CLIP
A LIFE-LINE TO LIFE

EMPOWERMENT LIFE PROGRAM 4
Equity and Sustainable Development

CLIMATE VULNERABILITY ASSESSMENT REPORT

SEPTEMBER, 2020

Table of Contents

1.0 Background

Ghana is a country that is vulnerable to climate change, due to its geographic location and economic dependence on agriculture. Agriculture forms an important part of Ghana's national economy and is key to ensuring food security as well as to maintain the trade balance, since it is the main source of livelihoods, employment, and export earnings. Cash crops such as cocoa contribute considerably to the GDP with 1.8% of Ghana's GDP in 2017 coming from cash crops, while the total share for agriculture was 18.3% in the same year (Ghana Statistical Service, 2018). Staple crops – namely maize, millet and cassava – are of great importance for food security. Agriculture is also amongst the sectors most exposed to climate change, since production of crops crucially depends of water availability and suitable climatic conditions. Those in turn are influenced by changes in precipitation (variability) and increase in temperatures projected under climate change. These shifts have already become reality in Ghana today. Researches, for example (Arndt, C., Asante, F., & Thurlow, J., 2015) have confirmed that smallholder farmers in Ghana are increasingly challenged by the uncertainty and variability of weather that climate change introduces, particularly in the Northern region of Ghana. The Prevalence of predominantly rain-fed, small-scale family farms, with only a small part of the sector being irrigated further increases the agricultural sector's vulnerability to climate change.

Climate change vulnerability in Ghana is greatest for those who: already experience high poverty; have limited access to alternative livelihoods; are strongly dependent on natural resources; and have the lowest capacity to cope with these changes. Thus, female-headed household and smallholder farmers are the most at risk groups. In Northern Ghana, these groups make up the majority of farmers. Women constitute 52% of the agricultural labour force and produce 70% of subsistence crops. In addition, they depend on water and crops due to their responsibilities in the household. They are hampered in their adaptive capacity to climate change due to various factors, including

inaccessibility of financial resources, a lack of information and technology, and unfavorable land tenure system.

Ghana has made significant progress in developing policies and frameworks on climate change. In 2013, Ghana's National Climate Change Policy was developed to provide strategic directions and co-ordinate climate change issues. In 2015, the National Climate Change Master Plan was launched and ten policy areas identified. Ghana has also ratified the UNFCCC, and the Copenhagen and Paris Agreement. In 2016, it submitted its first Nationally Determined Contributions to the UNFCCC, which is aligned with the national climate change master plan, the national medium-term development plans, the socio-economic transformational plan and the SDGs.

2.0 Introduction

The Empowerment for Life (E4L) program is in its fourth phase and is being implemented in 5 districts namely: Karaga, Kumbungu, Mion, Saboba and Savelugu districts in the Northern Region of Ghana. The program focuses on three key thematic areas; Inclusive Growth and Employment, Governance and Education. The Ghana Developing Communities Association (GDCA), Youth Empowerment for Life (YEfL) are implementing the E4L program in Ghana Venskab (Ghana Friends) in Denmark. Under GDCA, Changing Lives in Innovative Partnerships (CLIP) supports in the implementation of the *Inclusive Growth and Employment (IGE)* thematic area.

The program has worked with food security, livelihoods, climate change and employment for several years and continues to see it as an area of strategic importance, as it has overriding concern to the population in Northern Ghana, and to a higher degree determines their future opportunities and livelihoods. The program continues to pursue SDG 13 on climate change as it plays an important role, especially target 13.1 on strengthened resilience and adaptive capacity. The expected outcome for inclusive growth and employment under E4L is – '*rural communities are climate adaptive and have improved livelihoods and resilience'*.

The program work to promote that farmers have increased knowledge on the effects of climate change, and that communities develop localized climate change management approaches. Adaptation and mitigation measures are used to support farmers and vulnerable households especially women to reduce the impact of climate change on their livelihoods. This is done through capacity building for adoption and resilience to the impact of global warming, improving farmers, especially women's access to climate information, technology, and productive resources to strengthen their coping capacity, among others. The choice of contextualized adaptation technologies such as water conservation, irrigation, and improved seeds will be an immediate outcome of climate change vulnerability assessment. The program will also facilitate and build the capacities of farmers to adopt non-burning farming practices, biodiversity conservation and watershed management among others. Active youth will be identified and trained as community environment brigades to combat deforestation and bush burning in the communities and promote sustainable environmental practices.

The program has embarked on this vulnerability assessments to determine the magnitude of the impact of weather variations resulting from climate change on the productivity and livelihoods of smallholder farmers in the E4L operational districts. By this, the program will unearth the current resilient strategies of the farmers, areas of deficient adaptive capacity and the identification and implementation of the most appropriate climate resilient strategies to improve the livelihoods of the farmers.

3.0 Objectives/ purpose of the assessment

Goal/purpose of Vulnerability Assessment: To assess the vulnerability of communities in the E4L program districts to climate change in order to identify and implement the appropriate adaptation/resilient strategies to improve the livelihoods of smallholder farmers.

The specific objectives of the assessment were:

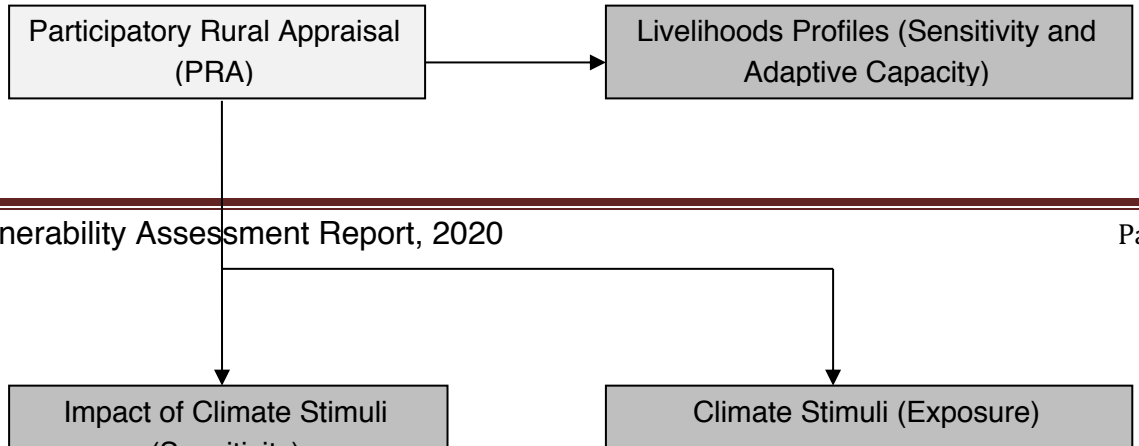
1. To assess how climate change has affected the livelihoods of smallholder farmers.
2. To identify, prioritize and adapt the most appropriate climate resilient options to improve the livelihoods of smallholder farmers.

4.0 Methodology

Bottom-up approach to vulnerability assessment was mainly employed in assessing the past and current vulnerability of the smallholder farmers. Diagram 1 below stipulates the main methodology used in the assessment. Simulation models to determine the future vulnerability of the districts were not conducted and thus, not included in this report. The report focuses only on the outcome of assessing the current vulnerability of the E4L districts of Karaga, Kumbungu, Mion, Saboba and Savelugu.

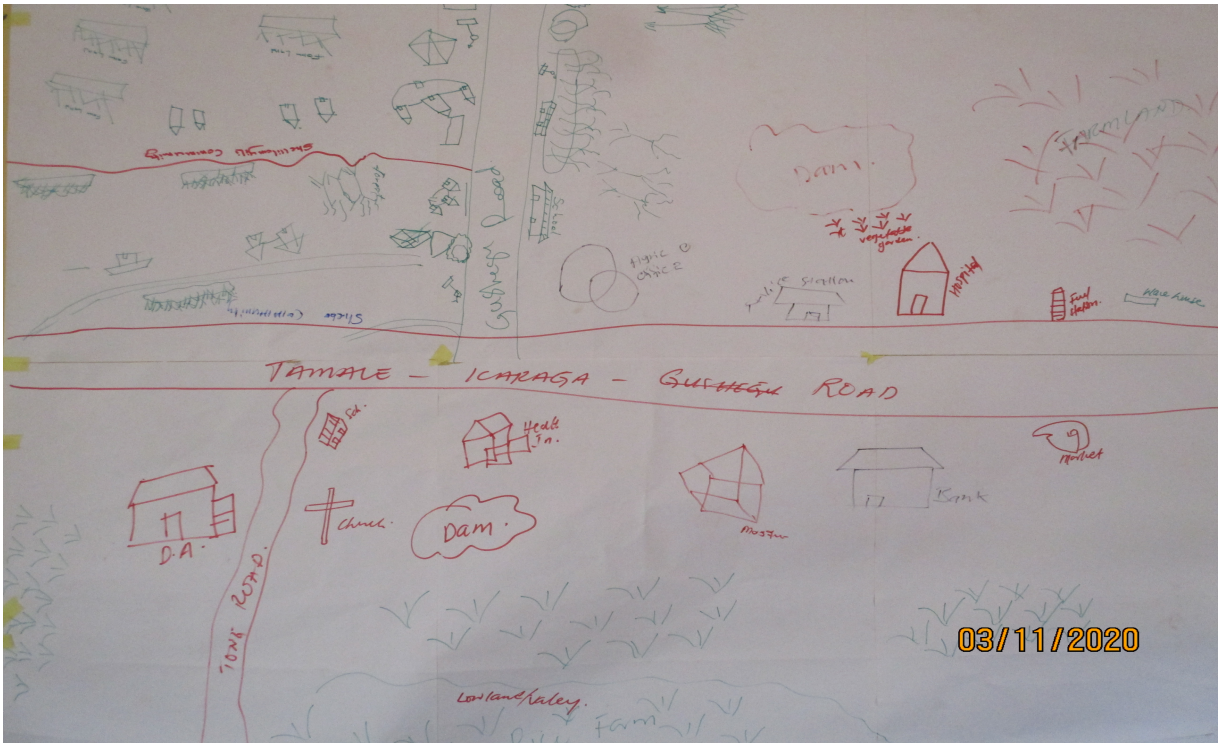
Qualitative information was gathered through participatory exercises involving mainly focus group discussions and the participatory generation of resource maps, seasonal and crop calendars. Participatory Rural Appraisal (PRA) tools were used at a local level to identify the key vulnerabilities of local communities, to understand how community members perceive risks and threats to their lives and livelihoods, and to analyze resources and strategies to address or reduce risks. The outputs produced using PRA tools cut across the different components of vulnerability. The information gathered using the individual PRA tools usually informs different aspects of the assessment. Based on perception of farmers on previous long-term climate data, climate trend analyses were performed for the districts in which the program communities are located.

Diagram 1; Methodology applied in the vulnerability assessment of the E4L districts



Community Resource maps were drawn by the farmers to depict the location of spatial features and the availability of resources in the communities. Subsequently, a discussion ensued about the location of certain features in the communities, e.g. markets and ponds. Finally, the farmers also indicated water bodies, irrigation water sources, areas that are particularly prone to flooding and waterlogging, and cropping patterns. Picture 1 below shows the resource map of Karaga district.

Picture 1; Resource Map of Karaga District



Seasonal climate calendars were used to draw out rainfall and temperature patterns and their extremes throughout the year. By constructing these calendars for the perceived current and past climate, changes in local climatic conditions became apparent. Moreover, this exercise formed the basis of discussions about the influence of weather conditions on agricultural production.

Crop calendars were drawn up during focus group discussions with communities. In addition to specifying which crops are cultivated in which period of the year, the crop calendars identify crop consumption patterns. Based on crop production and consumption patterns, periods of food shortage and livelihood patterns were then characterized. The crop calendar exercise also helped to identify major sources of income, threats to local livelihoods, and seasonal migration patterns of agricultural labourers.

Literatures were reviewed to determine whether farmers' perception on the changes in the weather conditions were consistent with scientific data. Through this, illustrations were extracted from (<ahref='https://www.worldweatheronline.com/' title='Historical average weather'>Data provided by WorldWeatherOnline.com) to contrast data generated from farmers in the 5 districts.

