

**PERCEPTIONS OF CLIMATE CHANGE AND ADAPTATION: A CASE OF
PEASANTS IN THE BUILSA DISTRICT OF THE UPPER EAST REGION OF
GHANA.**

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DEDICATION

I dedicate this work to my wife and children's. To my wife Awenjaab Bertha Awentemi especially, I thank you for your understanding in allowing me study abroad.

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ABSTRACT

Cropping patterns in the Builsa district of Ghana are gradually changing and faced with a perceived climate change and its negative consequences on the livelihoods of peasant farmers in the district, it is often assumed that climate change is the sole driver of changes in land-use decisions of peasants. The aim of this study is to examine the perceptions of farmers towards climate change and to measure the extent to which climate variability affect cropping patterns in the Bulisa District of the upper east region of Ghana over the last two decades (1990-2009), how vulnerable peasants are and some response or adaptive measures by peasants in the District to climate change.

Using household surveys, oral histories, group interviews and 24-hour dietary recalls, substantial changes in cropping patterns were observed by peasant farmers in the Builsa district. Peasants have not only adopted new varieties of crops like soya beans and garden eggs but in addition cultivate improved varieties of old crops. These changes in crops grown were explained not only by climate factors such as increased temperatures, reduction in rainfall amount and distribution over the years, shifts in the onset of rains, but also, non-climate factors. From my informants, the most important thing is not about the total amount of rainfall received in a year rather its availability during the critical months of the cropping season. My informants also observed that insufficient labour, inadequate extension services, inability to purchase improved seeds and other agricultural inputs, the decline in market for some varieties of old crops, global influence through the activities of markets, NGOs and state departments and agencies etc, are partly responsible for the types of crops they grow today. It was also observed that off-farm and non-farm livelihood activities were not given the needed attention they deserved by peasants which might increase their level of vulnerability to changes in climate. It is the non-farm activities and the structural factors influencing the farming system that deserve much attention if the risk of climate change is to be reduced. The analysis was done using the sustainable livelihood approach which brings onboard all the dimensions of the peasantry livelihoods.

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ABBREVIATIONS

ADRA: Adventists Development Relief Agency

IPCC: Intergovernmental Panel on Climate Change

NC: National Communication on Climate Change

NDC: National Democratic Congress

NGOs: Non-Government Organisations

NPP: New Patriotic Party

SARI: Savannah Agricultural Management Institute

SRMP: Savannah Resources Management Project

VIP: Village Infrastructure Project

Glossary

By Day: Sale of labour for instant cash

Pito: local name for the local beer brewed in Ghana

T.Z.: A locally made dish from the flour of maize, millet and sorghum

CHAPTER 1

1.0 Introduction

The intricate relationship between humankind and the environment has long been observed by both traditional users and academics alike and it is now with little doubt that humankind influences the environment and the environment in turn influences the activities of people. A significant environmental feature that people are said to have modified greatly through their activities in this 21st century is global climate. This modification it is predicted will have some positive and negative consequences (Rosenzweig & Tubiello 2007, pg.858) for different places and people across the globe thus generating a relatively new issue (climate change) which attracts both researchers and academics alike as it has the potential of affecting countries, communities, groups and the individual in their effort to appropriate environmental resources for survival.

There is interestingly some good debate at both the global and local scales as to the challenges climate change brings in terms of making some people and groups more vulnerable to hunger, malnutrition and disease and the adaptive strategies to be taken by regions which are more sensitive to change. Climate change, it is argued, is now seen as an issue influenced greatly by anthropogenic forces in the area of greenhouse gas emissions, and the IPCC (2001a cited in Adger et al., 2003) has the view that ‘there is little doubt that human- induced climate change is happening’. This according to them means "All societies consequently need to learn to cope with the changes that are predicted-warmer temperatures, drier soils, changes in weather extremes and rising sea levels” (Adger, et al., 2003). Some researchers have it that climate change and globalisation expose farmers to new conditions in which some are better equipped to take advantage of the situation than others, especially those from developing countries are becoming increasingly vulnerable (Leichenko & O’Brien, 2002: Thornton et al, 2010). Following from these view points, there has been some action by academics and environmental groups in Ghana in the direction of raising farmers’ awareness to climate variability and change and suggesting adaptive strategies as it is assumed that climate change is responsible for crop failure and a driver of changes in cropping patterns especially in the northern parts of the country. These types of actions by the donor community, NGOs and the government aimed at intervening, often neglects complexities at the local level and the results are often the formulation and implementation of policies and programmes which do not take a holistic approach at solving the identified

problems. This research is thus aimed at documenting farmers perceptions of climate change in the Builsa district of the Upper East Region and how climate change if it thus exist affect cropping patterns and farmers responses in terms of adaptation. In doing this vulnerability and adaptive strategies would be considered. In explaining vulnerability which to some extend determines coping strategies Adger and Kelly (1999) conceptualized vulnerability as ‘the state of individuals, of groups, of communities defined in terms of their ability to cope with and adapt to any external stress placed on their livelihoods and well-being. It is also argued in the literature Muller (2007) that much research is focused on mitigation measures to the detriment of adaptation to change.

1.1 Problem Statement

There seem to be a consensus in the literature that global climate is changing and bringing unfamiliar conditions to people all over the world. One interesting thing to note about these changes is that, they bring unequal effects to major ecosystems across the globe which invariably affects the livelihoods of people who depend directly on these resources for their immediate survival differently thus it is argued. Using some climate models, some experts have been able to predict future consequences of changing climate on agriculture in some regions, especially the developing world and have suggested ways to be taken if these consequences are to be minimized or avoided.

This line of reasoning about developing countries environmental problems with proposed standardized solutions to them is often embedded in “developmental environmental narratives” (Roe, 1991, p.288) or what is termed “received wisdoms” (Leach & Mearns, 1996, p.6) which are based on simplistic assumptions with ensuing policy interventions in most cases leading to the same environmental conditions or worse than they were before these interventions were introduced. Development narratives could assume the status of a story or an argument and like a story, most commonly have a beginning, middle and an end and if cast in the form of an argument has premises and a conclusion (Roe, 1991, p.288). One important feature of development narratives identified by Roe (ibid: 288) is their persistent nature even in cases where their validity is in question and the ability to let their listeners do something about them or believe them. Received wisdom according to Leach and Mearns (1996, p.8) “is an idea or set of ideas sustained through labelling, commonly represented in the form of a narrative, and grounded in a specific cultural policy paradigm”.

So the argument on climate change goes, that a region which is likely to be affected in general is Africa and in Ghana especially, it is the northern part with savannah vegetation that will be badly affected. Following from this, some environmental NGOs, politicians, policymakers, academics and pressure groups in Ghana often espouse the view that climate change affects the northern parts of the country influencing farming patterns and leading to agricultural change. Due to this perceived climate change and its potential effects on agriculture, several projects by the Government and NGOs have been initiated in the northern parts of Ghana to help farmers meet some of these challenges. Some of the NGO which operate in the Builsa district in this regard includes the Presbyterian Agricultural Station and Action Aid Ghana. My argument is that farming or cropping patterns are changing due to a multiplicity of factors but not necessarily or only as a result of climate change. Secondly, some of these governmental and NGO interventions come in the form of piecemeal and standardized approaches to which I contest that, in helping peasant farmers in the Builsa District cope with any challenges posed by a perceived climate change, a holistic approach is needed by drawing upon the local knowledge and views of the peasants themselves and looking at the social institutions that affect their use of resources.

The main aim of this research is therefore to examine the perceptions of farmers towards climate change and to measure the extent to which climate variability affect cropping patterns in the Bulisa District of the upper east region of Ghana over the last two decades, how vulnerable peasants are and some response or adaptive measures by peasant in the District to climate change. In doing this, the following research questions are pursued:

1. Has there been any anomaly in precipitation over the past two decades?
2. What do peasant farmers know about climate change and the sources of this knowledge?
3. Has this affected the types of crops grown within the last two decades and what are other alternative ways of living by peasants?

1.2 Objectives of the study

In trying to measure farmers perceptions of climate variability and how it affects cropping patterns in the Bulsa District of Ghana, the research sub-objectives will be:

1. Establishing the patterns of temperature and rainfall within the past two decades.

2. To analyse farmers understanding of the term climate change.
3. To document how vulnerable peasant farmers are to changes in temperature and rainfall patterns.
4. To document some of the ways they cope with these challenges.

1.3 Justification

The relevance of this work is to assess the perceptions of peasants in the Builsa District on climate change, how vulnerable they are to climate variability and change and the measures to be put in place either by helping them to improve upon the adaptive strategies identified by themselves or through policy reforms by the district assembly to prepare them cope with these challenges. One hypothesis is that the Builsa District is not as vulnerable as others might think to climate related events and the ongoing media hype about how poor the people and the District as a whole is, will not help bring the people out of their entrapped situation. On the other hand there exist opportunities in the District like dry season farming, tree planting especially the shea and dawadawa trees and other opportunities that if the people are mobilized by these environmental groups to seize these opportunities, it could lead to a better condition of living rather than directing their efforts at climate change. It is also worth noting that, Burkina Faso and Niger as relatively drier areas compared to the northern parts of Ghana, export a lot of onions and tomatoes to Ghana through dry season farming. Thus, the Builsa District which is drained by some rivers and its potential of ground water supply coupled with the ability to create dams for harvesting rain water provides a means of escape or if not a sustainable means for improved livelihoods even in the light of erratic rainfall patterns and higher temperatures. This is important because farming is the mainstay of the people in the district and if this is threatened it may aggravate the already poor conditions of the people. Results from this study could also be used by other districts in the region to improve the lives of their people.

1.4 Hypotheses

In pursuit of my research objective and questions, the following hypotheses would be tested:

1. There is no link between climate variability and cropping patterns in the Builsa District.
2. Other proxy factors account for changing cropping patterns in the district.

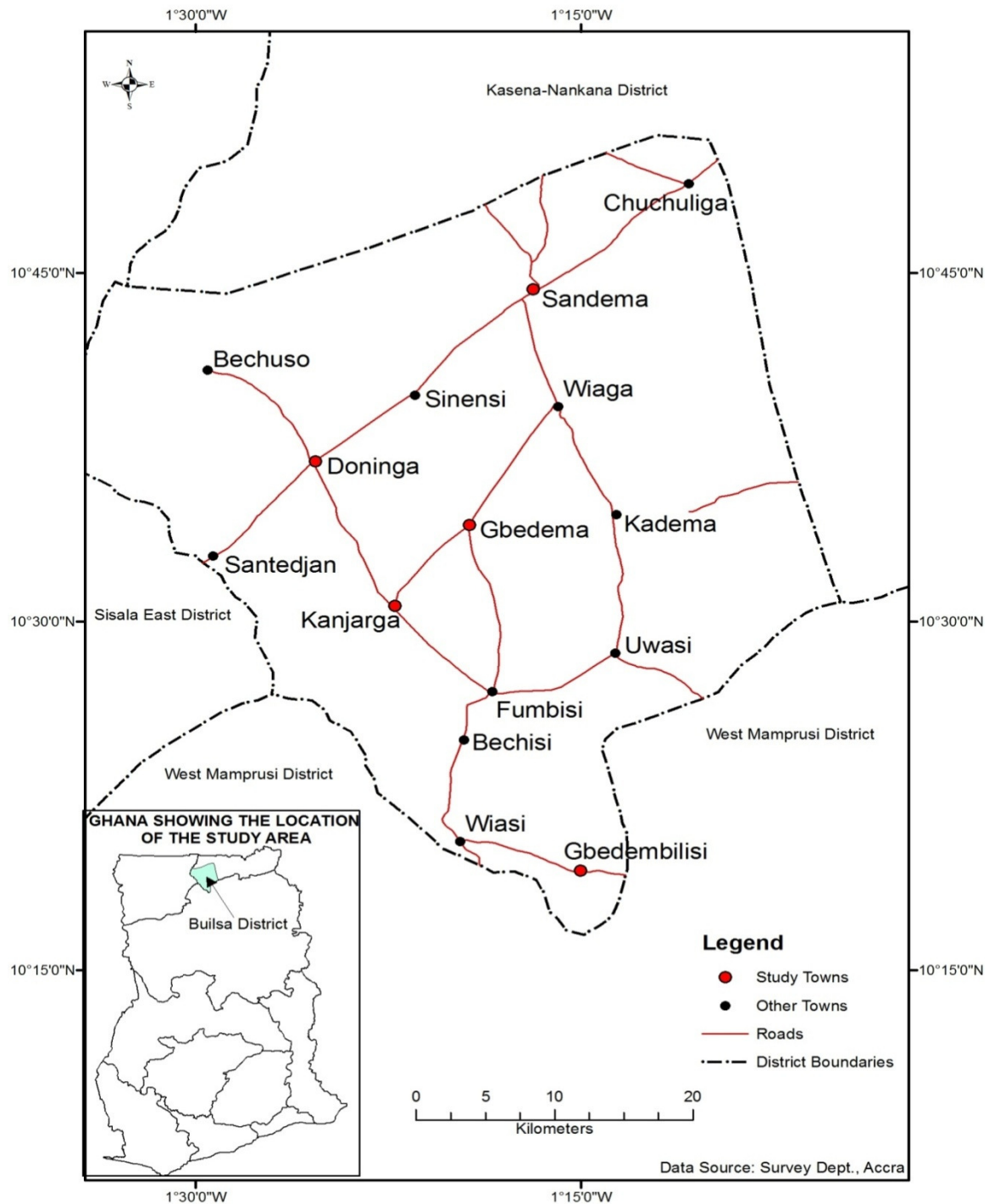
1.5 The Study Area

The Builsa District is one of nine Districts in the Upper East Region of Ghana. It lies between longitude 1° 05' West and 1° 35' West and latitude 10° 20' North and 10° 50' North. It is bounded on the North and East by the Kassena-Nankana East and West Districts, on the West by the Sissala East District and on the South by the West Mampruisi District and part of the Kassena-Nankana West District. The District covers an area of 2,220km² and constitutes about 25.1% of the total land area of the Upper East Region of Ghana. It is important to note that the information in this section is from the Builsa District Assembly unless otherwise indicated.

The District has an undulating topography and a significant proportion of it falls within the Volta basin. The district is heavily dissected by a number of important tributaries of the White Volta such as the Sissili, Kulpawn, Tono, Asebelika, Belipieni giving a very high drainage density. Most of these streams are however seasonal and dry up during the extended dry season with an adverse effect on the supply of water for both agricultural and domestic use. In addition, the high drainage density coupled with the low-lying terrain reduces the level of accessibility in the district. Between July and October in particular most rivers and streams overflow their banks, a number of roads, tracks and paths are flooded and settlements cut off from the centre.

The District has mean monthly temperatures ranging between 21.9°C and 34.1°C. The highest temperatures are recorded in March and this can rise to 45°C, whereas the lowest temperatures are recorded in January. The dry season is characterised by dry harmattan winds and wide diurnal temperature ranges. There is only one rainy season, which builds up gradually from little rains in April to a maximum in August-September, and then declines sharply coming to a complete halt in mid-October when the dry season sets in. Rainfalls are very torrential and range between 85mm and 1150mm p.a. with irregular dry spells occurring in June or July.

Map1. Map showing study communities



The vegetation of the district is characterised by savannah woodland and consists mostly of deciduous, widely spaced fire and drought resistant, trees of varying sizes and density with dispersed perennial grasses and associated herbs. There exist trees of economic value like baobab, acacia, sheanut and the dawadawa in the District. The soils of the Builsa District are

developed from five different geological formations namely Granite, Birimian rocks, Voltaian shale, Recent and Old Alluvium of mixed origin and Very Old River Terraces. Out of these, the dominant soil groups in the district are of granite origin and they cover over 70% (approximately 153,300ha) of the district's land area. They form the predominant soils in the northern half of the district and more than half of the southern section. Most of these soils are gravelly and concretionary, except for the lower slope and valley bottom soils, which are generally free of gravel and concretions. Majority of the soils can be used for agriculture except the Wenchi and Chuchuliga series, which are considered as non-agricultural soils and cover more than 2.0% of the district.

The soils are generally low in fertility, especially nitrogen, phosphorous and organic matter and greater part of the soil cover of the district is poorly drained. Intense erosion over time has contributed to serious reduction in soil depth and thereby to loss of arable surface. The alluvial soils of the South are on the whole very suitable for rice production due to the seasonal flooding in the areas. It is envisaged that the regular application of mineral fertilizers and maintenance of high organic matter levels will sustain crop production in the district.

The district has a total population of 75,375 according to the 2000 National Population and Housing Census with an average annual growth rate of about 0.82% over the 16-year intercensal period (1984-2000). The district has a population density of 34 persons per square kilometre and if compared with the regional figure of 104 persons per km can be said to be sparsely populated. Farming is the main occupation of people in the district and people in addition engage non-farm activities. The district is said to be one of the poorest in Ghana and lacks most of the basic amenities needed for an improved well-being.

1.6 Organisation of the study

The study is organised into two parts comprising eight chapters. The first part of four chapters contains the introduction to the study, methodology, theoretical setting and a review of secondary data on climate change in Ghana and the study area. The second part of four chapters deals with the results from the field, a discussion of these results and a conclusion to the study.

CHAPTER 2

Methodology of Study

2.0 Introduction

The methodology of the study is about how my data is gathered and what happened during the data gathering process. It includes the role I played during fieldwork and my position in relation to my informants in the data collection process. Even though I used qualitative methods in the data gathering process which I will be discussing, graphs will be used to illustrate some climatic parameters like rainfall and temperature in subsequent chapters thus suggesting a mixed method approach. The methods used in gathering data on the field are oral histories, household surveys, group interviews, interviews and 24-hour dietary recalls.

The interviews were conducted using an open ended question guide (see appendix 1). This allowed the informants to express their opinions on all what they knew about an issue when it was raised and also allowed me to explore more on certain issues that I had doubts. The entire interviews were conducted in Buili and were recorded with the consent of my informants. I will also discuss ethical issues, reliability and validity of the data I gathered and the limitation of the work.

2.1 Reconnaissance Visit to the Study Area

I arrived in the Builsa District during the farming season and almost all the farmers were busily working on their farms. On a motor bike, I moved to the villages surrounding the District capital Sandema to see at first-hand what the farmers were growing. After observing some of the crops they were growing, I continued to the southern parts of the district to observe the crops grown. Since the northern parts of the district is more endowed than the south, because the district capital is located there and it also has more wage earning jobs, I decided to conduct my research in the Builsa South constituency. On the day I began my fieldwork, I went to the District agricultural office to interview one of the extension officers when I met my school mate who happens to be a circuit supervisor for some of the villages in the Builsa south constituency and he opted to move around with me through the entire villages I intended to conduct my research. I can say that his services were valuable in that he introduced me to some interviewees in his own village and helped me to select some in the rest of the villages.

2.2 Site and Individual Selection

It is noted by some authors that one can start a qualitative research by identifying the site and the individuals to study (Creswell 2007, pg.118). Upon the reconnaissance visit in the district, I chose to have most of the villages that I intend to conduct my research in the Builsa south constituency. I chose these villages purposefully because they typify peasant situations in the district and also because these villages serve as the food basket of the district. Even though there were some villages in the Builsa north constituency which produce more food than the district capital, they were not covered because of time and logistics. Individuals were selected based on their ages, gender and experiences regarding farming in their communities.

2.3 Role and Status during fieldwork

From a sociological view point, every individual occupies a position in society and that position one occupies is his/her status. Linton (1936, pg.113) defined a status in the abstract sense as “a position in a particular pattern” and to me this pattern is a social pattern in which we as individuals participate in our daily transactions with others. Statuses have their corresponding roles which may be described as actions expected of you by virtue of occupying a particular status. A person can occupy more than one status at a time and the sum total of these gives that person his status in a society (Linton, *ibid.*). In some instances, one may assume a status general in a given social space for effective performance of his functions. This status general to me is what you are mostly identified with in a given social space and in this regard I was a student researcher to most of my informants.

In relation to my field work, I was a student and metaphorically a brother and a child to my informants but my status as a university student conducting research was the dominant one. I assumed these statuses taking into consideration the social context of the people in the Builsa district. The social context in the district is arranged in a way that anyone with ethnic belonging is assigned a given status base on age and gender. One is seen by his peers and people slightly older than him/her as a brother or sister and those who are capable of giving birth to you call you their son or daughter. So I did not need a biological belonging to assume the statuses assigned to me by my informants. My expected role was to ask my informants questions, help document their views on cropping patterns and climate change in the district and above all help them improve upon the farming system. This was in view of my higher education and they also expected me to advice and link them with agricultural extension

officers. This status as their own child in the university and interested in studying about their activities brought some joy to some of the informants. Some of my informants saw the interview process as an opportunity for their views to be recorded for posterity and that they also had a chance to say what they knew and have been doing over the years to others especially policy makers. While I was quite trail to see the smiles on the faces of the aged in their attempt to recount all they knew about the farming system to their son, it is important at this point to take cognisance of the role my position played in my attempt to collect information from my informants.

2.4 Power and position in qualitative research

It is noted that qualitative research is power laden since it is done in all social relationships (Hay 2008, pg.23). This social setting to me means that qualitative research involves interaction with human beings with the aim of gaining insight into their opinions, experiences and understanding of certain issues. If we agree that society is hierarchically arranged, then some statuses or positions wield more power than others and people are thus placed in terms of power in relation to each other. It is also noted that, the research process is an attempt to produce knowledge and this knowledge when produced can be both directly and indirectly powerful. The processes of constructing this knowledge in qualitative research situate the researcher and researched differently in relation to social structures and Hay (ibid) observed that this could give you and your informants different “*speaking positions*”. Some researchers observed that these positions could lead to a misinterpretations and misrepresentations of the researched by the researcher if care is not taken as the researcher in most cases wields more power to ask questions. To avoid this, Mullings (1999, pg.340) asked researchers to often seek for ‘positional spaces’ which are “areas where the situated knowledges of both parties in the interview encounter, engender a level of trust and co-operation”. Writing on the power relation between the researcher and the researched, England (1994 cited in Hay 2008, pg.23) identified three types of power relations which include reciprocal relationships, asymmetrical relationships and potentially exploitative relationships. England (ibid) described reciprocal relationships as existing in situations “where the researcher and researched are in comparable social positions and have relatively equal benefits and costs from participating in the research”. In asymmetrical relationships, those being studied wield more influential power than the researcher and in potentially exploitative relationships the researchers wield more influence than the participants or researched.

In conducting my research therefore, I can say the relations of power that existed between me and my informants were asymmetrical. In the group discussions for instance everybody had the chance to say what they knew about a theme or an issue being discussed. We saw ourselves as unequal trying to identify whether there are changes in climatic patterns over the years and how they are responding to these changes in terms of the choices they make in the crops they grow. So this relationship could be described as asymmetrical because I only introduce a theme and the group discusses it. I was at the receiving end, only talking if I want to clarify a point I did not understand very well and the discussion was left in the hands of group members. As the groups were dynamic (the groups comprises different age groups) we saw ourselves as unequal's with no one knowing it all and could even correct each other if a point is not well stated and a theme not well introduced. With the oral histories and the household surveys, all my informants were older than me and thus as the culture demands, they saw me as their son who did not witness what they had witnessed and has no experience about the climate of the area over the years. As their son, who is not well informed about their activities, I only had to ask questions and listen to them. I will describe this type of power relation as asymmetrical too.

Associated with positions and power in the data collection process is the ability to establish rapport with your informants and getting them to give you information closer to the truth of what they know about the issue you are dealing with. This brings up the outsider and insider perspectives in research where it is argued that one needs to either belong to a group be outside a group to be able to source the right information from the informants (Mullings, 1999, pg.340). Those who argue for belongingness has it that you can gain more insight into the group's opinions by virtue of the fact that you have some knowledge about the group. On the contrary outsiders believe that they will be seen by the group as neutral people and thus more information will be given to them than insiders and that they will be more objective than insiders (Mullings, *ibid*).

During my data collection process, I was an insider because I am a native of the Builsa District but in the selection of villages I did not select villages where people knew me. This made my informants to receive me like a stranger on their land but that did not change my position as an insider because most of my informants after asking of my name and the village I come from treated me as their own. As an insider, they assumed that I should know some basic things about their activities. For example they expected me to have known some of the crops they grow and the timing of the farming season. So in some of the sessions, it looks

very stupid to them for asking certain questions which I honestly do not know. In instance like that they ask me for the length of time I have stayed away from the village and if I say more than twenty years then they say that is why I am asking such questions. In order to get them to elaborate on certain issues, I have to pretend I did not know much about those issues so that they could explain them to me. This position as an insider notwithstanding, there were instances during the data collection process which made it clear to me that I was not going to get an accurate account especially when it came to annual household production figures. One such instance is shown in the excerpt below.

Researcher: can you say that your access to wild food was better when you were a child?

Respondent: *yes, we use to have easy access to bush meat, shea nuts, dawadawa fruits, etc but now bush meat is very scarce to come by.*

Researcher: But you still have access to shea nuts, dawadawa fruits, and other wild fruits that you can gather in the wild?

Respondent: (He chuckled) *but we are now living in the time of luxury and so pay little attention to some of these wild fruits.*

This excerpt was from an informant at Dogninga who in the earlier part of the interview laments how the uneven rainfall patterns and high temperature are making life difficult for them. The irony to me here is how they are now living in luxury and have no time for some wild fruits while at the same time the olden days were better than today. This and other observation during the interviews made me felt that my informants were not ready to share some information with me especially when it came to production data. It should also be noted that since the power relations during my data collection was asymmetrical, the informant's posses the data and can decide whether to share it or not.

2.5 Sample Population

According to Rice (2006, pg.223) "sampling is the acquisition of information about a relatively small part of a large group or population, usually with the aim of making inferential generalizations about the larger group". This is important taking into consideration the inability to interview an entire population before meaningful generalizations could be made. Since all of your target population cannot be interviewed, it is important for samples to be representative of the population we are trying to investigate and the investigator must try as

much as possible to minimize bias during sampling. Generally, there are two types of sampling that can be used in the data collection process and these are probability and non-probability sampling. Non-probability sampling is most often used in qualitative research and some scholars (Hay 2008, pg.155) noted that the aim of this strategy is to minimize the risk of making generalizations to an entire population.

All my sampling procedures are non-probabilistic and involved purposive sampling techniques. Purposive sampling according to Creswell (2007, pg.125) “means the inquirer selects individuals and sites for study because they can purposefully inform an understanding of the research problem and central phenomenon in the study”. Silverman (2010, pg.141) also observed that purposive sampling “allows us to choose a case because it illustrates some features or process in which we are interested”. Partton (1990 cited in Hay 2008, pg.72) identified different types of purposive sampling procedures. These include, extreme or deviant case sampling, typical case sampling, maximum variation sampling, snowball or chain sampling, criterion sampling, opportunistic sampling and convenience sampling. Some authors observed that sampling can be done at different levels (Creswell 2007, pg.126) which include the site level, event or process level and the participant level. Miles and Huberman (1994 cited in Creswell 2009, pg.178) also identified four factors to consider in this process. These factors include the selection of the setting, events, actors and the process.

In my case, sampling was done at the site level (the selection of villages) and at the target population level which is made up of households, individuals and groups. It is important to note that I used the typical case strategy and the snowball or chain sampling strategy in the selection of participants. In all, five sites were identified and 49 people selected as participants. I was interested in identifying how climate affects cropping patterns in the Builsa district. I conducted six oral historical interviews, six group discussions, six household surveys, eight 24-hour dietary recalls and two interviews. This is illustrated in the table 1.

Table 2.1: Selected villages, method use, number of participants and their occupations.

Name of village	Method	No. of participants	Age(yrs.)	Occupation
Dogninga	Oral History	2	70+	Farmer
	Household Survey	2	70+	Farmer

	Group Interview	10	20 - 70	Farmers
	24-Hour Dietary Recalls	4	Below 20	School Pupils
Kanjarga	Oral History	2	80+	Farmer
	Household Survey	2	70+	Farmer
	Group Interview	10	20 - 70	Farmers
	24-Hour Dietary Recalls	3	Below 20	
Gbedembilisi	Oral History	1		Farmer
	Household Survey	1		
	Group Interview	10	20 - 70	Farmers
	24-Hour Dietary Recalls	None		
Sandema and Gbedema	Household Survey	1		
	Interviews	3	30 - 70	Extension officer and mkt. women

From table 2.1, it is clear that all four methods were used in only three villages out of the five selected. This is because the three villages are not only in the Builsa South constituency which forms the food basket of the district, but they also epitomize or typify a setting for peasantry in the district taking into consideration characteristics such as the distance from the district capital, access to other forms of paid employment, the level of education and awareness of peasants, etc. In trying to select participants, a normal thing was to have used

the local government structures, which meant contacting the assembly man of the villages involved but this was avoided taking into consideration the politicisation of issues in Ghana. People will be more likely to read politics into the data gathering process by saying good things about their farm yields when they belonged to the currently ruling NDC and bad things about their activities when they are in the opposition NPP. Apparently from table 2.1, one will notice that most of my informants are old people. This was deliberately done taking into consideration a historical analysis of the climate of the area. The older people might have lived and cultivated the land for a longer time and it is assumed might have had some knowledge about the rainfall and temperature patterns over the years. They might have also witnessed the types of crops that were grown by their fathers and if there are changes in the types of crops they grow today and some of the possible causes of these changes.

2.6 Methods of Data Collection

2.6.1 Oral histories

The cultural turn in geography has necessitated the need to incorporate the voices of the marginalized into research and one way of doing this is through oral histories. Oral histories aim at what Hay (2008, pg.107) says “to record the first-hand knowledge and experience of interviewees”. Oral histories according to Hay (ibid) allow “researchers and participants to track and understand changes across spatial scales as well as temporal ones”. Thompson (2000 cited in Hay 2008, pg.108) described oral histories as “the voice of the past” and Robertson (2000 cited in Hay 2008, pg.108) said it is “a picture of the past in people’s own words”.

Based on this, I used oral history as one of the methods in my data collection process. I conducted six oral historical interviews with my informants with at least one person in all the villages I visited. I arranged preliminary meeting but not with all the informants, for instance in Gbdembilisi most of the farmers grow maize across and along a tributary of the White Volta and they sleep there during the farming season. So what I did was to go into the village and look for any old person who has stayed and farmed in the village for all his/her life and fortunately I found one who then led me to the rest of my informants in this village. The interview sessions lasted for at least an hour and an interview guide was used. Informants were first briefed on the reasons why I have called on them and the inform consent form read and explained to them. All the interviews were conducted in the informant’s homes and on farms except the agricultural extension officer whom I interviewed in his office. The

interview sessions began with a discussion on food security and how they were managing their farming activities to meet this need. After this, I went on to ask general questions on the types of crops they grow now and the types of crops that were grown thirty years ago or since they were children. I also asked if there were changes in climatic patterns and if these changes can be the cause of changes in their selection of the crops they grow today. Once I was interested in knowing whether rainfall and temperature patterns have been changing over the years, I selected informants who were above seventy years and have stayed and farm in their villages for all their lives. Below are plates showing oral historical interviews with some of my informants.

Plate 2.1-2.4 show some interview session with informants

Plate 2.1



Plate 2.2



Plate 2.3



Plate 2.4



Source: Fieldwork 2010.

The entire interview was recorded with a digital voice recorder upon the consent of my informants.

2.6.2 Group interviews

Another method used in my data collection process was to interview informants in groups. The group interviews were six in all and made up of three women groups and three men groups. The groups were divided into women and men base on the fact that it is not only men who are farmers in the district. Even though there are gender division in the types of crops grown, women participate in almost all the cultural practices in the principal crops (millet, sorghum and maize) grown in the district except weed control thus making their views very important to this study. Two group interviews each were held in Dogninga, Kanjarga and Gbedembilisi. These three villages form the core of my study because they typify the peasantry in the Builsa district taking into consideration their location and contribution to the food needs of the people in the district. All the interviews were conducted in Buili so there was no need for an interpreter. The group interviews offered me the opportunity to gain more insight into the types of crops grown in the district and some of the reasons why they are changing, especially those interviews with the women. The group interviews with the women also threw more light on how peasants cope when there is a bad harvest and some of the non-farm activities engaged by peasants in the district. These interviews also highlighted the gendered strategies in coping with crop failure and the way in which they get access to land will be discussed later in subsequent chapters.

2.6.3 Household surveys

The concept household has been described by several authors but I will like to use it here to generally describe a husband and wife with their children living in the same dwelling and contributing in all ways towards their well-being. In some instances there could exist multiple generations with husband and wife/wives living with son and grandchildren. But in the Builsa district elder sons who are married either move out or are separated from parents to form their own households with only the youngest son obliged to live with parents until they die. In this sense, the household includes all members who have migrated to live somewhere else but still contribute towards the welfare of its members. In addition, it should be noted that the household was chosen as my unit of analysis because it is the basic unit of food production and consumption. The household survey was intended to gather peasant's perceptions on climate change and how climate change affects their overall supply of food supply in terms of

the crops they grow. It is important to state at this point that my intension was to measure how climate change influences the types of crops they grow and the yields of these crops. I also wanted to identify if the food produced in the farming season is sufficient to meet the household food needs for the year and if not, what other strategies were used to survive until the next farming season. All these were geared toward measuring how vulnerable they are in self-food sufficiency and this is not in caloric and nutritional sense but in terms of supply.

From table 2.1 six household surveys were conducted which included a female headed household. Some of the issues discussed ranges from types of crops grown, to yields, how climate change affect these and other off-farm activities engaged by the household. It is interesting to note that not all members of the household were available during the surveys so I spoke mostly to the household heads. In other to cross check some of the information given to me specially the types of crops grown; I followed up with 24-hour dietary recall in the local primary schools.

2.6.4 24 –hour dietary recall

This method is often used to collect information on the food eaten by people within 24-hours to analyse the frequency of food intake and the nutritional components of the food. In my case, I conducted the 24-hour dietary recalls to confirm the types of crops grown by the farmers. In conducting these recalls four pupils each were selected from the local primary schools where the household survey and oral histories were conducted. The selection took into consideration two female and two male pupils. They were asked to give information on the type of food they ate in the morning before coming to school, after school and at dinner. The purpose of the dietary recall was to ascertain the crops grown so no efforts were made at quantification. The amount of food eaten by pupils was not quantified as my objective is to corroborate the types of crops grown by farmers.

2.6.5 Interviews

One of the ways of gathering data from informants in geographical research is through interviewing. An interview can be defined as ‘a face- to- face verbal interchange in which one person, the interviewer, attempt to elicit information or expression of opinion or belief from another person’ (Maccoby & Maccoby 1954 cited in Hay 2008, pg.79). When placed along a continuum, there are two types of interviews- structured and unstructured and in the middle of these are the semi- structured interviews. Interviews allow researchers to gain access to ‘information about events, opinions, and experiences while noting that people

opinions and experiences vary across age, ethnicity, and sexuality and class (Hay 2008, pg.80). Semi-structured interviews cannot be properly executed without the use of interview guides. Interview guide 'is a list of general issues you want to cover in an interview' (Buegess, 1982c cited in Hay 2008, pg.82).

I used semi-structured interviews in my data collection process which entailed interview guides. It is important to note here that, some of the methods used in eliciting information from my informants- oral histories and group interviewing are akin to unstructured interview structure as suggested by (Hay *ibid*, pg.88) in that, they focus on individual perceptions and histories. However, I used interview guides in combination with these methods. This was because, I wanted to know peasants perceptions and experiences of climate change and how it affected the crops they grow. The interview guide which is open ended, allowed in some cases for the discussions into other issues bothering food security and religion. I could recall in one instance involving an oral historical interview where the informant tried to link the food insecurity they are facing in his village in particular and the district as a whole to moral decadency and lack of respect for the gods. The solutions, to him can be found in appeasing the 'Kanjarga Mountain' god and other lesser gods. Without interview guides, it would have been more difficult to transcribe my records taking into consideration the time constraints.

2.6.6 Personal observation

As the data collection was done in the farming season, I had to interview most of my informants on their farms. They offered me the opportunity to observe for myself the types of crops they grow and the shifts in the onset of rains as observed by some of the farmers. I observed that in July some farmers were planting groundnuts which are not usually the case. I also observed that farmers now plant a lot of maize around the house which some time back used to be dominated by sorghum and that maize is now planted on a large scale by some farmers. This to me is surprising as people in the district are noted for their taste for both flour and T.Z. prepared from millet and sorghum. Although this was not strictly quantified, the number of household visits gave a firm base for understanding the cropping pattern.

2.7 Case study

According to Creswell (2007, pg.73) case study research "involves the study of an issue explored through one or more cases within a bounded system". It is observed among qualitative researchers that there are three variations of case study research. These include; the intrinsic case study, the instrumental case study and the collective case study (Creswell

2007; Stake 2000 cited in Silverman 2010, pg.139). In the intrinsic case study, attempts are not made to generalize beyond a single case and in the instrumental case the researcher focuses on an issue with the aim of illustrating it or providing insight into it. The collective or multiple case studies occurs where the researcher selects one issue and collects several cases to illustrate or provide explanation for it.

Applying this to my research, it falls under the multiple or collective case study. In my case cropping patterns are changing in the Builsa district and most people attribute this to climate change. So five villages were selected to collect farmer's perceptions of climate change and how it affects cropping patterns. It is also noted by Yin (2003 cited in Creswell, *ibid.* Pg.74) that the multiple or collective case study uses the "logic of replication" in which the researcher repeats the procedure for each case. I think this bears semblance with what I did in the main three villages which typify the peasantry in the district by repeating the same methods and procedures.

2.8 Ethical Issues in Research

Some scholars have observed that qualitative researchers face ethical issues during data collection and in analysing and reporting their results (Creswell 2007, pg.141). O'Connell-Davidson and Layder (1994 cited in Hay 2008, pg.20) defined ethics as "the conduct of researchers and their responsibilities and obligations to those involved in the research, including sponsors, the general public and most importantly, the subjects of the research". According to Lipson (1994 cited in Creswell, 2007, *ibid.*) ethical issues can be grouped into "inform consent procedures; deception or covert activities; confidentiality toward participants, sponsors, and colleagues; [.....] and participant request that go beyond social norms". The most important thing to me in qualitative research is to protect the identity of the informant and to ensure that their rights are not violated. Thus the pictures used in this study are with the full consent of my informants and they were aware that their pictures would be made accessible to several people over the world.

In my case, informed consent forms were introduced to my informants before the interview sessions. However, they saw these forms not to be necessary after I explained the aim of my research to them and assured them that the tape recording will be deleted after transcription and nobody will know who said what in the written account. Interestingly some of my respondents were not happy with that statement, perhaps this could be the first time that some of them will have their voices capture on tape and played back to them and they also wanted

their voices and problems to be heard by everyone. They suggested I rather sent the tapes far, so that their views can be heard and to keep them so that their children will one day have the opportunity to know what their farm activities were about. My informants voluntarily accepted to be part of the research process and were aware that they could refuse to answer any question deemed inappropriate and leave the research at will. They also agreed for their photograph to be taken for the research process and for use in the written account.

My status as a university student, their child and brother made my informants not to expect anything material from me. I did not disclose to them that I was schooling abroad and they know I was in one of the universities in the country if not their expectations would have been high. My initial plan was to give farmers some seeds after the interview sessions because it was during the farming season and I would have taken their precious time as some left weeding their plots only to attend to me. However, the planting season was almost over so I left with no option than to give them a token of money after the interviews were over.

2.9 Reliability and Validity of Data

Reliability is the “extent to which a method of data collection yields consistent and reproducible results when used in similar circumstances by different researchers or at different times” and validity is the “truthfulness or accuracy of data compared with acceptable criteria” (Hay, 2008). It is recognised that ethical issues in research do not end with the approval of a research proposal by an ethical committee of a university or any recognized body but goes on during and after the research process. This calls for researchers to be self critical when conducting research and this means reflecting on the social nature of conducting our research. To ensure the reliability of my data I repeated the same methods-household surveys, oral histories and group interviews with the same questions asked to for the purpose of comparing the responses. In this instance, I identified that changes in the rainfall and temperature patterns were observed by all informants across the study villages and the causes of these were mostly attributed to moral decadence. My informants were very comfortable to share information on climatic patterns and the types of crops they planted with me but when it came to output of their crops, most of them were very reluctant to share the number of bags they got per crop grown with me. This reluctance could be as a result of fear of being taxed or not getting help from NGOs and other aid bodies if the truth of their economic state is known. I can thus say my presence did not hinder much in my attempt to

gather the views of farmers on climate change since I was an insider most thought the information given will be used to improve their farming system one day.

2.10 Limitation of the study

The study did not cover the whole district but only the Builsa south constituency and some few informants in the district capital. I therefore do not intend to generalize my findings as I have observed some variations in the crops grown and other activities in the few villages that were selected for my study. What I intend doing is to gather the perceptions of farmers on climate change and how it affects cropping patterns in the Builsa district and to present this as an account of some farmers in the district. Also, I do not intend to measure food security quantitatively as it is very difficult to attain data on household production and income. It should also be noted that the Builsa district has no weather station on its own so I have to rely on rainfall and temperature records from nearby stations. I did not consider data on the number of rainy days within the critical months in the Builsa district because of the lack of a weather station in the district. I think this data would have been valuable to my study as peasants are much particular not about average annual rainfall but its distribution within the critical months of the cropping season.

CHAPTER 3

Theoretical Framework

Human environment relations: Climate Change; Theory of Agrarian change; Food Security and Sustainable Livelihoods

3.0 Introduction

Climate change is one of the major threats to the wellbeing of most rural people who rely heavily on rain fed agriculture and have less alternative livelihoods that are sustainable or well developed. Climate change is now generally accepted to have negative effects on the agricultural sector of developing countries but these effects are generally based on the use of climatic models like the General Circulation Model (GCM) to predict impacts. These GCM models which are used for projection of changes in climate and their related crop impact models used for prediction of impacts of projected climate change on crops are often fraught with contradictions and uncertainties taking into consideration the variable nature of African climate, human computational errors and the limitation of our knowledge (Challinor et al, 2007.pg.383). Using these model some researchers projected drier conditions in Sub-Saharan Africa (Held et al. 2005 in Challinor et al, 2007.pg.383) whilst others projected wetter conditions (Kamga et al. 2005 in Challinor et al, 2007.pg.383) especially over the Sahel region and Challinor et al (2007 pg.383) noted that “Spatial scale, extreme events, model error, and uncertainty are key issues arising from the use of climate change projections with impacts assessments” In the area of predictions of impacts on crop yields, it is observed that some models predict increasing yield with elevated CO₂ for some crop types but these predictions are not without some kinds of limitations. In general, these crop models only simulate impact on the world’s major crops while models for crops necessary for Africa’s farming system such as “sorghum, millet ,banana and yam” (Challinor et al, 2007.pg.384) are less well developed. These models are in addition noted for not being able to capture the intercropping nature of the African farming system which is a major strategy used by farmers over the years. In relation to this, Simelton et al (2010, pg.6) pointed out that “crop-climate models either assume that farmers will not make any changes in crops/cultivars grown (thus over-estimating the impact of changes in climate) or assume that farmers will use management practices that are ideally suited to new climatic conditions” It should also be noted that of interest to peasant farmers is not the projected changes in climate and its related

predicted impacts on crops but changes in the onset, duration and distribution in rainfall with the related changes in planting dates.

It is thus important to hear the views of peasant farmers on climate change and how it affects their activities as it is accepted that induced climate change and variability will impact negatively on rural livelihoods. This chapter will try to outline some theories and notions about human environment relations and how these notions have influenced research on environmental change. Third World environmental problems are often conceived of as a consequence of population growth with its resultant breakdown of cultural practices leading to misuse of resources with the result being environmental degradation. Solving Third World environmental problems within development thinking garnered a lot of support from applying equilibrium models like the ecosystem concept and econometric models of analyses. Following the failure of some of these assumptions, it has been increasingly observed that resource use and sustainability in developing countries and especially so among rural people is often surrounded by complexities ranging from local decision making, issues of access and how institutions at both the local and global level mediate through access to resources and resource use. This then calls for the use of disequilibria models and theories that capture the dynamism and complexities that mediate resource access and use.

Issues relating to climate change can directly and indirectly affect food security in that climate change can disrupt the supply and access to food and this will invariably affect livelihoods. Thus the sustainable livelihood approach will be used in my analyses because it captures the complexity of factors that affect resource use at the local level and does not assume away in a linear form that a single variable (climate change) is responsible for changes in peasants' decisions regarding land use (changes in cropping patterns). Some theories of agricultural change would be looked at taking into consideration some of the factors which influence these changes. It is assumed that climate change as an external stimulus acting in combination with other factors can be a driver of change in an agricultural system and these changes may positively or negatively affect livelihoods.

3.1 Human environment relations

In the 1970s and 1980s, there was a shift especially within the field of cultural ecology toward the analysis of how Third World communities approached the social and ecological problems of an external capitalist economy (Neumann 2005, pg.20). During this period too, most environmental thinking was dominated by Neo-Malthusianism with its embedded

techno centric and managerial approaches to solving Third World environmental problems. This approach was attacked and dismissed for being “simplistic, empirically unsubstantiated, and theoretically barren” and also that “techno centrist and managerial solutions ignored the social relations, economic constraints and political power structures that shaped land and resource use” (Neumann 2005, pg.28).

An alternative approach is then political ecology which according to Neumann (2005, pg.28) begins with the premise that “ecological problems were at their core social and political problems, not technical or managerial, and that what was required was a theoretical foundation to address the complex social, economic and political relations in which environmental degradation is embedded”. In their analysis, *Seeds of Famine*, Franke and Chasin proposed a radical approach towards studying human-environment relations. The approach uses “history, climate data, social processes, and more specifically, the effects of the imposition of the colonial economy and its postcolonial dependency relationships between the Sahel nations and the international capitalist system” (Franke & Chasin 1980 cited in Neumann 2005, pg.28). It was then Blaikie (1985 cited in Neumann 2005, pg.30) in his book ‘*The Political Economy of Soil Erosion in Developing Countries*’ who laid the methodological and theoretical foundation for political ecology. He proposed that, the starting point for investigating environmental problems “must be place-based” which means where the problem is occurring and the individuals proximately responsible for land-use decisions. The analyses of the problem is then “moved beyond to ‘non- place-based’ factors, that is the social relations of production and the nature of the state” (Blaikie *ibid.*, pg.30) and that the scope of analyses should be widened to include an assessment of the perceptions and rationality of local land users, government officials, conservationists, and scientists. Blaikie and Brookfield, (1987 cited in Neumann 2005, pg.33) also proposed a regional political ecology approach to studying human-environment relations. This approach they called ‘chains of explanations’ begins with the person with direct access to the land and then “trace the social relations of productions outward and upward to the local, national and, ultimately, the global scale”. Vayda (1996, pg.16) reasoning in line with this espoused the concept of progressive contextualisation which means the idea of approaching environmental issues with “concrete human actions and/or their concrete environmental consequences as our objects of study and then tracing the treads of causal influence upon these outward in space and backward in time”. How do these theories impact on my investigation on the perceptions of climate change and adaptations by peasants in the Builsa district? It is important to first of all

recognise that the Builsa district is not isolated from the region, national and the global and that there are both local and global structures of power that mediate resource use. Drawing on these lines of conceiving and examining environmental problems, my research begins with an identification of changes in cropping patterns in the Builsa district and then tracing the factors responsible for these changes from the local to the national and global levels.

3.2 Climate Change

A review of the literature reveals that climate change analysis are most often on how it affects the types of crops grown without giving attention to those who decide what types of crops to be grown and what influences the choice of crops to grow . This view point is supported by Bryant, et al. (2000) that “climate change effects on agriculture are often undertaken base on related damages it brings to individuals in particular and society as a whole”. They further argued that concern has shifted from an earlier focus on the potential impacts of climatic change on crop yields to actual and potential adaptations of agriculture to climatic change and variability. The role of human agency –“how farmers, their associations, the crop insurance industry and a whole host of government and political actors, as well as the scientific community itself mediate between external stimuli such as climate change and actual results in terms of agricultural change- is now explicitly recognized as an essential ingredient in adaptation processes” (Bryant, et al., 2000, pg.182). According to Bryant, (ibid, p.182), the human agency perspective explicitly acknowledges that human decision-making cannot be assumed away. It is purposeful and thoughtful. Even though these authors were writing on Canadian agriculture, their ideas are relevant to me as they bring onboard the myriad factors that influence agricultural change.

It is thus based on the role of human agency especially that of the peasant farmers and how they perceive climate change and its influences on agriculture in terms of vulnerability and adaptability that I set my theoretical framework. This framework will not treat climate change as the only external stimuli affecting agriculture and cropping patterns in the Builsa District but will also take into account political, socio-cultural and economic factors. Ecological outcomes it is argued are often a consequence of institutional arrangements for the exploitation of natural resources. These institutions are not static but are in a constant flux and often reflect people’s perceptions and aspirations. Thus people’ ability to identify a given problem and respond to it appropriately depends upon their level of awareness, the extent to which the problem threaten their survival or is relevant to their situation and other exogenous

factors like their way of integration into the global economic system, state policies and interventions. Climate change has become an issue of great concern since the 1970s due to some perceived potential benefits and threats it brings to people over the world. In the climate science literature, attempts have been made to separate climate change from climate variability but some researchers have seen these two terms almost inseparable. It is observed that climate has been a dynamic entity since time immemorial and varies across time and space and people and cultures have learned to live with some of these changes. But of concern today is what we term anthropogenic climate change which occurs as a result of the build-up of greenhouse gases in the atmosphere which scientists predict might have some negative consequences of a different dimension for fauna and flora on earth. Climate variability has been defined as the “observed year-to-year differences in values of specific climate variables within an averaging (typically 30 years), and climatic change as longer-term changes between averaging periods, either in the mean values of climatic variables or in their variability” (Hare 1985 cited in Ribot et al. 2009, pg.125). This distinction is important because climate variability affects the range and frequency of shocks that society absorbs or to which it adjusts and climate change alters the general resource base (Parry & Carter 1985 in Ribot et al. 2009, pg.125). Schippers and Burton (2009, pg.2) also observed that it is conceptually futile to separate climate change and climate variability but anthropogenic climate change is pushing us beyond the limit and will demand additional adaptation whether autonomous or induced.

The United Nations Framework Convention on Climate Change (UNFCCC) in Rio de Janeiro in 1992 came out with two categories of response to climate change: *mitigation* and *adaptation*. *Mitigation* refers to those actions designed to reduce emissions of greenhouse gases in order to achieve “stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system” (UNFCCC Article 2, cited in Schipper & Burton, 2009, pg.1). It is recognised in the literature that the word *adaptation* has not been given a specific definition by the UNFCCC which leaves it for several interpretations and has generated debate in the climate science literature. According to Burton (2009, pg.11) the word adapt can be “applied both to biological and to socio-cultural processes” traced its roots in evolutionary biology which is being applied in the social world as in social Darwinism and Herbert Spencer’s laissez-faire approach to social ills expressed in his survival of the fittest. According to Winterhalder (1980, cited in Smithers & Smit, 2009, pg.19) the roots of adaptation are in the natural sciences, specifically population

biology and evolutionary ecology where it refers to “genetic characteristics which allow individual organisms to survive and reproduce in the environment they inhabit”. The word *adaptation* has also found wide application within the social sciences where it is noted that “social and economic systems, and individuals within them, can and do adapt to changing environmental circumstances” (Smithers & Smit, 2009, pg.19). It is observed that the *adaptation* paradigm in the social science have found application in areas like “cultural ecology, natural hazards research, ecological anthropology, cultural geography, ecological economics and, more recently, climate impact research” (Smithers & Smit, *ibid*:19) which have come out with distinct concepts of adaptation. This is essential to my study since it is assumed that farmers are not relating to climate only. In cultural adaptation for instance distinction is made between a focus on the collective adaptation of system and that of the role of the individuals as decision-makers (Hardesty, 1983 cited in Smithers & Smit, 2009, pg.20). Other researchers have also pointed out the importance of scale in adaptation research. One approach of climate impact studies is to identify systems and their characteristics that make them vulnerable or resilient. Another is to look at the characteristics of the stimuli and yet others concentrate on the nature of the response be it structural or behavioural or whether they are taken before or after the environmental stimuli.

Another concept in relation to climate change that this research will explore is the *vulnerability* of people to climate change. It is argued that climate impact studies have tended to focus on direct “physical, chemical or biological effects, yet a full assessment of consequences for human well-being clearly requires evaluation of the manner in which society is likely to respond through the deployment of coping strategies and measures which promote recovery and, in the longer term, adaptation” (Kelly & Adger, 2009, pg.161). There are several definitions of *vulnerability* to environmental stress with some assessments of the term regarding it as the end point of any appraisal while others treat it as the main focus and yet others see it as the starting point (Kelly & Adger, *ibid*: 162). The IPCC Second Assessment Report (cited in Kelly & Adger, 2009, pg.162) defined *vulnerability* as “the extent to which climate change may damage or harm a system; it depends not only on a system’s sensitivity but also on its ability to adapt to new climatic conditions”. Sensitivity is seen in this context by Kelly and Adger (*ibid*) as “the degree to which a system will respond to a change in climatic conditions”. Drawing inference from these two concepts, they pointed out that the definition of “vulnerability must be contingent on estimates of the potential

climate change and adaptative responses” and assessment of the term dependent on the determination of any residual consequences after the adaptation processes.

This view of the concept is in contrast with its use in the food security literature where it is argued that the “space of vulnerability to food insecurity can be defined in terms of exposure to stress and crisis, the capacity to cope with stress, and the consequences of stress and the related risk of slow recovery” (Watts & Bohle, 1993 cited in Kelly & Adger, 2009, p.162). From a natural hazard perspective, Blaikie et al. (1994, cited in Kelly and Adger, 2009 p.163) separated biophysical from social dimensions of vulnerability. He defined vulnerability in the human dimension as “the capacity to anticipate, cope with, resist, and recover from the impact of a natural hazard” and the biophysical aspect which has to do with the exposure or measure of the hazard is often outside their definition of the concept.

Kelly and Adger (2009, pg.163) then traced the meaning of the word from its Latin origin “vulnus, meaning ‘a wound’, and vulnerare, ‘to wound’”. The word vulnerability derives specifically from the Latin word Vulnerabilis which is a term used to describe “the state of a soldier lying wounded on the battlefield”. They then identified the importance of this meaning to the discussion of vulnerability as it defines vulnerability by “the prior damage (the existing wound) and not by the future stress (any further attack)”. Reasoning from this, Kelly and Adger (ibid) has it that the “vulnerability of any individual or social grouping to some particular form of natural hazard is determined primarily by their existent state, that is, by their capacity to respond to that hazard, rather than by what may or may not happen in the future”. Vulnerability is thus defined as “the ability or inability of individuals and social groupings to respond to, in the sense of cope with, recover from or adapt to, any external stress placed on their livelihoods and well-being” (Kelly & Adger, 2009, pg.163). This definition lay emphasis on the ‘wounded soldier’ that is, the constraints that limits the capacity for effective adaptation and which exist independent of the future. The wounded soldier approach according to Kelly and Adger (2009, pg.164) “concentrates attention on the socio-economic and political context within which the impact process takes place, a context that may well determine vulnerability not only to climate stress but also to other forms of environmental and societal pressures”. Smithers and Smit (2009, pg.17) in examining adaption to climate change observed that climate is inherently variable and adaptation is part of our daily life and that “adaptation to climate does not occur in isolation from the influence of other forces, but instead occurs amid a complex set of economic (micro and macro), social

and institutional circumstances which establish a location-specific context for human-environment interactions”.

In examining social *vulnerability* Kelly and Adger (2009, pg.165) thus adopted an entitlement approach which according to them differs from the biophysical approach espoused by the IPCC arguing that “the extent to which individuals, groups or communities are ‘entitled’ to make use of resources determines the ability of that particular population to cope with or adapt to stress”. Determining levels of vulnerability to climate stress involves the use of the term ‘architecture of entitlements’ which refers to the “myriad factors that shape the availability of entitlements, their evolution over time, and the broader political economy of the formation and distribution of entitlements” Adger and Kelly (1991, cited in Kelly & Adger, 2009, pg.165).

3.3 Food Security

The concept of *food security* has been defined by different authors, institutions and organizations. Maxwell and Frankenberger in Maxwell, (1996, pg.291) reasoning from the 1986 World Bank definition defined food security as “secure access at all times to sufficient food for a healthy life” A widely used definition of the concept of *food security* is that by the 1996 World Food Summit which says “Food security exists when all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life”. From this definition, four main dimensions of food security were identified (FAO, 2008). These are the physical availability of food, the economic and physical access to food, food utilization and the stability of the other three dimensions over time. In relation to these dimensions, Maxwell (1996, pg.291) also observed a shift in earlier conceptions of food security which considered supply and shortfall of supply of food at the global or regional level to the local, household or individual level and has been widened to include elements like access, vulnerability and sustainability.

Food security has also been classified into two general types – chronic and transitory food security. While the former is said to be long term or persistent and occurs when people cannot meet their minimum food needs as a result of lack of assets and inability to access productive and financial resources the latter is short-term and temporary which occurs suddenly and characterized by a reduction in nutritional status and reduction in access to food. In-between these two broad categories is the concept of seasonal food insecurity which

is similar to chronic food insecurity as they are both predictable. It is however important to note that seasonal food insecurity can be transitory as it is of limited duration and recurrent. It is often associated with the fluctuations in climate, cropping patterns, work opportunities and disease (FAO, 2008). Some basic concepts associated with food security include safety nets, the severity of food insecurity, hunger, malnutrition, poverty and vulnerability. But as stated earlier, one of the objectives of this research is an attempt to assess how vulnerable peasants in the Builsa District are to climate induced food insecurity.

The (IPPC, 2007) acknowledges that climate change will have impacts on food production but the extent of these impacts is not yet known. The (IPCC, 2007) defined *food security* not in terms of the inability of agricultural production to meet food needs at the global, national and regional level but rather in terms of livelihoods that will meet the food needs of individuals and households through factors such as “household income, human health, government policy, conflict, globalisation, market failures, as well as environmental issues (Devereux & Maxwell 2001; Marsland 2004; Misselhorn 2005 cited in the IPCC, 2007) will influence the individual or household access to sufficient food. In this regard, three principal components of food security were identified which are “the availability of food (through the market and through own production), adequate purchasing and/or relational power to acquire or access food; the acquisition of sufficient nutrients from the available food ...” (Swaminathan 2000; Hugon & Nanterre 2003 cited in the IPCC, 2007) and climate variability may directly or indirectly affect all these three components on food security (Ziervogel et al., 2006 in the IPCC, 2007).

Builsa district as one of the poorest in the Upper East region of Ghana cannot be said to be food secured as peasants are faced with erratic rainfall patterns, few dams for dry season irrigation, poor soils, removal of agricultural subsidies, inadequate access to extension services, inadequate infrastructural development, low literacy levels etc. This situation of the district I assume will be aggravated by climate change and variability. Applying the concept of food security here I will like to identify the extent to which climate change affect the supply aspect of food and this has to do with the issues of vulnerability and adaptation in my research objectives. The question I will like to analyse is the extent to which households can produce to meet their food needs all year round and if not what other alternatives do they have in times of insufficient food supply? Majority of the people in the Builsa district depend on agriculture for their basic needs. The agricultural system in the district is basically rain-fed except some few areas with dams for dry season irrigation. So in trying to look at the supply

aspect of food in the district, some theories of agricultural change will be looked at. These theories will try to account for some of the factors that influence agricultural change in general and this is applicable in the Builsa district.

3.4 Theory of agricultural change

Notions about the inability of humans to feed themselves in view of an increasing number of people on earth has long been observed by earlier scholars but did not come to light until Malthus (1798) published his ideas on the relation between population growth and food production. Malthus alarmed that, the rate of population growth if unchecked will exceed food supply asked for positive checks to population growth. I think this publication ignited the debate on the relationship between food supply and population growth and brought counter ideas into the geography of agricultural change. Boserup (1965) in response to Malthus emphasized the role population plays in transforming agriculture through technology and espoused that, as people increase there will be new agricultural technologies to address the deficit in food supply. Boserup held that extensive agriculture with low overall production concentration is commonly practiced when rural population density is low enough to allow it, because it tends to be favourable in total workload and efficiency (output: input). She initially stressed that intensification's costs came in the field as fallows were shortened, but she (Stone, 2004) and others have also identified other modes of intensification which are capital-based and infrastructure-based intensification. In capital-based intensification which is characteristic of industrialized societies, the amount of human labour required to produce food generally decreases, whereas the total direct and indirect energy costs can climb to exceedingly high levels. In infrastructure based intensification, the landscape is rebuilt to enhance, or remove constraints on, production (Stone, *ibid.*).

Boserup's model has been accepted with mixed feelings with some dismissing it as simplistic (Stone, *ibid.*) and categorized factors that influence agricultural change to include ecological, social, and political-economic factors. However, her focus on labour availability is one reason for the “evergreen” role of her work, and also of relevance to this study. Wall & Smith (2005, pg.114) also reasoned that factors influencing agricultural adaptation could be “within and without factors” where the former includes ecological factors such as soil, water, terrain, and climate and the latter social and political factors such as technological innovations, market forces and policy towards the agricultural system. It is also argued (Bugri 2007, pg. 271) that the tenure system in Africa leads to land fragmentation which does not give room

for meaningful agricultural production efforts thus the need to adopt policies geared towards secured security of tenancy which will transform the agricultural system from subsistence base to commercial farms and will result in increase production (Bugri 2007, *ibid*). It is important to recognize that none of these factors are constant hence changes in them may induce subsequent changes in a farming system. It will be in-exhaustive to try looking at all these factors as there is a wide range of literature on each of them but a few will be considered.

The view is held that, an agricultural system is likely to change following the introduction and adoption of new technologies which are thought of as removing barriers to increased production. These changes are thought off to be in crop composition and often leading to increased farm incomes (World Bank 1981, pg.1). It is however observed that uniform adoption among farmers is often rare and that adoption varies across socioeconomic groups and time. The technology might be there but the access can be a problem as it is the case in the Builsa district where farmers cannot pay for the services of tractors, fertilizer, and other agricultural inputs needed for increase production.

Markets are recognized to be one of the most important factors influencing agricultural production in developing countries as they determine prices of inputs and outputs. It is observed that in some parts of Africa local markets have led to increased crop production through intensification (where there is pressure on resources) and extensification where resources are available (Grigg 2000 pg.6). The demand for particular crops within the local market (regional or national markets) could spur the intensification of such crops. To a very large extent, as to whether markets and the other factors will operate in favour of a farming system depends on policy. In the Builsa district no efforts are put at regulating market prices for farm goods. The market is left to the forces of demand and supply making it common to find farm produce being sold at cheaper prices during the harvest time and at very high prices during the lean season where farmers need enough food to work on their farms. At this point, what type of framework will we need to capture the complexities of factors influencing peasant's decisions on land use changes which will recognize farmers as active agents creating and recreating the conditions for their survival by responding to several constraints both internal and external which includes climate change?

3.5 Sustainable livelihood framework

In the 21st century there is a shift in focus in the use of econometric approaches which apply dichotomous methods in assessing the well-being of people to people centred approaches which are focused on how people especially vulnerable groups access different types of resources for their survival. These people centred approaches take into account how institutions at various levels affect people access to and use of resources. In this regard, the sustainable livelihood framework becomes inevitable when trying to assess the well-being of people. Chambers and Conway (1991, pg. 9) defined a livelihood in its simplest form as “a means of gaining a living” and the concept of sustainable livelihood combines the three concepts of capabilities¹, equity² and sustainability³. Chambers and Conway (ibid.) observed that while livelihoods can be predetermined like you being born into a class society, some livelihoods are also created with desperation. Drawing from other researches like Chambers and Conway (1992 cited in Scoones 1998, pg.5) the IDS defined a livelihood to comprise “the capabilities, assets (including both material and social resources) and activities required for a living” and a livelihood is sustainable “when it can cope with and recover from stresses and shocks, maintain or enhance its capabilities and assets, while not undermining the natural resource base”. From the IDS definition, Scoones (1998) identified five elements of accessing outcomes when certain livelihood resources are combined. These elements include employment creation, poverty reduction, enhancing well-being and capabilities, livelihood adaptation (vulnerability and resilience) and the sustainability of the natural resource base (Scoones ibid.).

Chambers and Conway (1991, pg. 10) noted that livelihood can be defined at various hierarchical levels but used the household as their unit of analysis for the purpose of clarity and brevity. It is also observed that livelihood analysis can start from the individual level and build up to “complex livelihood strategies and pathways at household, village or even district levels” (Scoones 2009, pg.1). Chambers and Conway (1991) providing an anatomy of a household livelihood envisaged the household to comprise people, their activities, their assets and what they gain from what they do. Store and resources are the tangible assets that the

¹ Capabilities: the ability to perform certain basic functions or what you are capable of doing and being.

² Equity: used here to describe an end to discrimination against all marginalized groups of people – women, the weak, the deprived etc. (Chambers and Conway, 1991)

³ Sustainability: used here to mean the ability to use resources to meet our needs while maintaining the very base that these resources come from.

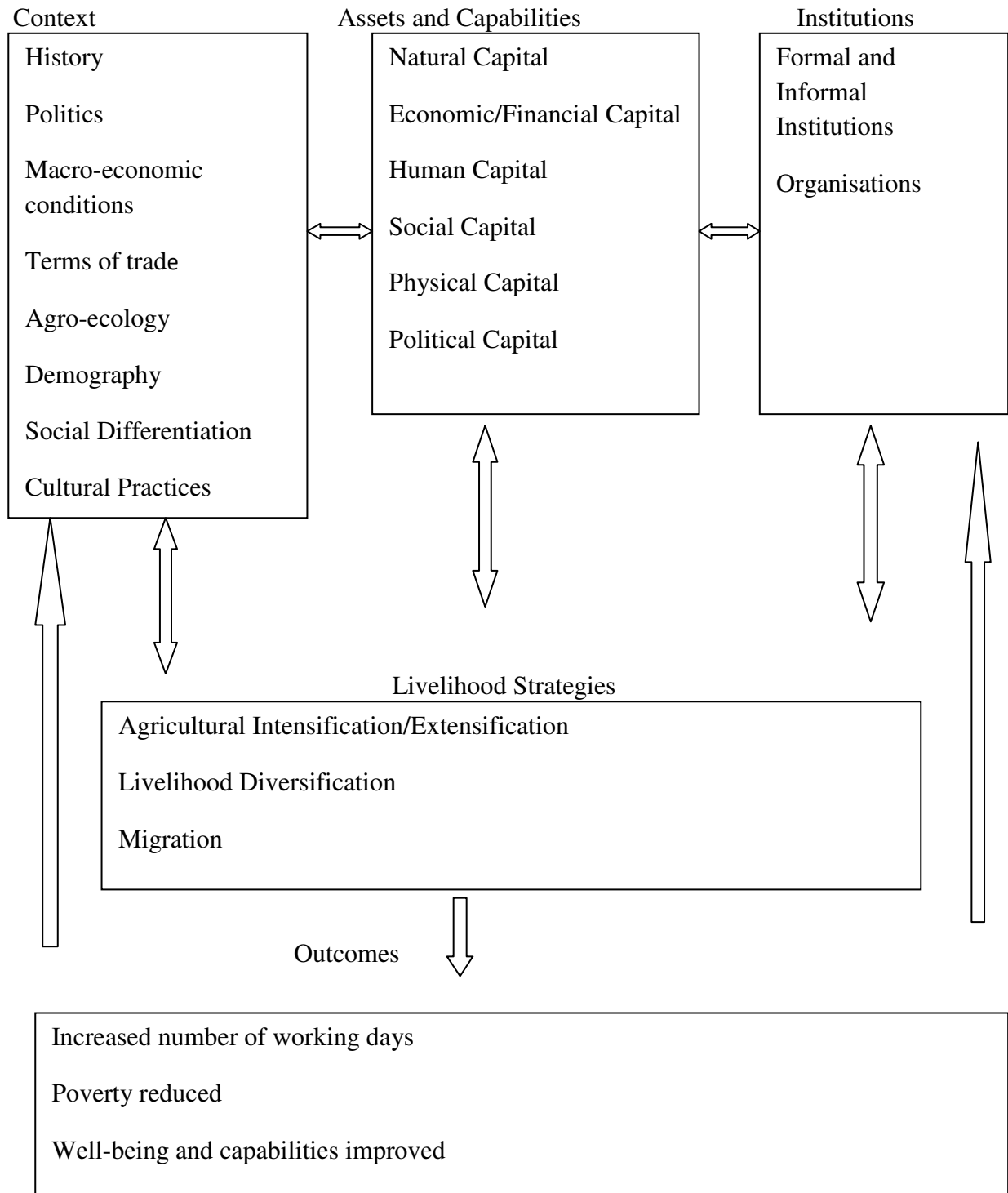
household have control over. Stores include “food stocks, stores of value such as gold, jewellery and woollen textiles, and cash savings in the banks of thrift and credit schemes” (Chambers and Conway *ibid.*). Resources include the land and all its attributes to farm equipment and domestic utensils. The combination of stores and resources makes up the assets of the household. The claims and access is the intangible asset of a household. Claims are “demands and appeals which can be made for material, moral or other practical support or access” and access “is the opportunity in practice to use a resource, store or service or to obtain information, material, technology, employment, food or income” (Chambers and Conway *ibid.*). People then make a living out of the tangible and intangible assets at their disposal. A more elaborate framework was that developed by Scoones (1998) which I would want to integrate some parts with a framework developed by Adato and Mein for my analysis.

From a review of the literature, I am tempted to guess that the sustainable livelihood framework operates from the assumption that there are different types of resource in a given context and people need combinations of these resources to achieve given outcomes (Scoones 1998; Yaro 2008). According to Scoones (2009, pg. 1) a livelihood is a “combination of the resources used and the activities undertaken in order to live” At the foundation of the livelihood framework is a capital base (Scoones 1998, pg.7) from which different types of livelihood strategies are pursued. There are various types of capital and Scoones (*ibid*) identified natural, economic or financial, human and social capital. He later (Scoones, 2009) added political capital. From this reasoning, the different types of capital become the tangible and intangible assets in figure 1 and from my simple analogy these are combined to pursue different livelihood strategies. It is identified that, agricultural intensification\extensification, livelihood diversification and migration are the three strategies being pursued in a given context (Scoones 1998, pg.9). It is also noted that the successful pursuit of any of these strategies depends on the identification of the different types of capital which can be combined to achieve a particular outcome. At the centre of these combinations is the role played by institutions and organizations.

The sustainable livelihood framework acknowledges at its heart, the role of institutions in mediating people access to resources and how institutions can be better organized to achieve sustainable outcomes. Institutional processes, which can be formal or informal and includes organizations, play a crucial role in achieving sustainable livelihoods (Scoones, 1998). Institutions are seen as setting the social spaces for negotiating and gaining access to the

various types of capital. Yaro (2008, pg.9) described institution as “defining the rules that legitimize people entitlements to environmental resources”.

Figure 3.1 Conceptual Framework



Adopted from Scoones (1998); Adato & Mein (2002)

Institutions are not static but dynamic and this invariably make peoples livelihoods dynamic since livelihoods are mediated through institutional arrangements. Yaro (2009, pg.2) observed that these institutions change in “reflection of wider and more powerful factors such as markets, government and donor policies, weather fluctuations and other biophysical changes”. Given the wide adoption and use of this framework within development work, there exist many variants of this framework. However, I would want to adopt the frameworks use by Scoones and Adato & Mein for my analysis. This framework is show in figure 3.1 above.

The questions then are how is the institutional arrangement in the district regarding land use? How do peasants perceive the problem of climate change? Is climate change alone attributable to peasant farmer’s behaviour regarding land use changes? How can issues of climate change and politics be incorporated into the sustainable livelihood model since it has been criticised for its inability to treat these issues at length (Scoones, 2009)? I however think that this model is capable of explaining the situation of the peasant farmers in the Builsa district as it is hypothesized that peasant farmers do not change crops in response to climatic factors alone but more importantly in response to non-climate factors which are captured within this framework.

Even though the framework has been abstracted at different levels by various authors I would like to approach my analysis from the simplistic anatomy presented in figure 3.1. I would like to operate on the assumption that the Builsa district has all the various types of capital mentioned in the paragraphs above and climate is part of the natural capital. This then implies that climate change alone cannot be said to be responsible for the changes in land use decisions in the district as other factors like policy, markets, taste, religion, globalisation, migration, etc are in synergy with climate. Another aspect of the framework of interest to me is the issue of livelihood diversification. Taking this word in its simplest form is to look at the various off-farm activities engaged in by farmers. I think this will be linked to the adaptation aspect of my research objectives as climate variability is likely to push peasants to consider other non-farms and off-farm livelihoods.

3.6 Conclusion

In the beginning of this chapter, attempts were made to trace earlier theories or modes of thinking that dominated research in human environment relations. It was discovered that applying ecosystem concepts in solving environmental problems in developing countries

which dominated development thinking in the 1970s and 1980s have given way to concepts and theories that espoused disequilibria following their subsequent failure. In the 21st century, we are faced with an issue of human induced climate change which is likely to negatively affect food security in the developing countries and which is often accused of as one most single factor which affects or is likely to affect agriculture badly.

This then led to the attempt to elaborate such concepts like climate change and food security. It brought up the need to consider some theories of agricultural change and how climate alone cannot be a driver of changes in an agricultural system. In trying to account for factors that influence peasants land use decisions in the 21st century, there is the need to use the sustainable livelihood framework which admits at its core that the process of changes in people livelihoods are many and complex. This complexity therefore demands a people centred approach which incorporates issues of access and power into the analysis but not just a dichotomous analytical method as it is with most econometric approaches of analysis which have dominated development thinking for a long time.

CHAPTER 4

Climatic patterns in Ghana

4.0 Introduction

Ghana is signatory to most international conventions governing the use of natural resources in an effort to providing better conditions of life for Ghanaians in a sustainable way and one of these conventions includes the United Nations Framework Convention on Climate Change (UNFCCC). Ghana as a party to this convention is obliged under Article 4.1 paragraph (a) to create national and update national inventories on climate related activities and present its findings to the UNFCCC. The Ghana National Communication on Climate Change (NC) shortly called, is a body tasked with this responsibility. Ghana completed its first task in 2000 with an overview of greenhouse gas emissions and predicted impacts of climate change on some sectors of the economy including the agricultural sector which is likely to be affected negatively. Ghana as a developing country has a lot of developmental problems including the need to feed a rapidly growing population and to reduce the drift of the youth from the rural areas to urban centres. The agricultural sector, which is central to ameliorating some of these problems, is largely rain-fed and climate change it is predicted will negatively affect this sector in Ghana if warming exceeds 1°C according to the NC (2000) as it will have the potential of reducing rainfall amount and distribution in almost all the agro-climatic zones in the country except in the rainforest (see table 4.2) which is necessary for the production of agricultural goods.

The majority of people in rural Ghana depend on agriculture for their livelihoods especially in the northern parts where alternative viable and sustainable rural livelihoods are underdeveloped and unexploited thus putting their livelihoods to some extent at risk under climate change. This chapter will have an overview of climate change in Ghana looking basically at rainfall and temperature patterns and how these parameters affects the agricultural sector in general and Northern Ghana in particular. Northern Ghana because this is where my research area lies and is also where there seems to be an observed gradual increase in temperature and a fluctuating, uneven distribution and unpredictable rainfall patterns. Even though it is pretty difficult to have access to reliable rainfall and temperature records for the Builsa district, I will make use of some records from nearby stations in the upper east region in an attempt to show the pattern of rainfall and temperature pattern for the

district. It is important to note that most of the information presented in this chapter is from the (NC) unless otherwise indicated.

4.1 Overview of Climate Change in Ghana

Ghana lies on the south central coast of West Africa between latitudes 4.5°N and 11.5°N and longitude 3.5°W and 1.3°E. Ghana shares a common border with the Republic of Togo on the east, Burkina Faso on the north and la Cote d'Ivoire on the west respectively. Ghana covers an average area of 238,539 square kilometres. The country has an estimated population of 20.2 million people as of the year 2000 (Population and Housing Census, 2000). With a fertility rate of 5.15 the population of Ghana is projected to be 36 million by 2015 which means the need for the country to grow more food to meet the needs of the growing population and even so under changing climatic conditions. The climate of Ghana is dominated by two major air masses: the dry and warm North-East Trade Winds (locally known as the harmattan winds) and the moist South-Westerlies or the monsoon winds and these winds influence rainfall in Ghana (NC 2000; Owusu & Waylen 2009). The moist maritime monsoons are associated with rainfall while the dry Trade Winds bring dry conditions. Thus the country has distinct dry and wet seasons depending on the dominant wind in the area. Temperatures throughout the country are typically high with annual mean generally above 24°C. Average figures range between 24°C and 30°C although temperatures ranging from 18 to 40°C or more are common in the southern and northern parts respectively. Over the past three decades (1970-2000) the country is observed to have experienced a 1°C rise in temperature (EPA 2000d cited in Yaro 2010, pg.38). Rainfall generally decreases from south to north with amounts ranging from 2000mm in the south to 1100mm in the north. Ghana has experienced a decline in mean annual rainfall from the period between 1951 and 1970 to the period between 1981 and 2000 (Owusu & Waylen 2009 in Yaro 2010, pg.39). Apart from the high temperatures and reduced rainfall, climate change is also likely to impact negatively in the coastal areas resulting in salt water intrusion into coastal aquifers and coastal inundations. Ghana's economy is strongly dependant on agriculture and this dependence is a cause of worry if climate change is to negatively affect the agricultural sector with peasants having little room to manoeuvre. The parameters of interest to me are temperature and rainfall and how they will have influence on the agricultural sector. This is because temperature and rainfall are often the most cited climatic parameters as being responsible for crop failure and have a negative impact on the general well-being of people

So I would present temperature and rainfall patterns and then discuss this against farmers' experiences.

4.2 Temperature and rainfall patterns

4.2.1 Temperature patterns

Using 1961 to 1990 as base line years, the NC (Ghana National Communication on Climate Change) observed a 1°C increase in temperature over the whole of the country. They also projected that mean daily temperatures will increase by about 2.5°C to 3.2°C by the year 2100 which is assumed to be higher than the global projected average of about 2°C over the same period. There are spatial variations in these projected increases between the various agro-climatic zones in the country as shown in table 4. 1

Table 4.1: Spatial variations in temperature increases in the various agro-climatic zones

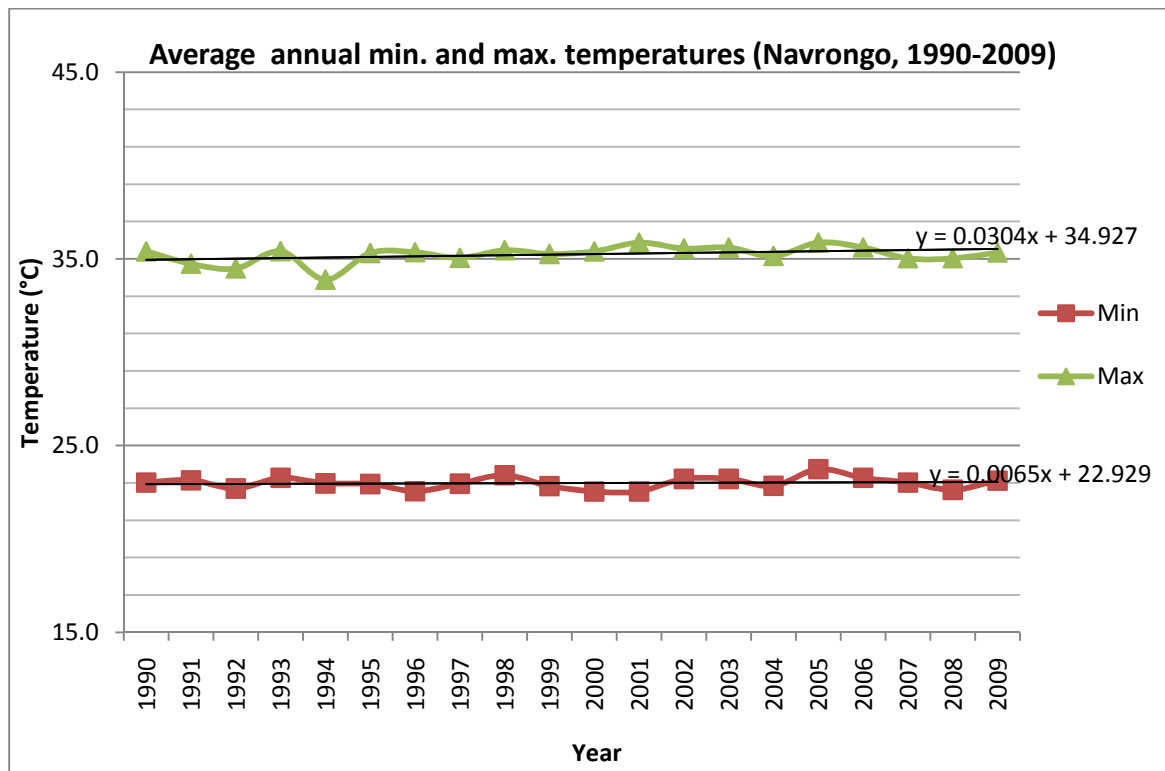
Zone	Increase in Mean Maximum Temperature by 2100 (°C)	Increase in Mean Minimum Temperature by 2100 (°C)
Sudan Savannah	3	2.5
Guinea Savannah	2.5	2.5
Transitional	2.5	3
Deciduous Forest	2.5	2.5
Rainforest	2.5	2
Coastal savannah	2.5	No Data

Source: Ghana National Communication on Climate Change (NC)

From table 4.1, it can be inferred that the northern regions which span the areas of the Sudan and Guinea savannahs are more likely to experience warming in the country compared to the other parts of Ghana. A related research observed gradual increases in temperature in

Northern Ghana⁴ in the 20th century averaging 28°C and with occasionally very high temperatures around 46°C during the dry season-November to April (Dietz et al. 2004, pg.156). I would like to state here that the conclusions reached by the NC could be debatable as it is observed that the GCM and other models developed specifically for climate modelling in the North cannot give a true picture of the climatic patterns over some parts of Africa. In addition, the NC used data between 1961 and 1990 which is less than sixty years and cannot reach any serious conclusion on temperature and rainfall patterns in Ghana as the climate of West Africa as a whole is considered to be more variable and would need more observed years to reach a reasonable conclusion. A cursory look at temperature records for some stations in the upper east regions from 1991 to 2009 suggests no linear pattern of increase but rather an undulating pattern with a year of high temperature records on the average being followed by a year of a slight reduction in temperature. These patterns are shown in the figures 4.1-4.3

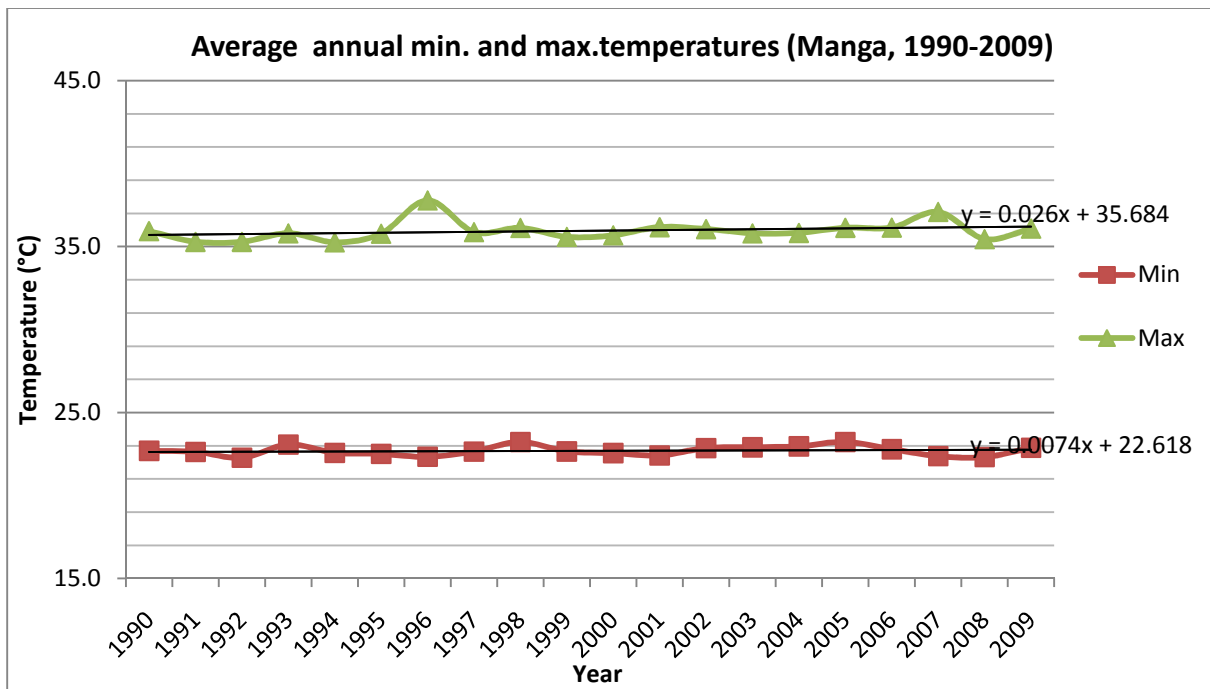
Figure 4.1



Source: Ghana Meteorological Agency

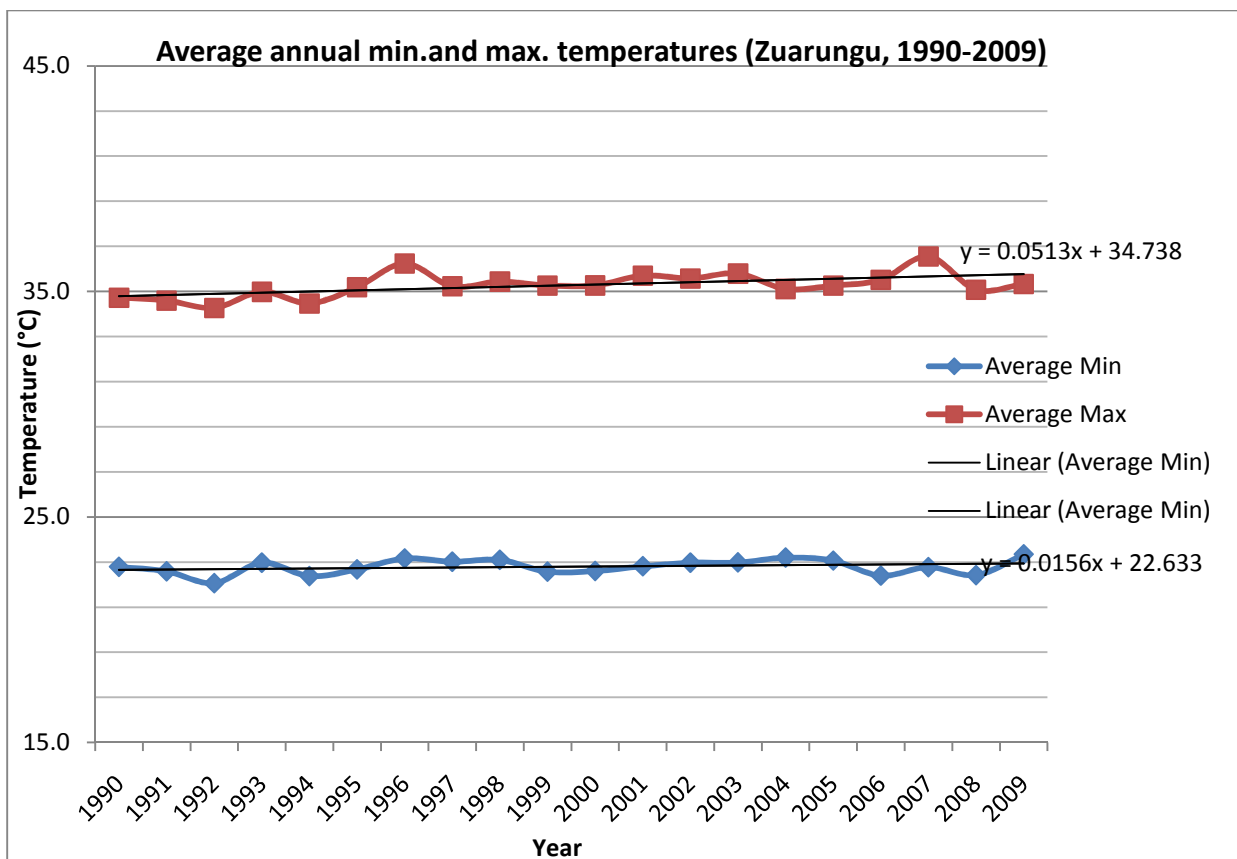
⁴ Northern Ghana refers to the three administrative regions in the northern parts of Ghana. These are the northern region, the upper east and the upper west region.

Figure 4.2



Source: Ghana Meteorological Agency

Figure 4.3



These three stations are located in the upper east region of Ghana and the Builsa district is part of this region. The Navrongo station especially shares boundaries with the Builsa district and since there is no established rainfall and temperature record stations in the Builsa district, it become inevitable to rely on data from the stations near by the district. From the figures above, the Navrongo station seem to suggest a slight decline in temperature in the early parts of the 1990s which has been increasing gradually to a relatively stable point in the late 1990s to the early 2000s and a downward trend in the late 2000s. I will describe the Navrongo station as relatively stable compared to the Manga and Zuarungu stations which have peaks records in the maximum temperature (37.8°C and 36.6 °C respectively) higher than the Navrongo station (35.9°C) for the observed period (1990-2009). In general one can say that both the maximum and minimum temperature recorded are not so extreme from the trendline averages.

4.2.2 Rainfall patterns

Ghana has three hydro-climatic zones which receive different amounts of rainfall throughout the year. These zones are the South-Western basin system, the Volta basin system and the Coastal basin system. The South-Western system is the wettest of all the systems and has mean annual rainfall of 1500mm to 2000mm. The Volta basin system which covers the northern parts of the country has annual mean rainfall ranging between 1000mm in the savannah areas to 1500mm and 2000mm in the forest areas. The driest system is the Coastal system with an annual mean rainfall of about 900mm. Using 1961 to 1990 as baseline years, it was observed that rainfall amounts showed a downward trend in Ghana as a whole except in some areas within the South-Western hydro-climatic system (Kete-Krachi). Rainfall was also observed in the various agro-climatic zones in the country and it is projected that annual rainfall totals will decrease by 9-27% by the year 2100, with the range representing spatial variations. The predicted decrease in annual rainfall in the different agro-climatic zones is shown in table 4.2

Table4.2: Spatial variation of rainfall in the various agro-climatic zones in Ghana

Zone	Projected Changes in Mean Annual Rainfall by 2100 (mm)
Sudan Savannah	-170
Guinea Savannah	-74
Transitional	-78
Deciduous Forest	-99
Rainforest	+110.5
Coastal Savannah	No Data

Source: Ghana National Communication on Climate Change.

From table 4.2 it is clear that mean annual rainfall for my study area (which is located within the Sudan and Guinea savannahs) will reduce by 2100. The relationship between increasing temperature and amount of rainfall was also studied historically and it was observed that the last 30 years (1961 to 1990) have witnessed a reduction in rainfall by 20% and runoff by 30% in Ghana as a whole (NC, 2000). In a related research Owusu et al. (2008, pg.5) also observed a downward trend in rainfall patterns in the Volta basin since 1951. They observed that annual mean totals of rain have reduced from “1,400 mm to 1,200 mm in the south and from 700 mm to 600 mm in the north”. This decline has been linked to earlier research that showed a general decline of rainfall in West Africa (Owusu & Waylen 2009, pg.115) in the 1970s although with an expected signs of improvement after the year 2000. The general shift in the ITCZ southwards and other human factors, though the human factors have been disputed by some researchers (Govaerts& Lattanzio 2007 in Owusu & Waylen 2009, pg.115), have been linked to this decline. Some authors have in addition linked the decline in rainfall over West Africa to changes in sea surface temperature (Sun & Wang 2010, pg.15: Vizy & Cook 2001, pg.795: Nicholson 2001) and the “variation in the location and number of rainfall stations” (Chappell & Agnew 2004, pg.548).

It is important to note that the decline in rainfall amounts is not uniform throughout the country and surprisingly (Owusu & Waylen., 2009 pg.119) seem to suggest that northern

Ghana is not greatly affected by these changes compared to the forested and southern parts of the country. This is surprising because the view is often held that climate change is likely to affect northern Ghana more than any other region in Ghana and some politicians, academics and non-governmental organisations like Care International (2007) say it is already happening –reduced rainfalls, higher temperatures, etc. It is good to note that this picture of a relatively slighter reduction in rainfall in northern Ghana compared to the southern parts should be treated with caution as northern Ghana is a vast area and comprises three administrative regions and there could be variation in rainfall amount and distribution between and within these regions. This caution is from my view that average figures can have the potential of subsuming little details that might be significant in contributing to drawing a conclusion about a phenomenon in a given area. Following from this, it is observed that rainfall patterns for Navrongo (one of the station in the upper east region of northern Ghana which is located in the Kasin Nankana district and shares boundaries with the Builsa district (see map of study area) have undergone less variation in the 1960s to higher variations in the latter parts of the 1990s (Yaro 2004 in Yaro 2010; Dietz et al. 2004).

4.2.3 Number of rain days

Yaro (ibid) observed that *all things being equal* an average of 75 rainy days well distributed between April and November is needed to achieve a good harvest. However out of the 36 years he observed for some stations in the upper east region, a total of 18 years recorded lower than expected rainfall with the spacing between subsequent rains decreasing from the 1960s until they reached a crisis in 1983 where only 16 rainy days were recorded. He described the rainfall situation after 1985 as a year of favourable conditions followed by a year of bad conditions (Yaro 2010, pg.41). Yaro (2010, ibid.) described a situation where there is an uneven distribution of rainfall in the critical months (April to November) as follows: *‘most rainy days are concentrated in the peak of the rainy season in July rather than April and May when a shortage of moisture can nullify the investments of farmers. The years 1964, 1966, 1970, 1976, 1977, 1989, and 1994 are years in which total rainy days are adequate but yet register negative values for the early months of the rainy season when crops really need moisture’*. Not surprisingly, Dietz et al. (2004, pg.155) observed that while the UNESCO's aridity assessment of the Bolgatanga area of the upper east region between 1930 and 1960 described it as having sub-humid conditions, an analysis of rainfall data for the same area between 1960 and 1997 show that the area has semi- arid climate and *“drought risk years were 1962-63, 1967, 1970, 1977, 1981, 1984, 1990, and probably 1995 and 1997”*

A century of rainfall data analysis between 1900 and 1993 by (Dietz et al. (2004, pg.155) for the whole of northern Ghana suggests a fluctuating pattern with good years recording up to 2000mm of rainfall (1917) and bad years recording averages of 200mm of rainfall. In general, it is observed that average rainfall for North East Ghana (Upper east region) showed an upward trend of more than 1000mm in the 1960s and a downward trend between 1969 and 1985 to an average record of 800mm. It then increased again in the early parts of the 1980s to an average of 975mm and a decline in the 1990s to an annual average of 930mm and the data for 1985 to 1997 does not suggest a further decline in rainfall for the area (Dietz et al. 2004, pg.158).

The Builsa district has no station on its own but is close to the Navrongo station which is about 18km away from the district is set up by the Ghana Meteorological Agency to take records of some climatic parameters including rainfall and temperature. I would thus like to look at the rainfall patterns from 1990 to 2009 for this and other two stations since earlier work has been done by (Yaro 2004; 2010; Dietz et al. 2004) up to 1993. I am aware that using rainfall and temperature data from Navrongo and Manga Bwaku for the Builsa district might not give me a true picture of the rainfall patterns of the district as there are observed variation in rainfall distribution and amount within the Upper east region. This notwithstanding, I think it can give me a representative picture of the nature of the rainfall patterns for the period 1990 to 2009 as these stations are closer to the district. The use of climate data from these stations is also necessitated by the fact that the Builsa district has inconclusive (Dietz et al. 2004) data on rainfall and temperature records over the years. Figures 4.4 and 4.5 show the rainfall patterns for the two stations listed above. These patterns show the total annual rainfall recorded in millimetres. A careful observation of the trendlines for both the Navrongo and Manga Bwaku stations suggest a steady increase in total average annual rainfall over the stated period. It is however good to note that there are extremes in the total average annual rainfall recorded over the observed period with 2007 recording the highest (1562.7mm) amount of rainfall for the Manga Bawku area and 1995 being the lowest with an average total annual rainfall of around 500mm for the Navrongo area.

Figure 4.4

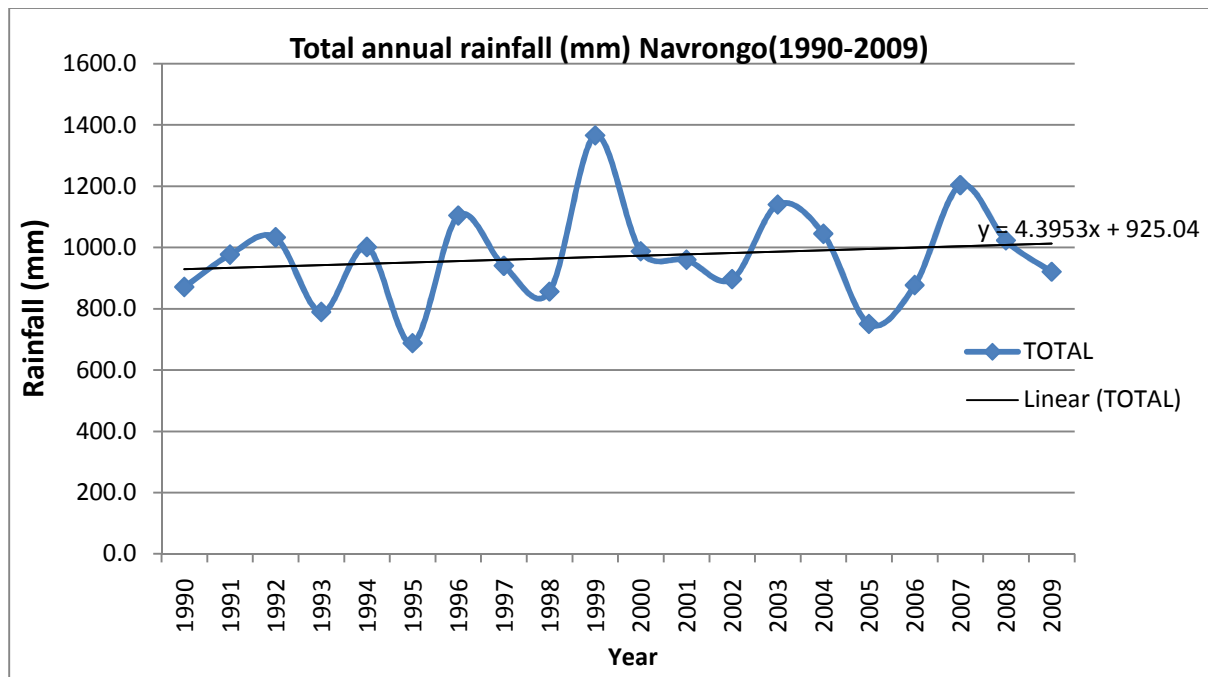
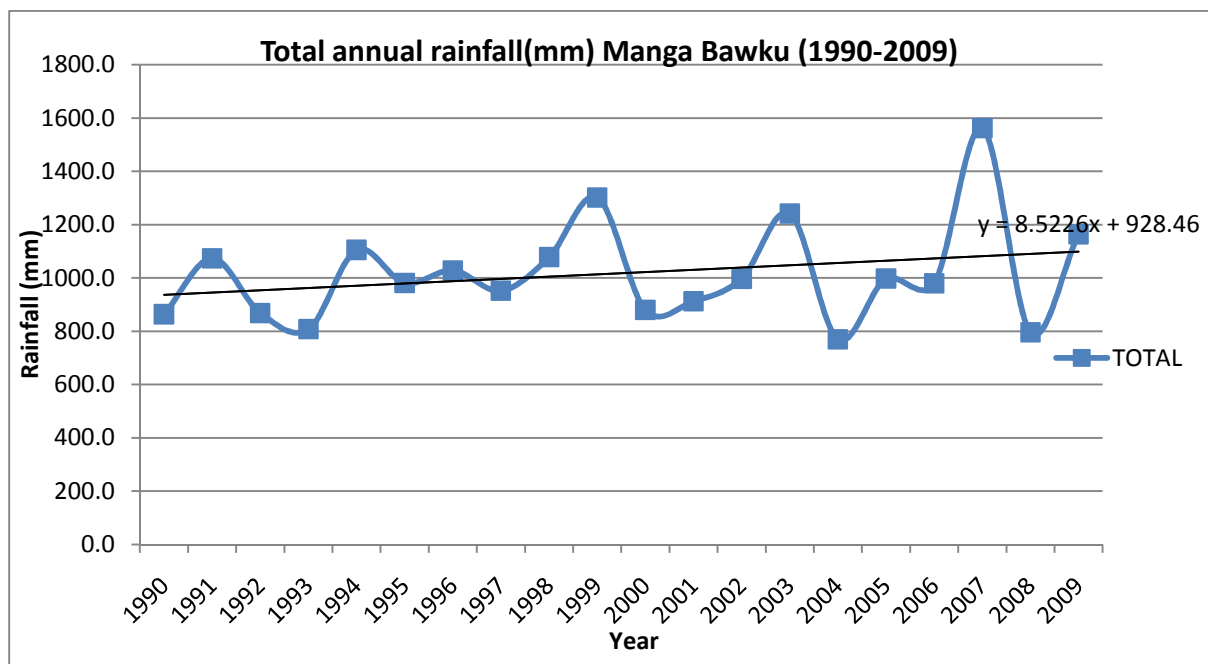


Fig. 4.5



Seven out of the twenty years observed recorded total average annual rainfall more than 1000mm and the rest of the years did not record an average rainfall below 700mm except 1995 and 2005 for the Navarongo station and 2004 for the Manga Bawku area. This suggests that the total average amount of rainfall for these stations can be pegged around 1000mm which show no decline in rainfall since the 1990s as suggested by earlier researchers. In

addition, the mean monthly rainfall did not suggest a decline at a decadal interval for the two stations observed (1990-1999 and 2000-2009). This is shown in figures 4.6 and 4.7. This observation is in contrast to that of the NC 2000 as there is a slight increase in rainfall.

Figure 4.6

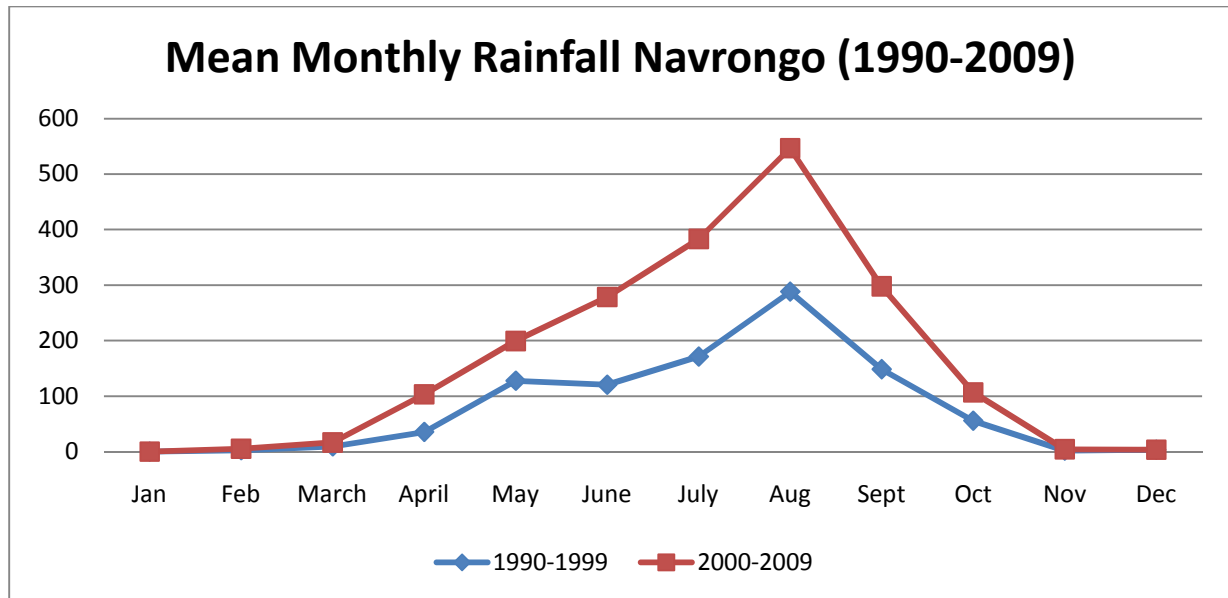
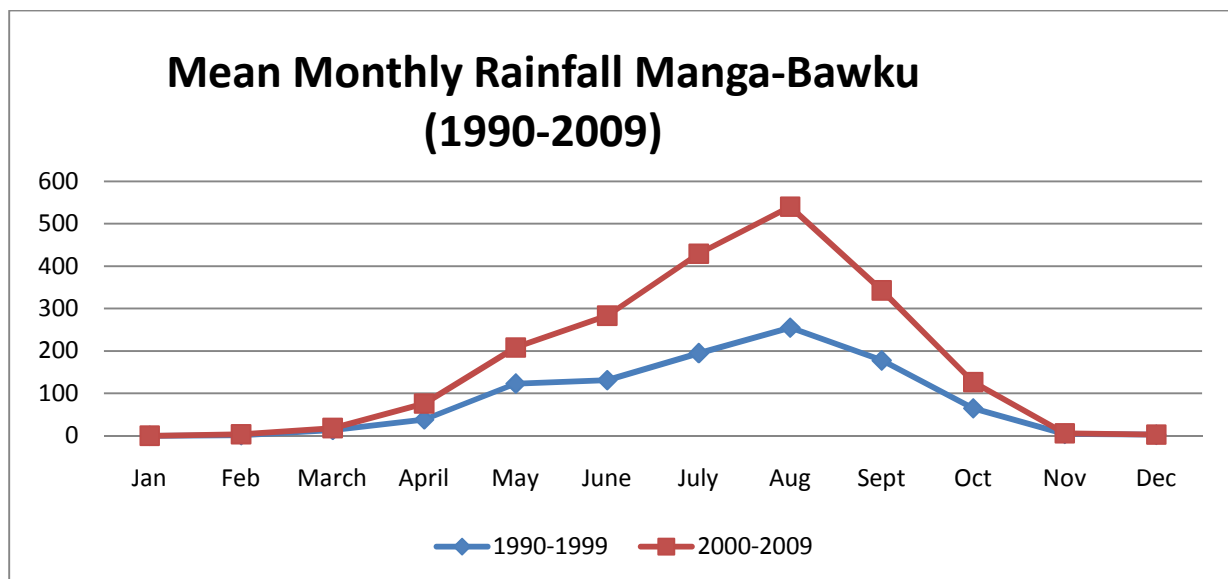


Figure 4.7



But the question then is if these increases in the total average records is enough grounds to conclude that climate change does not affect farming in terms of water supply as these activities in the Builsa district are mainly rain fed? My hypothesis is that, the most important thing as noted by Yaro (ibid, 2004), is not the amount of rainfall received annually but the

variations in the onset and distribution of rain in the critical months (April to November) of the growing period of crops. The critical period is the period where the farmers need the rain most and from the field data collected in the Builsa district on the distribution of the rainfall patterns, the farmers were quick to point out the increasingly uneven nature of the rains during the planting season (April to November) and the shortening of the rainfall period. This was a critical factor peasants recognised as contributing towards their decision to shift to early maturing crops since rainfall duration is shortened.

4.3 Conclusion

From a statistical view point it becomes clear that while the temperature pattern for my study area remains stable there is a slight recovery in rainfall from the 1990s and this twenty year period have not recorded annual averages below 200mm as observed by Dietz (ibid). Even though two decades of observed rainfall is not enough to arrive at a conclusion of the rainfall pattern of the district, the figures shown above does not seem to augment what the NC is projecting. The issue as I pointed out earlier is not with only the amount of rainfall received but also with its distribution during the planting season. It is unfortunate that I have not been able to access data on the number of rainy days in the critical months for farmers in the district but it is however clear from this data that the distribution of rainfall is erratic and the numbers of rainy days or months as observed by some farmers have also reduced. These two parameters coupled with other factors as will be presented in the subsequent chapter combine to influence farmer's decision to grow one variety of crops but not the other.

CHAPTER 5

Livelihoods strategies in the Builsa District

5.0 Introduction

This chapter presents the results of my fieldwork. It starts by exploring how some livelihood activities of peasants in the Builsa district are organized. A livelihood in this context will be used to describe the means by which people make a living. The people of the Builsa district are predominantly farmers but some do engage in off-farm and non-farm activities like hunting, basketry, weaving, pottery, etc. There are only few people in the Builsa district who are employed by state agencies and non-governmental organisations. Farming in the district involves the rearing of animals and the cultivation of crops with the immediate aim of feeding oneself and family and the surplus for sale to solve other domestic problem. Even though there are a few dams dotted around the district for dry season irrigation, these dams are seasonal and small thus limiting their capacity to store water for a long time. This makes the use value of these dams insignificant in the dry season and especially in years where the amount and duration of rainfall is below average. The cropping system is mainly low technology and rain-fed and the immediate source of labour for production is the household thus making household composition a critical contributor towards household food sufficiency. Peasant's use of external input like fertilizers, insecticides, and herbicides is minimal. Mostly, the hand hoe and the machete are the farm implements used to cultivate the land even though some rich families make use of the ox drawn ploughs and tractors.

5.1 Household composition

The term household is used here to describe a smaller unit made up of people who cooperate socially and economically among themselves with the ultimate aim of making a living. In this regard a household in the Builsa district could be a man, his wife or wives, children and grandchildren or a single parent with children whose members cooperate to make a living. The use of the term here includes all migrants who cooperate and contribute towards the welfare of the household and not necessarily people occupying the same dwelling. Culturally, it is a plus for a Builsa man to marry more than one wife while it is forbidden for a woman to have more than one husband thus making polygamous households acceptable in the district. The polygamous households are however on the decline as none of my informants during the household survey had more than one wife and is now giving way to monogamous households. This could be as a result of several factors including the deliberate attempt by the

state to reduce the fertility rate through family planning programmes in the early 1980s, the proliferation of Christianity, education, globalisation, etc and also the increasingly expensive nature of child upbringing, that is, if more wives will necessarily mean more children. In the Builisa district, the household is the basic unit of production and the household is often with a head that is a male but in times of death, the surviving spouse if a female can assume the responsibilities of a household head. The household head mobilizes the rest of the members for production and assume full control of the output of some crops like millet and sorghum to no control over the output of other crops like groundnuts, rice and beans. Household size and composition is very critical in attaining household food sufficiency as the production system depends to a large extent on household labour. During my research, I conducted six household surveys at the three main villages selected (see table 1) and it was observed that households in my study area have an average size of eight members. At the extreme ends, the household with the highest number of members recorded 11 members and the household with the lowest number of members recorded 5 members which were headed by a female. Most of the households were headed by males all of them married with their wives and some of their children living with them except the female household head who lost her husband some years ago. It was only in one household that the eldest son of the household head had migrated to the south and in another household too, the household heads elder's son is a teacher. Out of a total of 51 members in the six households surveyed, 32 (63%) of them were children of school going age and could barely help in terms of farm labour.

5.2 Farm labour

In a peasant community like the Builisa district, the availability of labour is very crucial towards food sufficiency of the household as a production and consumption unit. All the household heads during the group discussions and interviews said they relied on own labour in executing their farming activities. *'My main occupation is farming which I do on my own. Sometimes, I also engage the help of communal labour and if I invite them, I can get between seven to eight people. If it is by day I have to pay them 2 cedis a day (like NOK 10 per day as of July, 2010) if I have to cook for them, buy drinks...'* This is an excerpt from the female headed household in Dogninga on labour, which reveals that there are two types of labour in addition to own labour. The two types of labour is however not easily accessible thus making farmers to engaged these types of labour occasionally. These types of labour are 'by-day' workers and communal labour. By day workers are people who sell their labour in the villages for cash. They usually take their money on the spot after the work had been

completed thus earning the name 'by day'. People usually sell their labour during the farming season only when they need cash for something urgent as they are also seriously engaged in their farm work. The amount of money paid to a by day worker depends on the conditions of engagement as the female head household noted in the excerpt above. The other informants too agreed that you have to pay the by-day workers up to 4 cedis (20 NOK) if food is not provided and 2 cedis if food is provided. They also observed that the problem in accessing this type of labour is not only the difficulty in getting money to pay for it but also the difficulty in getting people to work on your farm at the right time of the cropping season.

Communal labour had been the practice in the area for a long time. It is a system by which the entire village helps out any member of the village who is not able to control the weeds on his farm alone on time. It is rarely engaged during land preparation and planting but becomes very visible during weed control. This is because a farm once cultivated would not require more labour for the subsequent cultivation as the farmers only need to gather the crop residues of the previous crops and burn. Labour is required during land preparation in cases where farmers need to cultivate new bush plots which have been in fallow for a longer time. What one needs to do to enjoy this type of labour is to go round the village farmers to notify farmers of your intention to engage their labour. This must be done at least three days before the actual day of the activity because you might not be the only one looking for help. Upon invitation, they will respond immediately or later on as to whether they can make it to the farm of the invitee or not. The rule to the communal labour is that, the more you honour the invitations of others, the more you are likely to get positive responses when it is your turn to invite others. As the female head household indicated above, the number of people who will respond is often not certain and these numbers kept decreasing over the years. An important aspect of the communal labour I would want to question is as to whether it is free of charge as the term implies or not? This question I think has been addressed by all my informants. They all recounted that communal labourers have to be fed in addition to providing them with drinks, cola nuts and tobacco. The provision of food is not as important in some cases as to the drinks, cola and tobacco as one of the informants stated emphatically that "*with the communal labour, drinks and tobacco determines the number of people who will come*".

5.3 The farming system

As noted earlier, the farming system in the Builsa district comprised the cultivation of crops and rearing of farm animals. These activities are year round but the cultivation of crops is

intensive between the months of April and September every year. Peasants have both compound and bush farms on which crops are grown. In addition, peasants rear different kinds of animals. These activities are cyclical and can be shown in table 5.1.

Table 5.1 shows the calendar of activities for peasants in the Builsa district.

Months	Farming activity	Crops planting time	Maturity period
• Benpaali Chiik (January).	Time for rest after the yearly activities	Water Melon, Cabbages, Garden eggs, Tomatoes, etc	
• Dogta Chiik (February).	Start of compound plot preparation	Nil	
• Wulum Chiik (March).	Hottest month and time for bush plot preparation	Nil	Water Melon, Cabbages, Garden eggs, Tomatoes, etc (3 Months)
• Sampola ale vaala nakka Chiik (April).	Intensive land preparation and last month for this activity	Nil	
• Borik Chiik (May).	Planting of major crops and maturity of the dawadawa fruits	Sorghum Millet Maize	
• Chaama ale puurik chiik (June).	First weed control, planting of groundnuts and other legumes. Typical of this month is gathering shea nuts.	Groundnuts Bambara Groundnuts Beans	

<ul style="list-style-type: none"> Wutulik ale naara chiik (July). 	Second weed control and harvesting of early millet. Drying and storage of early millet.	Sweet potatoes	
<ul style="list-style-type: none"> Nyiam ale chaaug Chiik (August). 	Wettest month and month for last weed control in late millet and sorghum	Nil	Early Millet Maize (3 Months)
<ul style="list-style-type: none"> Kpiak chiik (September) 	End of weed control activities and start of fallow plot for the subsequent year.	Nil	Beans Groundnuts Bambara Groundnuts (3 Months)
<ul style="list-style-type: none"> Nanpisinta ale cheka chiik (October). 	Harvesting of late millet, sorghum and legumes	Nil	
<ul style="list-style-type: none"> Fanoni chiik (November). 	Harvesting, drying and storage of late millet and sorghum	Nil	Sorghum Late Millet (5 to 6 Months)
Burinya Chiik (December).	Celebrating Fiok and Christmas	Nil	

NB. Animals are kept alongside these activities. Source: field work 2010

5.4.1 The cropping system

Crops can either be grown on a compound farm around the house or on a bush farm some kilometres away from the house. Some of the activities evolving around the cultivation of crops are land preparation, planting or sowing, weed control, harvesting and storage. These activities are cyclical and interlocked making harvesting, drying and storage of the different

types of crops to occur at different times of the year. A factor that is contributing to this pattern is the planting at stake of different kinds of crops which have different maturity periods. This is often done to maximize space and minimize risk in case some of the crops fail due to reduced rainfall or pest invasion of particular kinds of crops. Some of these activities would be considered in the sections below.

5.4.2 Land preparation

The preparation of land begins immediately after Christmas but this is not intensive until March when every serious farmer should be seen busily preparing his farms for planting. There are two types of land preparation in the district. The first type involves the preparation of previously cultivated plots and in this case, the farmer only have to gather the crop residues and burn and also control leaves emerging from shrubs that were cut during the previous cultivation. The first type of land preparation is most common with the compound farms but is used for bush farms when the farmer is satisfied with the fertility of the soil after some years of continuous cultivation. The second type of land preparation involves the fallow plots. With this type, preparation of the plot for the subsequent year's cultivation may start in the previous year where the soil is tilled and shrubs and trees are cut and laying in wait to dry for burning. Tillage especially is often done around September when there is still moisture in the soils. This is strategic because it reduces the amount of energy used as the soils become harder between November and April and in addition, it reduces the work load of the farmer in the subsequent cultivation. This is the time that more labour is often needed. In instances like this, the farmer uses communal labour or ox drawn plough to till the land. As soon as the dry season sets in the branches of the trees and shrubs are burnt and the soil is till with either a hand hoe or an ox drawn plough. This applies to already cultivated plots. With the fallow plot the farmer now takes care of emerging shrubs as the soil had been tilled already. This type of land preparation is common with both farms and after the soil is prepared; the next thing to do is waiting for the rains to plant.

5.4.3 Planting

From my informants, the cropping season use to begin from the third month after Christmas and ends in the first month of the subsequent year. But now, due to delays in the onset of the rains, it has been shifted to April or May and some were still planting around July when I was on the field to collect my data. I must emphasise here that planting is highly dependent on rain. Farmers usually plant on the bush farms first before attending to the compound farms

and I think this is because the bush farms are often planted with late millet and late sorghum which takes a longer duration to mature. Intercropping is the main strategy of farmers in the district where they not only plant different types of crops at stake but plants different types of crops on the same piece of land at the same time. It is only vegetables like okra which is planted by women along the edges of the compound farm after the main planting has been done.

Plate 5.1 shows a compound farm in the Builsa district.



On this farm we have different varieties of millet and sorghum planted together at the same time with okra planted along the edges. I will be quick to add that the millet which is very visible in this picture is the early millet which over-shadows the late millet and the sorghum. The early millet matures in three months after planting and the indigenous varieties of the late millet and sorghum takes between six to seven months before they are ready for harvesting.

The bush farms can be mono cropped or combined cropped as the compound farms and they are often situated some kilometres away from the residence of the farmer.

Ethics: These plates have been published with the consent of the farmers involved.

Plate 5.2



Plate 5.2 is a bush farm on which late millet and sorghum are planted together.

Planting is done with simple tools like the dibber or a machete as shown in plate 5.3. There is some form of division of labour during planting with the men creating the holes with the dibber and the women putting in the seeds and closing after them. However, crops that are grown by women like groundnuts, beans and sometimes maize can be planted with women creating the holes for their fellow women to put in the seeds and close after them as show in plate 5.3.

Plate 5.3 shows a woman and her daughter planting groundnut in Dogninga with a dibber.



5.4.4 *Weed control*

The hand hoe, fire and machete are still the tools used for land preparation and weed control and this is shown in plate 5.4.

Plate 5.4



Plate 5.4 show two young men controlling weeds on their maize compound farm with a hand hoe. Just besides them is a chicken feeding on free range.











5.4.5 Crops grown






Almost all my informants observed changes in the types of crops grown over the years. *‘Crops which used not to be grown on a large scale and not by everybody are now being grown. Crops like maize, rice and the “Chinese groundnuts”.* This is an excerpt from an oral historical interview with an informant in Kanjarga.

The crops grown in the district can be categorized into indigenous crops and new varieties of crops. Some varieties of the indigenous crops are no longer patronized by the farmers and is either not grown at all or grown on a small scale by some farmers. Some of the indigenous varieties too have been replaced by new varieties of the same crops. In addition, there exist entirely new crops like cotton, soya beans (*Glycine max*), water melon, garden eggs (*Solanum aethiopicum*), fruits like water melon and other vegetables which were introduced to farmers recently and were hitherto not cultivated in the district. It is important to note that the

cultivation of some of these crops, garden eggs especially suggests the spread of underutilized crops in the district. Peasants listed the old varieties of crops being grown as millet (*pennisetum spp.*), sorghum, maize (*Zea mays*), rice (*Oryza sativa*), cowpea (*Vigna unguiculata*), groundnuts (*Arachis hypogaea*) and other pulses. It was however noted that maize and rice was not planted on a large scale compared to today. One of my informants at Gbedembilisi during a group discussion explained that they use not to grow groundnuts and rice on a large scale and these crops in the olden days were grown mostly by rich families. Some old and new crop varieties grown in the district are shown in table 5.2.

Table 5.2 Main crops/varieties grown in the Builsa District

Crops	Varieties	
	Old	New
Oryza sativa (rice)		 
Vigna unguiculata (cowpea)		 
Sorghum bicolor (Sorghum)		
Arachis hypogaea		

Pennisetum spp.(Early Millet)		There are claims by some farmers that there exist new varieties of millet but these claims were hard for me to substantiate.
Pennisetum spp.(Late Millet)		
Vigna subterranea (Bambara groundnuts)		
Glycine max (Soya bean)		
Solanum aethiopicum (Garden eggs)		

Source: Fieldwork 2010.

But now, they grow these crops on a large scale and the crops grown by them currently included rice, groundnuts, sorghum, millet, maize, beans; Bambara groundnuts, soya beans and cotton which was grown on a small scale. It is important to recognise that there is no complete shift to new crops but rather the new introduction of indigenous crops. My informants at Gbedembilisi listed some of the completely new crops as water Melon, sweet potatoes, yam, pepper, tomatoes, garden eggs and other kinds of vegetables eaten locally.

In relation to this, an interview was held with one of the extension officers at the district capital Sandema where he categorizes the crops grown in the district into two. These are

category A and B crops. To him, the category 'A' crops included millet, sorghum, rice, bean and Bambara groundnuts which are some of the indigenous crops grown by peasants. The category B crops are soya beans, cowpea improved varieties of certain crops like the jasmine rice which was not previously grown in the district, improved varieties of cowpea and the introduction of vegetable farming where vegetable like lettuce, cabbages, pepper and tomatoes are cultivated for commercial purposes. The vegetables are mainly cultivated in the dry season near river banks or dams by the use of irrigation water. This is predominantly a new development but there is no economic data to support the area of land cultivated and the extent to which these activities supplements household income.

All my informants in the entire group discussions agreed that there are changes in the cropping patterns. In a group discussion with some women at Dogninga on the crops grown today they said they now plant more of groundnuts, maize, sorghum, millet, soya beans instead of more of the pulses they planted in thirty years ago. They attributed the reduction in the cultivation of pulses especially the Builsa beans to the reduction in rainfall. I also observed that in villages where they cultivated the improved varieties of pulses was mostly for commercial purposes as they said fertilizer and insecticides were used. This means there is now a reduction in pulses and increase in staple grain crops which could have implications for the protein needs of the family. It is important to note that these women now grow new varieties of legumes thus emphasising not only a shift in the types of crops grown but also shift in the varieties of the same types of crops grown. The group also admitted that they now planted new varieties of sorghum e.g. the Buwku white, maize and do not plant the Builsa groundnut and beans on a large scale.

5.5 Observed changes in crop grown

The observed shifts in crops grown were more visible in the rice, sorghum and beans crops. However, peasants claim that there were shifts in the millet varieties but these shifts were not visible and hard for me to substantiate. It should be noted that a crop like soya beans was introduced to farmers in the district some few years ago and this is an entirely new crop to the peasants. There are also conflicting reports as to when maize was introduced into the district. Some farmers have it that maize was grown by their forefathers. That type of maize was called the yellow corn and was not grown on a large scale. Others too say they had other varieties of maize that was grown by their forefathers but the reason why it was not grown on a large scale as today was that they did not find so many uses for it during those times. But

now maize is increasing being used for so many dishes and the preparation of ‘pito’ (a locally brewed beer from sorghum or maize). This also suggests that the diets of the peasants are gradually changing. The 24-hour dietary recalls from pupils in the study villages were meant to corroborate the crops grown by my informants and the results in addition show some changes in diet as shown in table 5.3.

Table 5.3: 24-hour dietary recalls

Pupil	Time	Frequency	Made from	Remarks
01	6.00 - 7.00 am	T.Z with vegetable sauce	Sorghum	In their house, T.Z. Is often eaten. The parents also grow rice on a large scale.
	12.00 - 1.00pm	Rice with groundnut soup	Locally grown	
	6.00 - 7.00 pm	T.Z with vegetable sauce	Sorghum	
02	6.00 - 7.00 am	T.Z with Vegetable sauce	Sorghum	She eats bambara groundnuts from local food vendors sometimes the new variety of beans in the evening at home.
	12.00 - 1.00 pm	Banku and T.Z with Vegetable sauce	Maize	
	6.00 - 7.00pm m	Rice and tomato sauce	New variety	
03	6.00 - 7.00 am	T.Z with groundnut soup	Sorghum	Her parents cultivate millet and sorghum as their main crops
	12.00 - 1.00	Flour	Late millet	

	6.00 - 7.00 pm	T.Z with Vegetable sauce	Sorghum	
04	6.00 - 7.00 am	T.Z with Vegetables and groundnuts	Millet or sorghum	He eats food made from maize occasionally because they do not cultivate it on a large scale
	12.00 - 1.00	Flour	Millet or sorghum	
	6.00 - 7.00 pm	T.Z with Vegetable sauce	Millet, sorghum or maize	
05	6.00 - 7.00 am	T.Z with vegetable sauce	Millet, sorghum or maize	
	12.00 - 1.00 pm	Gari with tomato sauce	Cassava	This is imported as cassava is not grown in the district. She eats banku 5 times, bambara groundnuts 5 times and beans 6 times a month.
	6.00 - 7.00 pm	T.Z with vegetables and groundnuts	Millet or sorghum	
06	6.00 - 7.00 am	T.Z with Vegetable sauce	Millet or sorghum	This pupil said there were no significant changes in diet and eats more T.Z. to rice
	12.00 - 1.00 pm	Rice or T.Z with groundnut soup	Rice or sorghum	
	6.00 - 7.00 pm	T.Z with Vegetable sauce	Sorghum	

Source: Fieldwork 2010.

Table 5.3 suggests that the most frequently eaten food in the district is T.Z which could be prepared from millet, sorghum or maize. But the T.Z. eaten by most pupils is prepared from sorghum, followed by millet and maize. Some of the pupils were specific about the type of rice that was eaten which was grown by their parents and this suggests that there is a shift in patronage for the local rice variety to the improved varieties rice. There is the increase use of maize in the preparation of T.Z. and pupils did not mention pulses as part of their major diet for the three meals they had in a day. It should be noted that T.Z. is eaten with a sauce made for vegetable like okra, tomatoes, pepper, and the leaves of different kind of locally grown crops. The people in the district have a preference for the cultivation of millet but they now grow maize in addition. In an explanation to the increased cultivation of maize, an informant said he grows any crops that he comes across as he does not know which the rains will favour. From this explanation it can be inferred that farmers are diversifying crops and diets in response to food insecurity or as a risk spreading strategy.

5.6 Animals reared

Peasants keep animals like poultry, guinea fowls, sheep, goats and cattle. Only a few of them keep donkeys and pigs. The system of animal keeping in the district can be described as free range to some extent. This is because animals like goats, sheep, donkeys and cattle are herded during the farming season only and left on their own when that season is over. Poultry and other birds are not controlled and are allowed to feed around the compound house with a coup to rest in at sun set. My data was gathered in the farming season and plate 5.5 shows a young man returning home with his animals after the day' work.

Plate 5.5 some animals kept by farmers



Pig rearing used not to be an option in the district but one of my informants keeps pigs. When I asked him why he rears pigs he said they give him quick money as they grow faster. These animals especially the cattle, goats and sheep are not primarily kept for milk production. It is only sometimes that the herders do take milk especially from the cattle for their own consumption and just some few bottles for sale. The animals are kept for prestige and as a form of buffer in times of crop failures. In addition, they provide manure for compound plots and are used for ox-ploughing.

5.7 Non- farm activities

Apart from growing crops and keeping animals, peasants engage in other activities like haunting, charcoal burning, petty trading, basketry, fishing, migration and the collection of wild crops like shea (*Butyrospermum parkii*) and dawadawa (*Parkia biglobosa*) fruits. The issue of common pool resource differed between households as well as types of resources. While all my informants agreed that they use to have access to bush meat and other common pool resources like wild fruits some say this is no more but other still have some of these economic trees visibly on their farms. One informant from Kangarja who agreed that at certain times he hunts and gets some game was quick to add that this does to contribute in any way to supplementing the household food needs for the year. The informants in Kanjarga and Dogninga attributed the lack of bush meat to the introduction of the gun and the activities of the Fulani people. They narrated that in the olden days they use to hunt with the bow and arrow and their dogs. In such instances one cannot kill as many game as possible and this allowed the wild animals to reproduce. But with the introduction of the gun, hunters go in the night to kill all the animals now leaving nothing in the bush. The pastoral Fulani too are very destructive because their cattle destroy vegetative cover where the wild animals use to feed. Moreover, the Fulani herdsmen disengage all the traps we set for the game when they come into contact with them because the traps affect the grazing of their cattle. At Gbedembilisi, my informants did not have problems with game which is predominantly a male activity and they were caught just on their way to hunt as shown in plate 5.6. The women group at this same village agreed to having problems with taking care of the early millet and gathering shea nuts since both activities occur at the same time. This implies they spend most of their time during this part of the year gathering shea nuts which apart from providing them with immediate food can be sold directly or processed into shea butter.

Other non-farm activities engaged in by peasants in the Builsa district included charcoal burning and harvesting firewood for sale. These activities are predominantly female and are done mostly in the dry season. During the group discussion with women at Dogninga, they listed charcoal burning and the harvesting of fuel wood for sale as some of the strategies they used when the harvest from the food crops grown was not sufficient for the household in a particular year.

Petty trading is non-farm activity engaged in by both sexes but different items are sold by the different sexes. For example as men engaged in buying and selling animals, cigarettes,

tobacco, cola nuts etc women buy and sell fish, dawadawa, daily consumables and food crops. Fishing is done by men and the catches sold by their wives. Weaving, pottery, basketry and seasonal migration to work in the southern parts of the country or in very remote farms overseas are non-farm activities that informants said they engaged in along farming.

Plate 5.6 Peasants share their view on climate change



Source: Fieldwork 2010.

CHAPTER 6

Factors influencing changes in cropping patterns

6.0 Introduction

This chapter forms part of the results from the fieldwork and the main aim is to highlight what peasants in the Builsa district perceive to be responsible for their decisions to grow one type of crop variety and not the other. I would first of all look at peasants understanding of the term climate change and what in their opinion is responsible for the changes in the rainfall and temperature patterns. Secondly, the question as to whether it is climate alone that is affecting their activities would be addressed and in so doing other proxy factors responsible for the changes in cropping patterns would be outlined. Finally, the chapter would try to look at some of the things peasants think can be done to help live with these changing conditions without compromising their ability to feed themselves.

6.1 Perceptions of climate change

The observed changes in cropping patterns have been attributed to several factors by peasants and during the group discussion and interviews, it was identified that factors such as changes in rainfall and temperature patterns are the first to be identified by farmers. Other factor which farmers enumerated included labour, taste, marketability of some crops, inadequate use of external inputs, low interest in agricultural extension services, and other social activities like the celebration of funerals closer to the onset of the rainy season are some of the factors responsible for these changes. In the interviews and group discussions held with my informants some agreed that they have heard of the term climate change but others say no. Even though the educational level of my informants was not asked before the interviews and discussions, I observed that the awareness of the term climate change is related to ones' level of education as peasant who can speak some little English agreed to having heard of the term either from radio or NGOs. I also observed that the ability to determine changes in the cropping, rainfall and temperature patterns comes with age. These would lead me to suggest that even if peasants have not heard of the term climate change, they are conscious of their environment and are aware of changes in the climate which they depend for most of their livelihood. Below is an interview I held with the women group at Dogninga on their views about climate change:

Interviewer (me) *Have you heard of the term climate change?*

Response (from a member of the group) *we have not heard of the term because we cannot speak English but if you could explain it in Buili* (The term was explained). Another respondent from the group: *Yes, what you have described we know but we also have special terms for describing that. Our forefathers told us that the water age is gone (the time the climate patterns were good) and we are now in the 'kroba' years when it scarcely rains. This we think is affecting our cropping patterns.* In another instance with the men group at Doninga when the same question was posed, the first respondent reiterated the term climate change and then pushed it onto the rest of the group members. The entire group then said yes and their sources were from the agricultural extension and Presbyterian agricultural station an NGO based in the district. When I asked the group to tell me what they have heard about the term, this was what a member had to say: *they said once there are changes in the rainfall patterns, we must plant different types of crops in rotation or plant early maturing plants.* A retired agricultural extension officer observed that there are significant changes in the crops grown today and these changes are largely due to changes in rainfall patterns but also reduced soil fertility. It could be that this officer is speaking from 'received wisdoms' as most farmers did not mention soil fertility problems and the increase in cultivation of maize which is a nutrient demanding crop compared to sorghum and millet do not support this claim.

6.1.1 Perceived Causes of change in rainfall and temperature patterns

Several reasons have been attributed by peasants as the causes of the changes in the rainfall and temperature patterns and this again goes with the level of exposure. While farmers who are relatively exposed in term of access to some basic education and level of engagement with local NGOs on agricultural issues attributed it to factors such as farming along rivers, drying up of rivers, those who have no education at all attributed it to moral decadence and the lack of respect for the gods. A peasant at Kanjarga during an oral historical interview attributed the changing rainfall and temperature pattern to decadence in moral standards as follows: *'It is because of a change in the attitude of the generations after our forefathers towards local norms and practices. For instance after land preparation we use to consult the Kanjarga Mountain which will give us rain but they no longer do that. The change in the temperature is also as a result of that'*. In a related interview with an informant at Kanjarga, the spiritual head of the Kanjarga Mountain, the strongest god in the area who was randomly selected attributed the changes in rainfall and temperature patterns to the lack of respect for that and other gods in the area by today's generation. He even assured me that if the people were willing to approach him with fowls and other animals to appease the gods, it will rain

right now. But once they were not ready to do so, there was nothing he can do about the situation.

However, in response to the causes of the high temperatures and low rainfall a farmer in Dogninga during the household survey attributed the erratic rainfall patterns to deforestation and farming along river beds while the remaining five respondents in the house survey attributed it to the work of God and the gods who are either annoyed or angry with them as a result of human inequities and thus withholding the rains from them. Also, it was this same informant in Doninga who agreed to having heard of the term climate change. He heard of the term from Action Aid Ghana. I noticed that this informant could speak English fairly and have some awareness of developmental issues. In relation to this, the Agricultural extension officer and his retired colleague also noted that the causes of change in rainfall and temperature patterns is a result of the action of man himself, like the depletion in vegetative cover, reduction in regenerative capacity, reduction in evaporation and the emission of greenhouse gases into the atmosphere. Bad farming practices like felling all the trees to make a farm due to ignorance, charcoal burning, etc can be said to be responsible for the high temperatures.

6.2 Proxy indicators of climate change

A measure of the perceptions of climate change does not end with only observed changes in rainfall and temperature patterns but also with some proxy indicators like the growth of obnoxious weeds, the incidence of pest invasion, etc. During fieldwork, peasants accepted that their crops are often affected by some natural disasters such as army worm invasion, insects, locust, high temperatures, low and uneven distribution of rain and birds. On a frequency scale, peasants agreed that the frequency of these events is now on the rise and some of them occur once in at least every five years. Peasants also observed that these events affected their crop yields.

6.3 Change in rainfall patterns

It was observed by my informants that there are changes in the rainfall patterns and these changes are partly responsible for their decision to grow new varieties of crops. In an interview with an informant at Kanjarga on his views in the change in rainfall pattern this is what he has to say: Interviewer (me): *How was the rainfall pattern that supported the types of crops grown when you were a child?* Respondent: *The rainfall patterns have changed. At most, the rains use to come in April where we plant but now we wait until May or June. It is*

the shift in rainfall pattern that has affected the types of crops we grow. Because the rains come late, we just plant anything we lay hands on to see which of them will succeed for us. In a related discussion with the men's group at Kanjarga, they did not hesitate to unanimously agree that change in the rainfall pattern is the major driver of the changes to the crops they grow today. They said previously the rains use to follow a pattern that allowed them to grow their crops but of late that pattern has changed. Initially by March they would have planted but now (that is in July) they have not finished planting. They use to prepare the land around December and by March the rains are in for planting but now the onset of the rains are not predictable and come around May or June. In relation to this, the women group in Kanjarga also observed their inability to grow some indigenous varieties of crops as a result of changes in the rainfall patterns and this is captured in the words of one of the group member as follows: Interviewer (*me*) *why don't you plant more of the varieties your forefathers use to plant?* