to effectively adapt is constrained by inadequate income, lack of expertise and inappropriate public policies (Bishaw et al., 2013). There is, therefore, the need to investigate how different communities are supported by institutions to effectively implement agricultural adaptation under climate change. . The study contributes to this discourse as it aims to evaluate how both forms

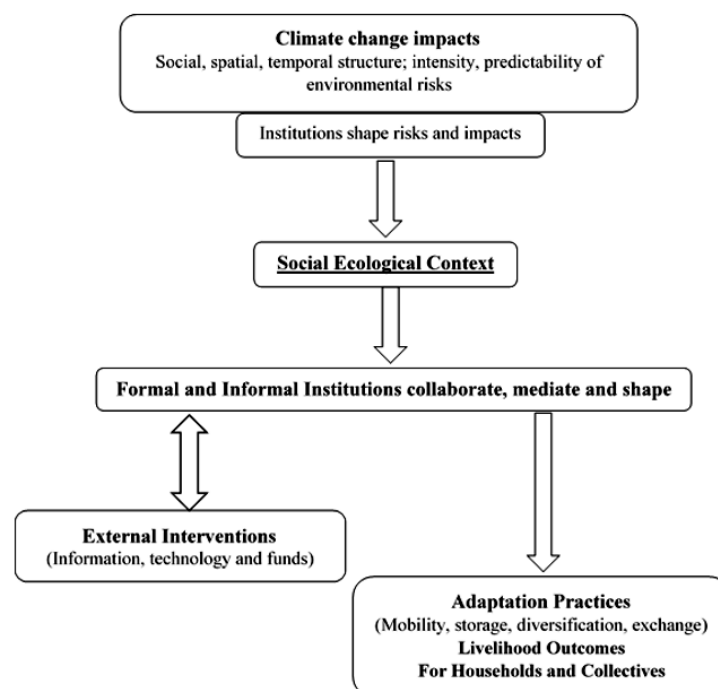


Figure 1: Climate Change Adaptation, Institutions and Livelihoods (AIL) Framework (Modified from Agrawal, 2008)

of institutions (formal and informal) support the implementation of adaptation strategies in the Upper West Region of the Ghana.

## Materials and Methods

### Study Area

The Upper West Region, located within the Guinea Savannah and Sudan Savannah zones, has a unimodal rainfall pattern with total figures ranging between 800-1200mm annually. It experiences a tropical continental climate with mean monthly temperature between 21°C and 32°C (GSS, 2010; ALP, 2015). The rainfall season prevails from May to September/October followed by a long dry season from October to May. February to April is the hottest period in the region. Vegetation in the region is characterized by short grasses and few woody plants appropriate for livestock production. The landscape is gently undulating ranging from 200-350m with the Black Volta

running across from North to South.

The Lawra and Nandom Districts which were selected as case study sites, are two of the nine districts that make up the Upper West Region (Figure 2). Lawra is bounded to the East and South by the Jirapa/Lambussie District and Lambussie-Karni District, respectively. The total land area of the district is estimated at 18,476 square km with 157 communities, of which 95% of its inhabitants live in rural areas. The Nandom District, carved from Lawra in 2012, is bounded to the East and South by Lambussie and Jirapa, respectively, and to the North and West by the Republic of Burkina Faso. The district has a total area of 567.6 square km, also with 86% of its inhabitants living in rural areas. Both districts have a decentralized governance system which is supportive of the traditional governance system in the community (GSS, 2010). The two systems complement each other towards

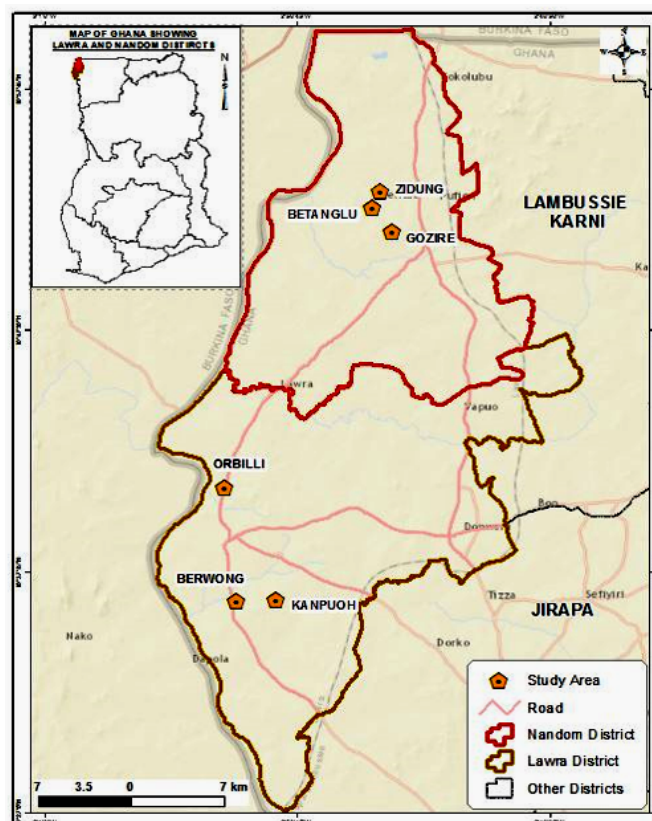


Figure 2: Map of Study Area - Lawra and Nandom Districts  
Source: RS/GIS Lab: Department of Geography and Resource Development (UG)

achieving a common development goal.

*Meteorological data of the Upper West Region*  
 Semi-arid regions of the country will experience higher levels of land degradation and variability of rain and increased temperatures with climate change. This is already evident as the rainfall during the period 1968-1997 has been on average 15-40% lower than during the period 1931-1960 (Nicholson et al., 1999; Yaro et al, 2015). Climatic data from the Babilie station (located in Jirapa in the Lawra District) for annual rainfall over the past 30 years shows inter-annual variability with a slightly increasing trend from 1984-2014. A change detection analysis between the first 10 years (1984-1994) and the last 10 years (2002-2014) of rainfall data shows an elevated amount of rainfall over the years

from June to August (Figure 2). However, average temperature rather shows a slight decrease from 1984 to 2014 (Figure 3). A change detection analysis was done by using the first 10 years of the climate data (1984-1994) and the last 10 years of the data (2002-2014). The result (Figure 3b) shows a steady rise in temperature from April to August and then a rapid decline from the month of October through to December.

*Surveys and data analysis*

Primary data was obtained through household questionnaires, focus group discussions (FGDs), one-on-one in-depth interviews and institutional level surveys. The surveys mainly assessed perceptions about climate change and impacts on their livelihoods, adaptation strategies and the roles of identified institutions

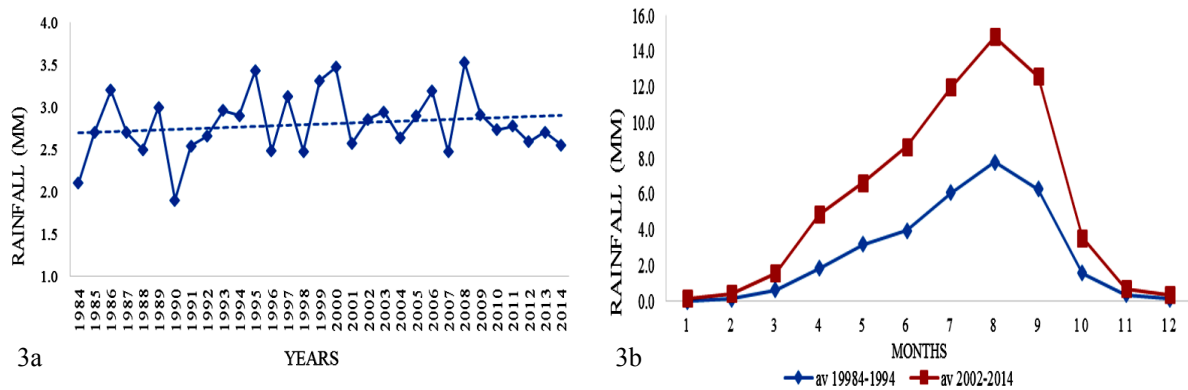


Figure 3: (a) Annual and (b) monthly rainfall pattern in Upper West Region over 30 years (1984-2014)

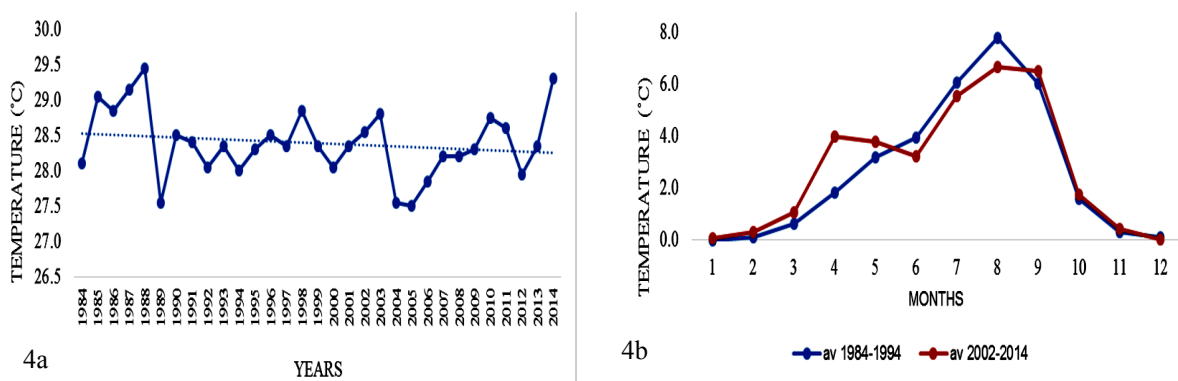


Figure 4: (a) Annual and (b) monthly temperature in Upper West Region within the last 30 years (1984-2014)

in the implementation of adaptation strategies. In each district, three communities were selected through stratified sampling: in Lawra District the Orbilli, Kanpuoh and Berwong communities, and in Nandom District - Gozire, Zidung and Betanglu. Two of the communities from each district (from Lawra – Kanpuoh and Orbilli; and from Nandom -Zidung and Gozire) were selected based on the existence of planned adaptation initiatives (from earlier scoping activities and interviews), while the remaining two communities (Berwong and Betanglu) were selected due to the absence of planned initiatives.

Based on the population of each community, a total of 135 questionnaires were administered, comprising 20 household heads each in Kanpuoh, Zidung and Betanglu and 25 households each in Berwong, Orbilli and Gozire of smallholder farming families. In each household, both male or female occupants were interviewed, with preference given to respondents who have stayed in the community for more than 10 years so that they could account for changes observed. Six focus group discussions (FGDs) were also carried out, one in each community.

Each FGD comprised of 6-7 males and 6-7 females. In-depth interviews were conducted with 20 farmers overall who were above 60 years old. Seven key informants in leadership positions (chiefs, community leaders, and government officials) were also interviewed to obtain insights in their awareness of climate change and the adaptation mechanisms of communities across space and time.

## Results and Discussion

### *Understanding of climate change*

Decisions people make towards climate change adaptation is based on their perceptions about climate change and its likely impacts. This was particularly evident among the older farmers who have worked on the farmlands of Lawra and Nandom Districts for more than 20 years. The research findings show that 100% of the smallholder farmers interviewed in Betanglu, Gozire and Orbilli have heard about or are aware of climate change/variability, in addition to 84%, 88% and 95% of respondents in Berwong, Zidung and Kanpuoh communities, respectively. The remaining respondents who had not heard about climate change, have however observed various weather changes such as increasing temperatures and irregular

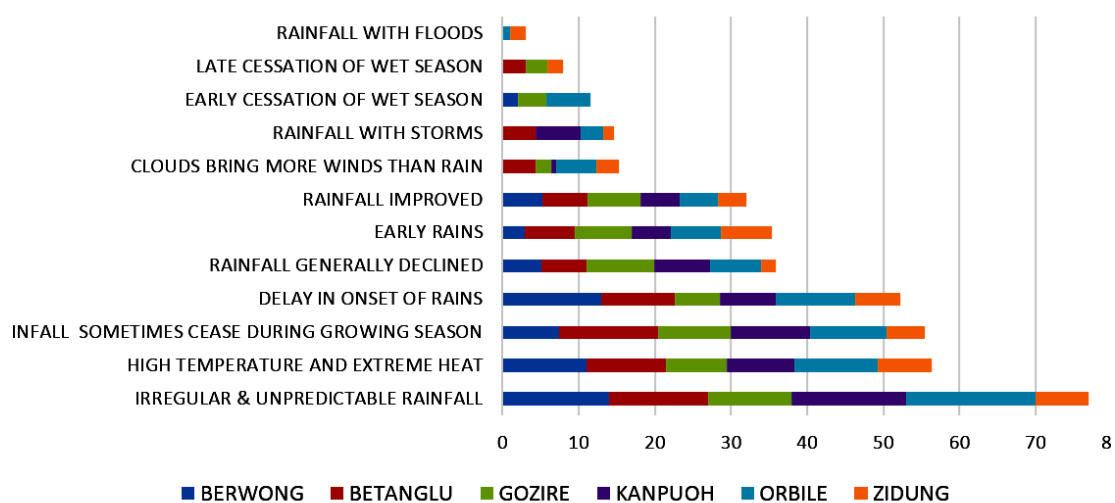


Figure 5: Observed changes (percentage of respondents) in weather patterns in Lawra and Nandom Districts

rainfall over the past years.

High temperatures together with low and irregular rainfall patterns reported by farmers in all the six communities are, however, contrary to the climatic data from the Babile station. Annual rainfall rather shows a slightly increasing trend over the past 30 years (Figure 3) and a slight decrease in temperature from 1984 to 2014 (Figure 4). The perception of reduced rainfall may be based on the variability of rainfall within each growing season, as experienced by the farmers and supported by the data, rather than overall annual change (Fosu-Mensah et al., 2012). A large number of the respondents observed irregular and unpredictable rainfall (77%), high temperature and extreme heat (56%) and erratic rainfall during growing season (55%) as the main changes in the past years (Figure 5). In an interview with the chief of Betanglu, Naa Batholomew Depuur, he observed that *“the increase in temperature has resulted in drying up of the soils which makes it more difficult to farm as it requires more water to moisten the soils. The extreme heat observed recently in the weather has resulted in high death of livestock in the community”*. Nonetheless, 32% respondents also observed early rains and improvement in the rainfall. For those who had heard about climate change, a government agency is the main source of information in all the six communities (52.6%), followed by the media (14.1%) and family/friends (12.6%). Information from school/teacher and internet sources were obtained and utilized by respondents only in Gozire (8%). The level at which farmers trust the information received from the various sources also has an influence on the extent and their willingness to use that information.

In Zidung community, for example, a farmer commented that *“we have really benefited from the use of compost on our farms as taught by Agric”* while another elderly woman in the same community indicated that *“We end up losing more yields when we follow the announcements from the extension officer”*. Overall, the majority of the farmers (60%) trust information obtained from the government as compared to other sources.

#### *Climate change impacts*

The majority of the respondents (50% and above) in all the communities believe that issues related to climate change are very relevant to their lives, indicating that these have caused low crop yield and poor soil fertility. However, a number of respondents in Berwong (12%), Orbilli (28%) and Zidung (10%) rather believed that these were not relevant as they did not see the direct relationship between their food and clothing requirements to the changes in climate. Based on the following livelihood indicators: food & clothing; health; education; housing, electricity & water; and transport, farmers' perception of their vulnerability to climate change impacts on agricultural livelihoods were determined (Figure 6). Majority of respondents in Zidung, Orbilli, Kanpuoh, Gozire and Betanglu observed an increase in food & clothing with only Berwong indicating a decrease in food & clothing, as a result of changes in weather/climate in the last 10 years. In an FGD in Betanglu, respondents explained that the introduction of new sorghum varieties (*Sorghum bicolor*, locally known as 'dorado') provided by the Agriculture extension officers in 2012, has rather provided them with additional food choices.



Figure 6: Observed changes in livelihoods indicators (percentage respondents) in the last 10 years in Lawra and Nandom Districts

With regard to health, no changes were perceived by the majority (>50%) as a result of changes in weather/climate. Although hospitals cost have generally increased, respondents observed no change because they use herbal medicine which is cheaper than hospital. In communities such as Orbilli and Gozire, however, more than 40% reported

decrease in the health sector in the last 10 years. A female farmer in Orbilli blamed increasing health costs, narrating that "within a period of 4 years, the cost for National Health Insurance Scheme (NHIS) card increased by more than 100% in which drugs are excluded. It used to be GH¢4.00 in 2013 but GH¢20.00 in 2017." In all the communities, with the



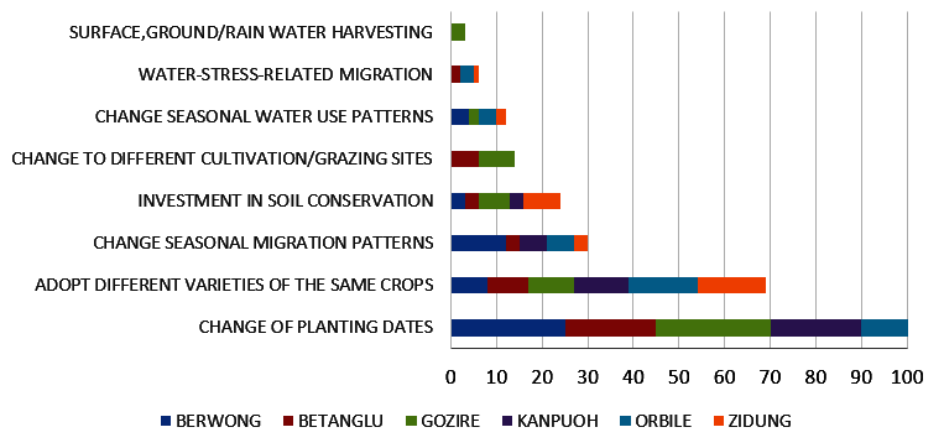


Figure 7: Agricultural adaptation strategies in Lawra and Nandom Districts (\*multiple answers per respondent)

exception of Orbili, majority of respondents believe that there has been a decrease in the education of their children as a result of the changes. They attributed this to the low crop yields in the community which brought in inadequate income to support their children's education. For all the communities, majority indicated that transport and housing facilities showed no changes.

#### *Climate adaptation*

The majority of farmers in all six communities have responded to observed climatic change and impacts by changing planting dates and planting different crop varieties as the main strategy. Berwong community is the only exception, as respondents indicated seasonal migration as its next dominant strategy practice after changing of planting dates in the community (Figure 7). Farmers in Berwong (especially female farmers) prefer to rather migrate to Burkina Faso to cut firewood and sell rather than undertake any of the mentioned adaptation measures, mainly due to their lack of understanding about climate change risks, available adaptation strategies as well lack of access to financial resources. Respondents in only the Gozire community carry out surface and ground water harvesting. As explained by one of the male farmers, "each farmer creates a small pond on the farms to collect water during raining seasons to be used in

the lean season. The collected water supports farming for a while, but it dries up easily". In both districts, individual adaptation options are linked to community based adaptation strategies. For example, in Gozire, the community minimized deforestation and bush fires as a way to control and maintain the soil quality under the changing climate. This was manifested in the crop yield and the general livelihood of the people.

#### *Institutions and their roles in climate adaptation*

For this study, formal institutions found in both districts include government agencies, Non-Governmental Organizations (NGOs) and research institutions. Chiefs and farmers/producers association were identified as the informal institutions.

*Role of formal institutions* - Government agencies such as the Ministry of Food and Agriculture (MoFA), Savannah Agricultural Research Institute (SARI), the Ministry of Environment, Science, Technology and Innovation (MESTI) and the Environmental Protection Agency (EPA) have representatives at the District Assemblies who work closely with the local farmers. These institutions play different but related roles in the implementation of climate change adaptation strategies (Table 1). The extension officers provide weather information to farmers in the communities either through contact persons in

the community, through the radio stations or through the chiefs. The respondents indicated that the extension officers inform them about the rainy seasons and planting dates at least one month before cultivation.

With respect to technical support to farmers, the extension officers have taught most of the respondents composting in order to boost the soil quality in the area, especially in Zidung and Kanpuoh. In an interview with an elderly woman in Zidung, she explained that *'We were taught making use of our domestic waste by converting it into compost and use on our farmlands by Agric'. This technique has retained the soil fertility and increased our farm production in recent years'*. According to the respondents, government agencies do not provide any form of financial support to their communities but provided avenues for farmers to acquire loans through the introduction of the Village Savings and Loan Association (VSLA) (Figure 8).

The NGOs identified in the communities are either locally or foreign based and provide significant support in the field of agricultural climate change adaptation. The Centre for Indigenous Knowledge and Organisational Development (CIKOD), CARE International, ESOKO, Nandom Deanery Integrated Rural Development Program (NANDIRDEP) were

some of the active NGOs associated with climate change adaptation in the districts at the time of the survey. These NGOs also provide information/knowledge transfer to farmers in the communities. CIKOD concentrates on food security under climate change by providing improved crop variety (groundnuts) to the local farmers in Gozire. In Orbilli, ESOKO supports in agricultural adaptation by providing agricultural information through text messages to farmers. According to an extension officer in Gozire, *'external institutions consider the activities community members are engaged in before they provide their support. For instance, one of the main challenges this community encounters is the threat of bushfires from neighbouring communities. CIKOD observed the commitment the community has made towards zero tolerance to bush burning and deforestation and then organized fire service training for the youth in the community. The NGO also provides some materials to the community for safety firefighting.'* CARE International also supports farmers by providing storage facilities to farmers in Betanglu. According to an interview with the Deputy Director of CIKOD, the NGO also provides marketing training to the women to support the sale of farm produce. In terms of financial support received from NGOs,

TABLE 1  
Adaptation option, formal institution involved and the type of support

Adaptation Options	Institution	Type of support
Adopt varieties of same crop	MoFA, CIKOD	Information & knowledge transfer and Technical support
Change planting dates	MoFA	Information & knowledge transfer (early warning information)
Change to different cultivation/grazing sites	MoFA-	Information & knowledge transfer - new farming methods (farming along ridges and stone bonding)
Crop diversification	MoFA, CIKOD	Information & knowledge transfer and Technical support
Diversify into non-farm income	VSLA	Information & knowledge transfer
Investment in soil conservation	CARE International MoFA	Information & knowledge transfer and Technical support; CARE International (v2 project- nitrogen fixing crops) MoFA (composting)
Tree planting	MoFA CARE International	Information & knowledge transfer and Technical support

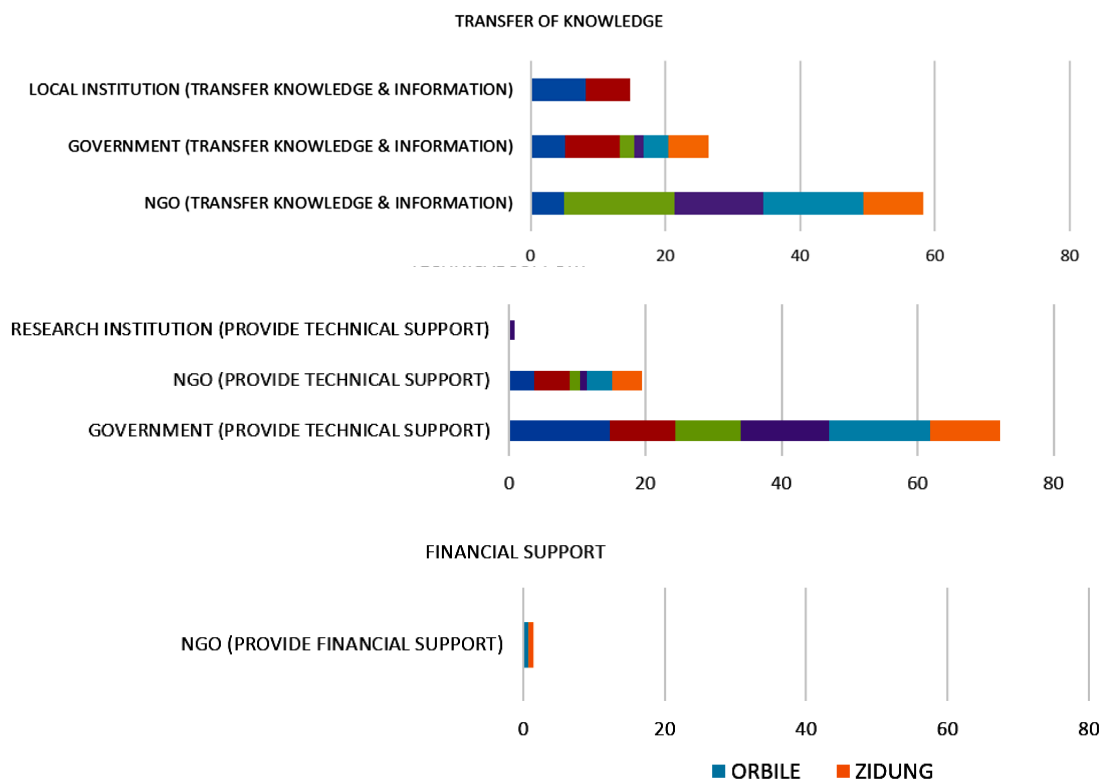


Figure 8: Perceived roles of formal institutions in climate change agricultural adaptation

in Orbili, this was in the form of wages to farmers for working on their farms through projects such as the World Food Programme (WFP) and Farm Plus by Care International; and in Zidung, subsidized fertilizer and VSLA training from MoFA and provision of small dams for farming in dry season and storage facility by Care International. This project also encouraged farmers to work on their farms using proper soil conservation techniques and creating dams as an alternative water source during dry seasons.

Research institutions that visit the two districts were University of Development Studies (UDS) Wa and Tamale campuses, University of Ghana (UG) and, Kwame Nkrumah University of Science and Technology (KNUST). These are mainly students or senior researchers who visit the communities for data collection and research purposes only. The Centre for Scientific Innovation and Research (CSIR) also conducts research in some of these communities. Research institutions do

not provide knowledge/information transfer, technical or financial support to farmers in any of the communities surveyed. According to the chief of Betanglu, their community *often get student researchers who come to conduct research*.

*Role of informal institutions*

Chiefs (paramount and sub-chiefs), community leaders, local farmers/producers associations and market women groups are the main informal institutions identified. Aside from their social responsibilities, chiefs enact and enforce strict measures for the achievement of a communal goal as adaptation strategies. In Gozire for example, punishment for bush burning by the chief served as a deterrent to other potential culprits. As narrated by the chief in Zidung, *“stricter measures/bye laws are put in place to check both social and environmental controls in the community”*.

Farmers/producers association also aid in climate change information dissemination

on early warning systems. This role is very particular in few communities such as Gozire and Orbilli. During a FGD at Gozire, respondents indicated that “Those of us who don’t have radio tapes get early warning information from the head of farmers’ group”. Formal institutions interact with the community through development of projects which has been accepted and approved by the local chiefs.

#### *Successes and challenges to climate change adaptation*

According to the findings of this study, many of the adaptation measures in the community are firstly initiated by the smallholder farmers and later supported by external agencies. Thus, external agencies first consider local initiatives present in a community before they provide their support. In an interview with Lawra’s technical personnel (EPA), he suggests that, ‘communities’ that have developed initiatives towards climate change adaptation have the tendency to attract government agencies and NGOs to provide assistance towards

*the implementation of those strategies. For instance, Kanpuoh had assistance (borehole and milling factory) from MoFA, Ghana Environmental Management Project (GEM Project) and Food and Agriculture Organization (FAO) among other institutions because of the community’s initiative towards zero tolerance to deforestation and bush burning.’* This, however, is in contrast to the findings of Padgham *et al.* (2015) which reports that external agencies implement adaptation strategies without considering community input and local protocols.

Knowledge and information transfer have been mostly carried out by NGOs than government agencies. The information dissemination was mostly times done at the inception of a project by these organizations during a durbar or at the chief’s palace. Although government agencies provide knowledge and information, there are limited numbers of extension officers to provide extensive coverage. Technical support through the training of farmers on soil conservation, composting and the VSLA

TABLE 2  
Successes and challenges of institutions to climate change adaptation as perceived by the communities in Lawra District

<b>Institution</b>	<b>Description</b>	<b>Achievements</b>	<b>Challenges</b>	<b>Way forward</b>
Government Agriculture extension	Provide knowledge and Technical skills to farmers	Taught composting, how to farm on ridges and stone bonding	They made the community people open up their problems, but they did not solve it (poverty)	Fertilizer support Money
NGO (CARE International)	Farm plus project: Selected poor and needy people to work on their farms and converted it into food	Paid farmers for farming on our own lands	The selection was bias and selected persons did not provide information to the community after the training	It should involve all community members
	V2 project: Farmers were taught on nitrogen fixing crops	This helped to improve soil quality	The project was short lived (not more than two years in Orbilli)	Wish it could be sustainable (long lived)
	WFP: Farmers were asked to dig dams for farming (irrigation)	Paid for the hours they constructed the dams and now the animals drink from the dams too	The project was short lived (not more than two years in Orbilli)	Wish it could be sustainable (long lived)
Local institution (Chief)	Create awareness Enforces the laws (helping to fine culprits for the benefit of the community)	Deter potential culprits	Bureaucracy in dealing with issues	Should be given more recognition

TABLE 3  
 Successes and challenges of institutions to climate change adaptation as  
 perceived by the communities in Nandom District

Institution	Description	Achievements	Challenges	Way forward
Government Agriculture extension	VSLA: Farmers advised to save and take loans from the savings.	Farmers provided with saving boxes, Sustainable The institution is pleased with the communities performance	No money was provided for a start	Farmers want a dug out for storing water during dry season (for animals and dry season gardening)
	Advised on the dangers of bush burning and cutting down of trees	This was supported by traditional rulers and stricter measures were put in place to ensure no tree is cut. Gave farmers some seedlings for tree planting Provided farmers with cutlasses, Wellington boots and spray machines to quench fire during fire outbreak.	Trees could not survive the existing weather. Few trees thrived in Zidung and Gozire.  The tools used to fight bushfires are not enough	Trees that thrive well in specific communities should be provided
	Taught farmers composting, soap making and Shea processing.	This provided an alternative source of income for the farmers	Few processing machine was provided Maintenance of the machine was difficult	This only benefits the women in the community and not all farmers
NGO (CARE International)	Provided storage facility for farm produce (Betanglu, Zidung)	The facility guard or produce against pest.	The facility is not enough for the whole community. Issues with regards to maintenance of the facility.	Enough storage facility should be distributed in the communities
NGO(CIKOD)	Farmers were taught how to make composting (Gozire, Zidung and Betanglu)	Supported farmers through the provision of improved seeds in 2015 Monitored on the success of the seeds in 2017	One crop variety is provided at a time. This is not enough to support household income	Different crop variety should be given to farmers
Local institution (Chief)	Call for meeting to find out issues with the community with regards to climate change	Sensitize communities about relevant information (e.g. climate change)	Language barrier: Sometimes translators use English words to give explanations which is difficult to understand especially if the things explained are not tangible. Distortion of information before it gets to the final listener	Similar words in the language should be used explanation

is done by government agencies in all the communities.

The study reveals that government-led programmes towards climate change adaptation have remained sustainable in all the communities. Berwong community, for example, has not had an NGO project in the last 10 years, are still using composting techniques taught to them by MoFA in 2012. There is also effective monitoring by the NGOs on the success of a programme in communities involved until the closure of that project. For instance, during the survey at Gozire, CIKOD has visited the community to check on the progress of the new groundnut seeds given to farmers in 2015. The NGO-led programmes appear to be taking up the 'adaptation space' from governments in both districts in the aspect of information and knowledge transfer and financial support (Padgham et al., 2015).

The traditional authorities are decision makers in the communities and are more concerned about the conservation of natural resource management. There are stricter rules to culprit who burnt trees. The survey shows that there are more local institutions in Lawra than in Nandom, bush burning and deforestation seems to be higher in the former than the latter.

### **Conclusion**

Changing of planting dates, planting of different varieties of the same crop, planting of trees and seasonal migration are major responses of smallholder farmers to perceived impacts of irregular and unpredictable rainfall, that rainfall ceasing rainfall during growing seasons and delayed onset of rains. NGOs (Care International, CIKOD, and ESOKO), government agencies (MoFA and NADMO), research institutions, chiefs and farmers group associations are the main institutions in the communities studied. The formal institutions mainly support climate change agriculture adaptation through the provision of early warning information, technical knowledge, and financial support (although negligible) to smallholder farmers at varying

scales. The major barriers are the inadequate financial capacity and skilled personnel to sustain on-going climate change adaptation strategies among farmers. Despite the lack of planned interventions in some communities such as Betanglu, farmers are learning from those communities that have, such as zero tolerance to bush burning in Zidung and Gozire. Informal institutions, on the other hand, mainly enforce laws on natural resource management and conservation and provide available information to farmers. Smallholder farmers' ability to adapt is hindered by lack of information about the risks associated with climate change and lack of access to financial resources.

Communities that do not develop initiatives towards climate change agricultural adaptation will remain poorer and incapacitated to face future climate change risks, as there are no agencies to invest in them. Interventions facilitated by mainly by MoFA are therefore needed in these communities in order to bridge the poverty gap between communities and avoid potential future conflicts over access to dwindling resources. With the growing overdependence on foreign/external support in the communities that have already developed adaptation initiatives, there is a risk of impacts on new local innovations. NGOs should concentrate on building farmers capacity that will lead to sustained implementation of strategies long after the NGO programme/project ends. Capacity building can be supported through training of radio/TV journalists about climate change risks and impacts. Student researchers can also educate farmers on climate change as they interact with them on their farmlands. This will help in more efficient dissemination of higher quality climate information among farmers. In addition, relevant findings from research institutions should be provided to the District Assemblies and chiefs' palaces in user friendly format such as posters or fliers. This will serve as a guide to new research being carried in the district and can also be easily communicated to the community members

during durbars or festivals.

### Acknowledgements

This work was carried out under the Adaptation at Scale in Semi-Arid Regions project (ASSAR). ASSAR is one of four research programmes funded under the Collaborative Adaptation Research Initiative in Africa and Asia (CARIAA), with financial support from the UK Government's Department for International Development (DfID) and the International Development Research Centre (IDRC), Canada. The views expressed in this work are those of the creators and do not necessarily represent those of DfID and IDRC or its Board of Governors.

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