5.0 Assessing the current vulnerability

5.1 Exposure to Climate Change

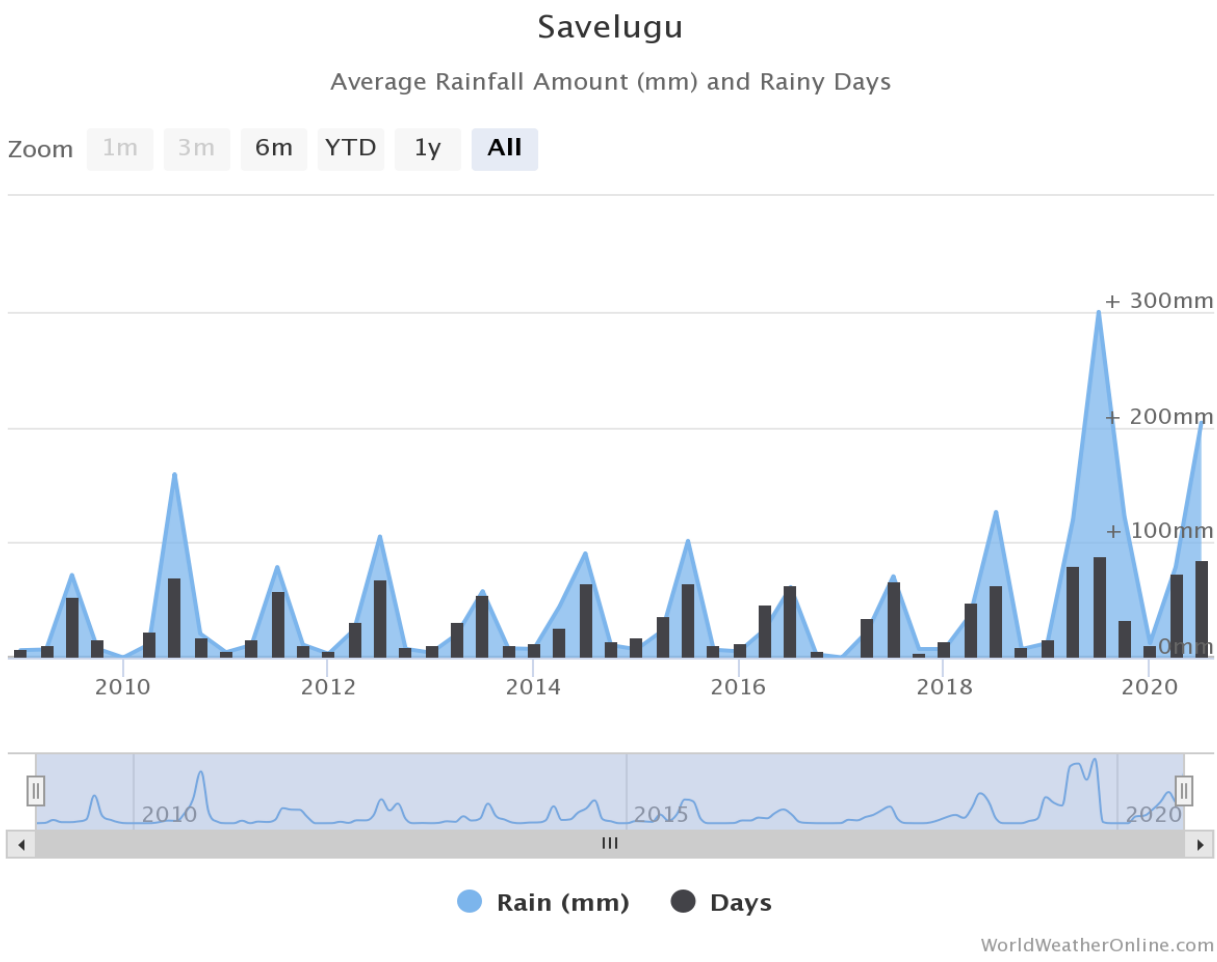
Climate trends at the level of the individual communities were assessed through the participatory development of seasonal calendars that focus on weather behaviour for the past forty (40) years. The farmers pointed out that temperature in the five districts has gradually become warmer than before. Since 1990, rainfall has become increasingly more erratic. The number of rainy days and the amount of rain per month vary considerably from year to year. The perception of the farmers on the rise in temperatures has been confirmed in many research reports including the Climate Risk Analysis for Identifying and Weighing Adaptation Strategies in Ghana by Lisa Murken &

Christoph Gornott, 2019. Unexpected sudden downpours frequently interrupt rice-harvesting activities in October and November. Livelihoods of households are lost due to severe drought and flooding of farmlands. Furthermore, new pest and diseases affects their crops and livestock from 2010 – 2020 such as the fall armyworm.

5.1.1 Perception of Communities on Climate Change (Exposure)

Farmers' perspective on climate change from the Focus Group Discussion (FGD), it emerged that farmers have experienced increment in rainfall amounts and changes in the rainfall regime. It was reported that there have been changes in the onset and as well as the cessation of rainfall for the rainy seasons in recent decades. In illustration 1 below, it is evident that there has been an increase in the average rainfall amount from the year 2010 to 2020. Similarly, the years of 2019 and 2020 have recorded more rainy days than the previous years. This confirms the perception of the farmers that the rainfall amount have increased and more erratic in nature.

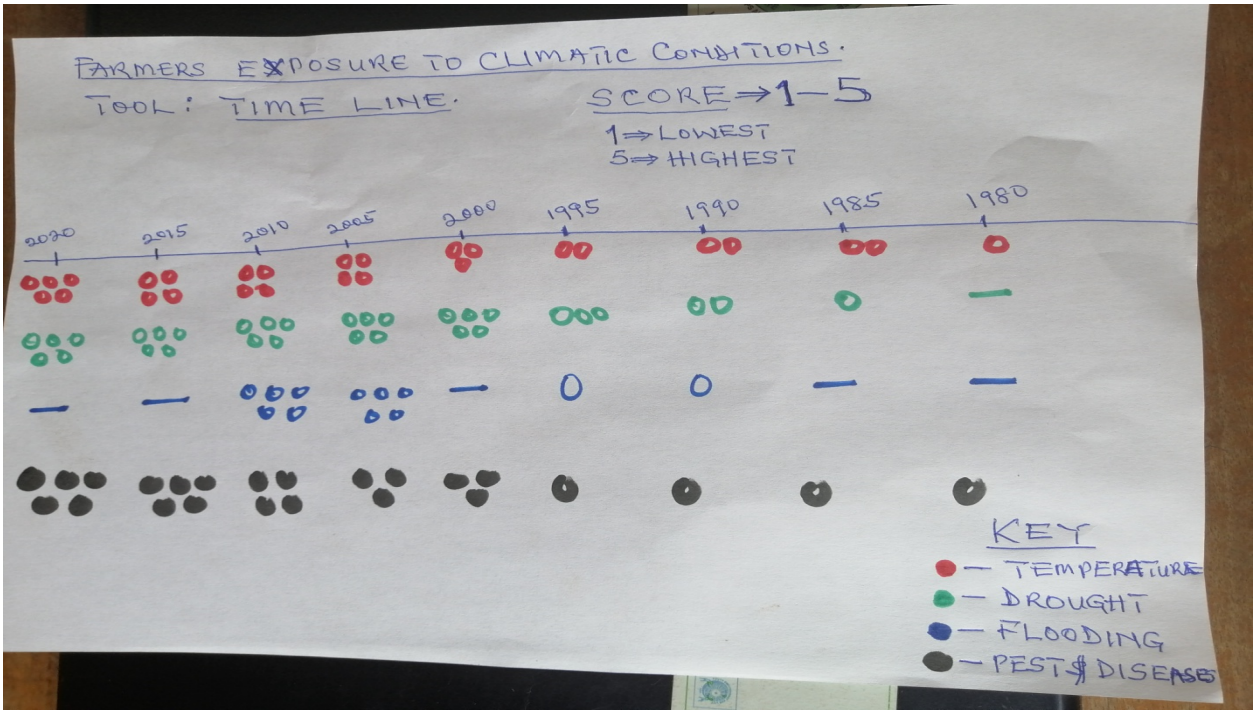
Illustration 1; Average rainfall amounts and rainy days in Savelugu Municipal



The farmers believe that the situation is mainly due to changes in rainfall patterns, which they cannot predict for their planting dates. Farmers reported the changes in the rainfall pattern to have occurred over the past 15 - 30 years but the effect has been especially severe in the past 3 years. This observation is consistent with typical behavior in which recent harsh conditions are remembered more clearly than older events. At Tuya community in the Mion District, it was observed that, they used to experience more rains in July, that is the peak of the season and this is now being experienced in September recently. In addition, the rainy period has extended to late October. When asked what they think is the cause of the changing pattern of rainfall, some claimed it is God's way of doing things. Others said the cause resulted from using agro-chemicals, bad farming practices and deforestation. In fact, all the focus groups in

the five (5) E4L districts agreed that deforestation is a major cause of the recent declines and changes in the rainfall pattern in the savanna zone. The farmers believe that the cause of the changes in the rainfall pattern is the cutting of big trees in the surrounding forests and the destruction of forest cover by some community members through bush fires. The farmers believe that by enforcing community laws on bushfires, the climate will change to favor them.

Picture 2; Climate Hazard Trend Analysis/Timeline

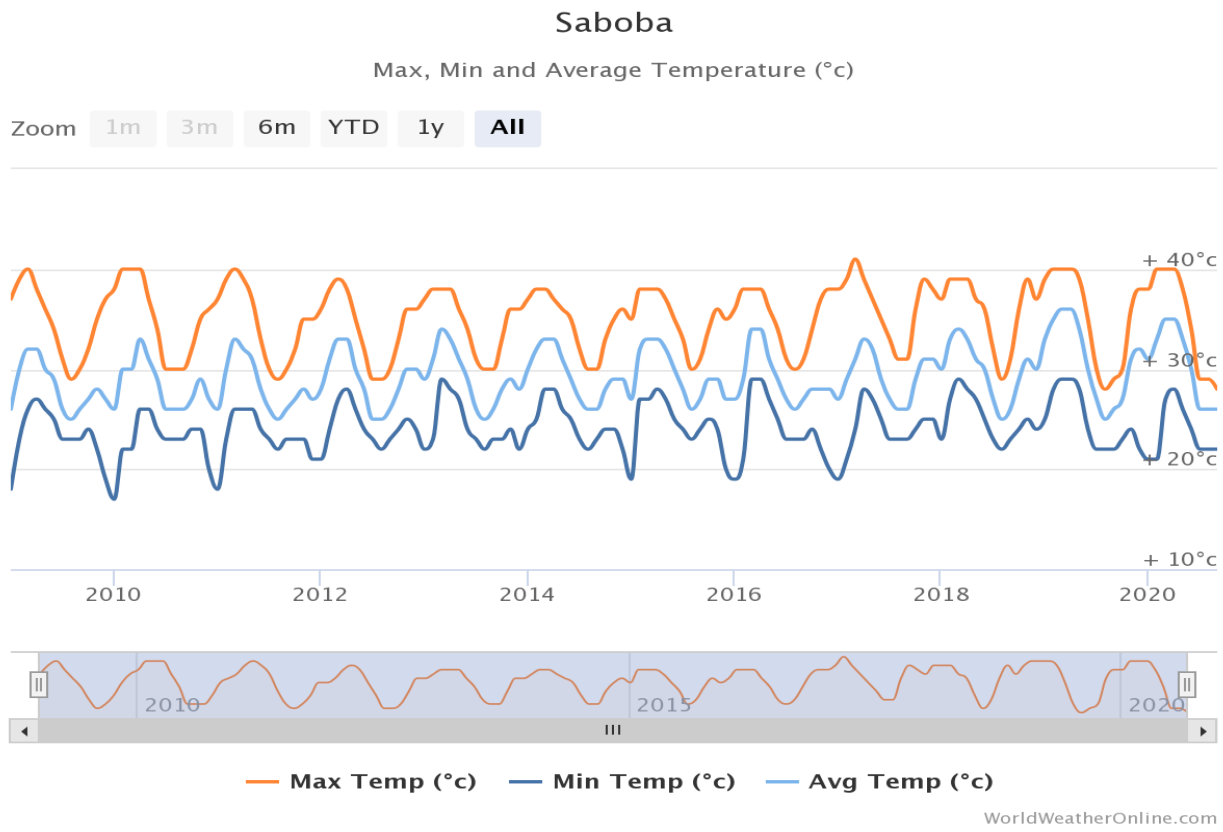


The farmers also perceived that, they are experiencing more drought than before due to changes in the weather and rainfall patterns. According to them, it is difficult to predict the exact period and intensity of the drought. Similarly, they experience intense yearly flooding of their farmlands and homes during the rainy season.

In a climate hazard trend analysis in Karaga as shown in picture 2 above, the farmers indicated that there has been a continues rise in temperature from the year 2000 to 2020. This means that they are experiencing warmer weather conditions than before.

Similarly, the farmers have experienced more drought, and pest and diseases from the year 1995 – 2020. From illustration 2 below, it can be discerned that the year 2019 and 2020 have recorded maximum temperatures of 40+ as compare to the years from 2012 – 2016 and 2018. Though the years; 2010, 2011 and 2017 have equally recorded a maximum temperature of 40+, the intensities are different as indicated by the shapes of the graphs. Similarly, the year 2019 and 2020 has recorded higher minimum temperatures of 20+ as against the past years; 2015 - 2017. This confirms the assertion of the farmers that temperatures are rising and as a result they are experiencing warmer conditions than before.

Illustration 2; Average temperatures in Saboba District



5.2 Sensitivity to Climate Change

Government statistics and focus group discussions showed that rain-fed agriculture remains the primary occupation in the program districts. The main crops for farmers are maize, rice, soybean, and groundnut. These crops are affected greatly by flooding and drought leading to low crop yield and its associated consequences. The 2019 four - week prolonged drought experienced in early August destroyed many maize farms in all the five districts. Due to changes in rainfall patterns, incidences of water logging are increasing and agricultural yields are going down. For example, in 2019, many rice fields were due for harvest and water was still in the fields hampering harvesting and thus reduced the productivity of the farms. Also, with shifting of rainfall patterns, more crops are affected, as farmers do not have full control/knowledge on the planting season.

5.2.1 Livelihoods Sensitivity to Climate Change

The observed climate variability has influenced heavily on the livelihoods of farmers in the communities. During a focus group discussion session, it was discovered that the economic activities of the farmers are greatly impacted by changes in weather conditions due to climate change. Below is an assessment of how climate change has affected the main livelihood activities of the smallholder farmers in the communities.

Crop Farming

According to the survey, it is estimated that about 98% of households in the communities have food crop farming as their main source of livelihood. It is predominantly rain-fed crop farming. As a result, it is impacted greatly by the changes in the weather condition in the form of droughts, floods, erratic rainfall, pest and diseases, etc. The table below shows the percentage of households having crop production as their major occupation in the districts assessed.

Table 1; Crop farming households in the districts

District	Number of households	Percentage (%)
Karaga	7162	98.6
Kumbungu	3860	97.9
Mion	8040	98.7
Saboba	8187	97.7
Savelugu	12703	97.0

(Source; PHC, 2010)

It was revealed through the FGDs that, the erratic rainfall patterns manifest their impacts in reduced crop yields since crops do not have enough water for the entire growing season. The erratic rainfall patterns and the corresponding impacts on crop water needs and crop yields have grave implications for food security in the communities, since they subsist on the food they produce every year. Crop failure and/or reduced crop yield would imply that their source of livelihood is at risk. Peasant farming is the only source of food supply in the communities, the implication of crop failure is starvation and malnutrition.

More so, floods manifest its impacts in crop failure due to waterlogging and in other cases complete destruction of crops. Flood also leads to loss of farmland, implying that no form of agricultural activities will be done in the farmland. It was also revealed that droughts, floods, diseases and pest such as the fall armyworm, variegated grasshopper reduce crop yield, making the communities food insecure. Based on a discussion on crop calendars, it was revealed that majority of the farmer households are food insecure from April – June. This was attributed to poor yields, and food shortages leading to increase in the prices of food crops. According to them, already their harvest does not feed them all year round and the manifestation of climate change in poor crop yields has worsen their plights by strengthening their food insecurity.

Livestock production

Livestock production is also another main source of livelihoods for smallholder farmers in communities in the districts. Literature from the 2010 Population and Housing Census

(PHC, 2010) indicates that an average of 70% of the households in the districts is engaged in livestock production. The table below presents the number of households and its percentages for the respective districts that are engaged in livestock production.

Table 2: Number of households engaged in Livestock production

Districts	Households	Percentage
Karaga	4584	63.1
Kumbungu	3208	81.4
Mion	4465	54.8
Saboba	6952	83.0
Savelugu	9001	68.7

(Source; PHC, 2010)

According to the farmers, they rely on cash from the sale of the livestock to buy food when their crops fail them. Unfortunately, this livelihood source is also greatly impacted by climate variability. It unearths that, their animals are affected in the form of new pests and diseases, no/inadequate quality pasture for grazing due to drought, difficulty in watering their animals since most stream, dams and rivers easily dry-up. All these manifest in low productivity and high animal mortality. It was also revealed that veterinary services are very poor in the communities since it is difficult to get vet officers to treat animals when they are sick.

Agro-processing

Majority of the women in the communities are engaged in agro-processing, this include; rice, sheanuts, soya bean, etc. The women argued that, their main source of water for processing food crops are from dams, streams, rivers, boreholes and dugout in the communities. These water sources are not able to provide them with water all year round due to lower level of water in them due to rising temperatures and droughts. This they said has affected their businesses. Usually they have to spend more time in getting water or even buy water and this is adding up to their cost. Furthermore, poor crop yield resulting from erratic rainfall, droughts, floods etc. has contributed in increasing the price of crops for processing.

The diagram below provides a general illustration of the sensitivity of the smallholder farmers' livelihoods to climate change.

Diagram 2; Livelihood sensitivity to climate change

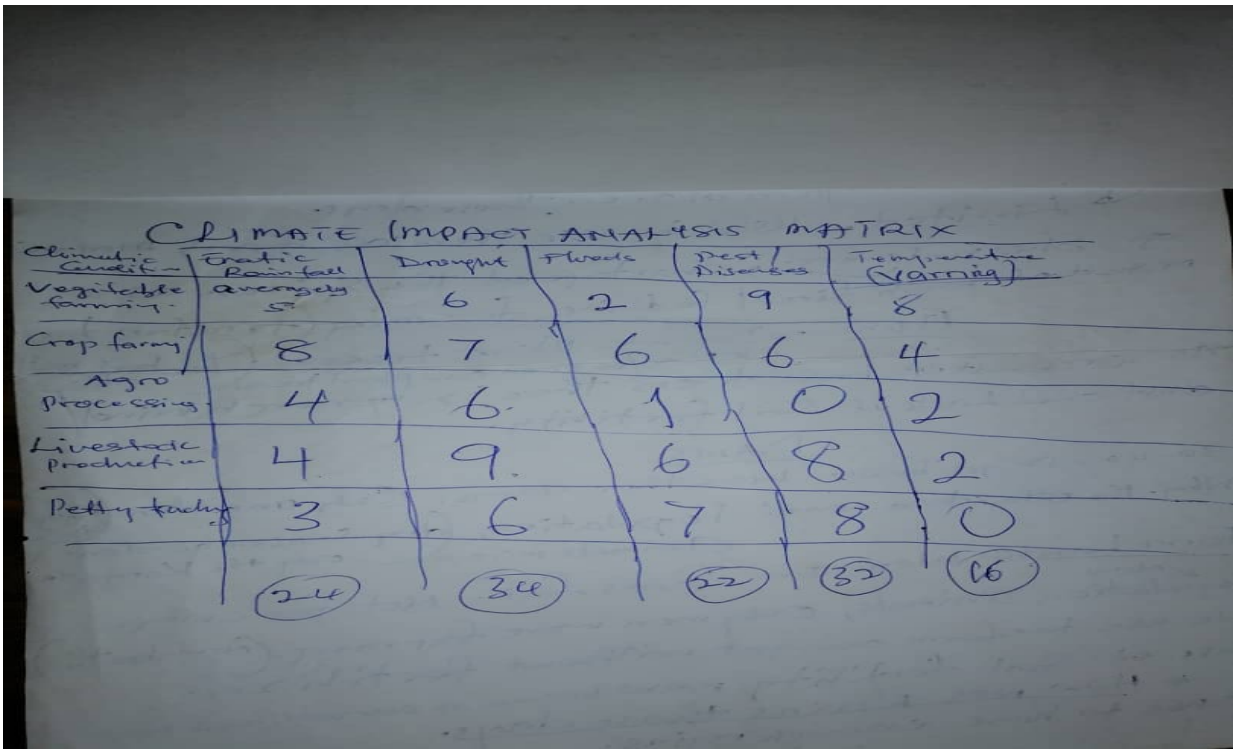
Observed climate changes	Experienced impacts on livelihood systems	Potential future risks
higher temperatures linked with decreased water availability	Drying up of water bodies; less flow in dams, rivers and streams	Growing food and livelihood insecurity; Scarcity of water for drinking and agriculture; increase in health problems; increased workload for women and children; children staying away from school
	Loss of land	growing food insecurity,
	Decreased quality of pastures, lack of fodder	Dependence on cash income; food insecurity
	Increased pests	Crop failure Reliance on cash income
	early vegetative period	Crop failure

(Source: Field Survey, 2020)

In a FGD session at Jilimani community in the Saboba district where farmers were facilitated to discuss the impact of climate change on their livelihoods through Climate Impact Analysis tool. It was evident from the discussion that crop farming and livestock production were the most impacted by climate change variables; temperature rise, drought, floods, erratic rainfall and pests and diseases. This is illustrated in picture 3 below. Drought was ranked 1st as the weather variable that had the highest impact on their livelihoods, followed by pests and diseases, erratic rainfall, floods and rise in

temperature. Also erratic rainfall was seen as one with much impact on crop farming, whilst drought was identified to be impacting more on livestock production.

Picture 3; Climate Impact Analysis matrix



CLIMATE IMPACT ANALYSIS MATRIX

Climatic Credit	Erratic Rainfall	Drought	Floods	Pest / Diseases	Temperature (Warming)
Vegitable farming	averagely 5	6	2	9	8
Crop farming	8	7	6	6	4
Agro Processing	4	6	1	0	2
Livestock Production	4	9	6	8	2
Petty trading	3	6	7	8	0
	24	34	22	32	16

(Source: Field Survey, 2020)

Picture 4; Participatory climate impact analysis matrix

(Source: Field Survey, 2020)

5.3 Adaptive capacity to climate change

Farming households perceive themselves to be highly vulnerable to extreme events, especially flooding, and have developed various strategies to cope with these extreme situations. These strategies include the protection of property in times of extreme events, use of organic fertility to improve agriculture fields, use of improve seeds (very limited people), sale of properties, migrate to other communities /cities etc. Local farming communities do not only have to deal with extreme events like floods; they also respond to low crop yield or total crop failure due to waterlogging, high temperatures or insufficient rainfall. In order to ensure sufficient financial household resources, farmers also often borrow money from the Village Savings and Loans Association (VSLA), others borrow at a high interest rate from local moneylenders. Another common way to deal with a lack of financial resources in times of crisis is to sell livestock, thereby diminishing the household's resource base. It was also pointed out that, they have

improved capacity in the use of good agriculture technologies which supports them to adapt to the changing climate.

5.3.1 Existing adaptive/resilient capacities

Though the livelihoods of smallholder farmers are greatly affected by climate change as discussed above, they have employed strategies to reduce the climate impacts. Through the FGD on coping and resilient strategies they are using to reduce the climate impacts on their livelihoods, they enumerated a number of strategies. The table below depicts the current resilient strategies that farmers in the respective districts are using to reduce the climate impacts.

Table 3; Current resilient strategies used by farmers

Name of District	Coping/Resilient Strategies
Karaga	- Planting early maturity crops - Use of drought resistant crops - Good agriculture practices (eg; planting in row and planting distance) - Application of fertilizer and manure - The use of ash and neem to control pest and diseases - Non-farming activities; Petty trading, agro-processing
Kumbungu	- Use of improved seeds - Good agricultural practices (eg; planting in row and planting distance) - Organic compost preparation and application - Village Savings and Loans Association (VSLA) - Non-farming activities; Petty trading, agro-processing
Mion	- Sale of animals to buy food - Solidarity from family and friends

	- Hunting - Migration to bigger cities - Good agricultural practices(eg; planting in row and planting distance) - Non-farming activities; Petty trading, agro-processing
Saboba	- Change in crop varieties - Sale of livestock - Consumption/food intake is regulated - Rely on other family/community members - Suspend activities such as funerals and many other social activities, - Village Savings and Loan Associations
Savelugu	- Good agriculture practices (eg; planting in row and planting distance) - Migration to bigger cities - Sale of properties/animals to buy food - Use of improve crop varieties - Village Savings and Loans Association (VSLA) - Non-farming activities- petty trading

(Source; Field Survey, 2020)

5.3.2 Identified Gaps in adaptive/resilient capacities

The assessment has exposed gaps in strengthening the adaptive capacities of the smallholder farmers in the 5 districts. Interestingly, all the gaps identified in each of the districts are similar. The following are the major gaps that were outlined by the farmers during the FGD session.

1. Lack of Climate information/data; the farmers lamented that they are not able to effectively plan the farming periods/season due to non-availability of accurate

information/data. This has made the farmers more vulnerable as they are unable to predict the weather variables to effectively plan their farming. This often leads to crop failure as discussed in the chapters above.

2. Livelihoods diversification; some of the livelihood options mentioned by the farmers include; beekeeping, fish farming, agro-processing, dry-season vegetable cultivation, small ruminants production, trading etc. Because farmers lack or have inadequate capacity in alternative livelihood sources, they heavily rely on rain-fed agriculture that makes them the most vulnerable to climate change.
3. Irrigation; Majority of the farmers are not aware of cost effective irrigation systems and as such do not practice them though there are available dams and rivers in their communities. Some of the irrigation options identified include; dug-outs, rain water harvesters, drip irrigation etc. With this, smallholder farmers will engage in whole year crop farming with little/no impacts of climate change.
4. Post-harvest loss technologies; the farmers worried that, the few crops yield they get are further loss to poor or inadequate capacity on post-harvest technologies. Effective post-harvest management is crucial to avoid food loss along the value chain. With climate change altering growing and harvesting seasons, post – harvest management is crucial to cope with increased uncertainties. It is a risk reducing strategy that lowers the vulnerability of crop production to climate impacts
5. Improved crop varieties; smallholder farmers in northern Ghana mostly use traditional crop varieties, which can be vulnerable to climate impacts such as droughts, floods or also diseases. In order to improve the resilience of crops to climate shocks and to raise yields, improved crop varieties are bred from traditional varieties. Improved varieties can substantially improve agricultural yields and resilience. In northern region, recent research showed that only about 20% of farmers use improved seeds, which is even less than the estimated 25% of farmers who use improved seeds in Sub-Sahara Africa in general (Innovation

for Poverty Action, 2018). Similarly a research on the GoG flagship program- PfJ showed that only 35% of farmer in the E4L implementing district use improved seeds (CLIP, 2018).

6. Disaster risk management; the farmers blamed the changes in the weather variables to the destruction of the environment, eg; deforestation, destruction of biodiversity through bush fires, etc. These activities embarked by members of the communities also destroy the organic matter content of the soil, making it unsuitable to support plant growth. Effective environmental management systems in the communities will combat the associated risk of climate exposure experienced by farmers in the communities.
7. Good Agricultural Practices; Though some of the farmers in the communities indicated they have improved capacity and practice good agricultural practices, majority of them still lack capacities on good agricultural practices. Good agricultural practices reduce the climatic impact on crops and supports plants growth and yield.
8. Climate SMART Agriculture; This will build the resilience of farmers to climate impacts in the communities. In that, due to low precipitation caused by climate change, climate SMART agriculture (conservation agriculture) will support and growth and yield of farmers in the communities.
9. Improved access to financial services; Through the E4L program, a number of VSLAs have been formed and this has improved farmers access to financial resources. There is still the need to facilitate the formation of more VSLAs and their linkage to financial service providers and mobile money agents to further improve on their access to financial services in the communities.
10. Linkage to stakeholders/district assemblies; the assessment revealed a gap between the farmers and major Government departments in the districts. It was found out that, majority of the farmers are not aware of the mandates of major departments/stakeholders in the district and as such does not know who to engage on what issues.

5.3.3 Available District/Community Resources to support adaptive/resilient capacities

1. Availability of dams/rivers; all the 5 districts have perennial dams that can support irrigation. For example In Saboba district there are perennial dams in; Tanjemeli and Namongbani in the Demong Area council, Natagu and Wapuli, another dam between Jilimani and Nakpanboln. Stream/river in wapuli from saboba and it runs through these communities; Natagu, Jilimani, Nakpaboln and Wapuli. Also the river Oti passess through Sanguli, Sobiba and Kpegu. There are Perennial Dams also at Kpegu, Sanguli and saboba town.

2. Economic trees; There are economic trees in the districts that smallholder farmers can utilize to diversify their livelihoods. Some of these trees include; shea nut trees, dawadawa trees etc. Also, these trees can support beekeeping in the communities.

3. Vast land for food crops and animal grazing; the districts are also characterized by vast arable land and grazing fields that supports commercial livestock production. As a result, about 70% of households in the districts keep livestock at small scale (PHC, 2010). This provides an opportunity for farmers to engage in commercial production of livestocks.

4. Markets; Availability of markets in the districts for business transactions. There is huge market demand for food crops, livestock, agricultural commodities in the value chain, honey etc. This means the market will support the various livelihood diversification initiatives of farmers in the communities.

5. Relevant Institutions/stakeholders; there are relevant key stakeholders/institutions in the district that will also support in building the

resilience of farmers in the communities. These institutions include; MoFA, District Assemblies, Business development offices (BUSAC),etc

6.0 Assessing the overall current vulnerability

The overall current vulnerability assessment for the 5 districts showed that local livelihoods are heavily dependent on rain-fed agricultural production (98% of households). Shifting or unpredicted rainfall patterns and increasing temperatures lead to decreasing crop yields. Incidence of pests and diseases eg fall army worm, variegation grasshoppers also reduces agriculture productivity. Longer periods of waterlogging and floods put an additional stress on crops and further reduce yields. As a response to decreasing agricultural production due to shifting rainfall patterns and increasing temperatures, most farmers tend to shift to or also engaged in non- crop farming activities such as livestock production, petty trading, craftsmanship etc. Majority of the youth migrate to bigger cities for greener pastures. Some of the districts also suffer from additional stresses through flooding and riverbank erosion.

7.0 Conclusion and Recommendation

The assessment has revealed that, the overall current vulnerability of the E4L districts and communities in terms of; how they are exposed to weather variability, how climate change impact on their livelihoods, existing adaptive capacities and adaptive capacity gaps needed to be filled to improve the farmers' resilience to climate change.

It is evident from the above array of analysis that climate change has impacted negatively on the livelihoods of smallholder farmers in the E4L districts. This has contributed to making them poorer and strengthens or increases their food insecurity. To build the resilience of farmers to climate change, the assessment has revealed a list of appropriate adaptation strategies that can improve the adaptive capacities of farmers

in the communities. Table 4 below provides a list of recommended resilient strategies to improve the adaptive capacity of the smallholder farmers in the communities.

Table 4: Recommended appropriate resilient strategies for implementation

District	Appropriate Resilient strategy	Key activities	Responsibility
Karaga	Irrigation for dry season vegetable farming	Acquisition of land closer to water body Provision of farm inputs seed/seedlings Provision of farm tools including water pumping machines and hose. Provision of fence for garden	Community E4L program E4L program E4L program
	Cage Fish Farming	Fabricate of fish cages Procurement of nets (inner, harper, outer and cover nets) Procurement of fingerlings and fish feed Procurement of canoe	E4L program
	Green house farming	Land for green house Procure materials to set-up green house Procure farm inputs (eg; seed/seedling etc) Procure farm tools	Community E4L program E4L program E4L program
	Bee keeping	Identification and selection of appropriate site Provision of bee hives	Community and E4L program

		Training and sensitization	E4L program
	Promoting and improving livestock for sale	Acquire land, pen and fence Purchasing of livestock for rearing Animal husbandry training	Community E4L program CLWs
	Improve capacity in post-harvest technologies	Training on post-harvest loss technologies Procure technology inputs	E4L program
	Improved access to climate information	Establish a multi-stakeholder platform to include; farmers, researchers, meteo stations, Mofa, DAs, etc Establish a platform to facilitate farmers easy access to climate data Link farmers to meteorological stations	E4L program
Kumbungu	Irrigation for dry season vegetable farming	Acquisition of land closer to water body Provision of farm inputs seed/seedlings Provision of farm tools including water pumping machines and hose. Provision of fence for garden	Community E4L program E4L program E4L program
	Promoting and improving livestock	Acquire land, pen and fence Purchasing of livestock for rearing	Community E4L program

	for sale	Animal husbandry training	CLWs
	Disaster risk reduction strategies	Formation and training of community environment brigades Establish community woodland and growing of economic trees Link environmental brigades with community journalist for advocacy	E4L program
	Improve capacity in post-harvest technologies	Training on post-harvest loss technologies Procure technology inputs	E4L program
	Promoting and improving livestock for sale	Acquire land, pen and fence Purchasing of livestock for rearing Animal husbandry training	Community E4L program CLWs
Mion	Improved access to climate information	Establish a multi-stakeholder platform to include; farmers, researchers, meteo stations, Mofa, DAs, etc Establish a platform to facilitate farmers easy access to climate data Link farmers to meteorological stations	E4L program
	Value addition to food	Identification of value addition capacity	E4L program

	crops (agro-processing)	needs - Training on identified value addition capacity need/gap - Market linkage	
	Disaster risk reduction strategies	- Formation and training of community environment brigades - Establish community woodland and growing of economic trees - Link environmental brigades with community journalist for advocacy	- E4L program
	Irrigation for dry season vegetable farming	- Acquisition of land closer to water body - Provision of farm inputs seed/seedlings - Provision of farm tools including water pumping machines and hose. - Provision of fence for garden	- Community - E4L program
Saboba	Cage Fish Farming	- Fabrication of fish cages - Procurement of nets (inner, harper, outer and cover nets) - Procurement of fingerlings and fish feed - Procurement of canoe	- E4L Program

	Bee keeping	Identification and selection of appropriate site Provision of bee hives Training and sensitization	Community & E4L program E4L Program
	Improving access to climate information	Establish a multi-stakeholder platform to include; farmers, researchers, meteo stations, Mofa, DAs, etc Establish a platform to facilitate farmers easy access to climate data Link farmers to meteorological stations	E4L Program
	Irrigation for dry season vegetable production	Acquisition of land closer to water body Provision of farm inputs seed/seedlings Provision of farm tools including water pumping machines and hose. Provision of fence for garden	Community E4L program
	Green House farming	Land for green house Procure materials to set-up green house Procure farm inputs (eg; seed/seedling etc) Procure farm tools	Community E4L program E4L program E4L program
	Bee keeping	Identification and selection of appropriate	E4L Program

Savelugu		site - Provision of bee hives - Training and sensitization	
	Promoting and Improving livestock for sale	- Acquire land, pen and fence - Purchasing of livestock for rearing - Animal husbandry training	- Community - E4L Program
	Improving access to climate information	- Establish a multi-stakeholder platform to include; farmers, researchers, meteo stations, Mofa, DAs, etc - Establish a platform to facilitate farmers easy access to climate data - Link farmers to meteorological stations	- E4L Program

(Source: Field Survey, 2020)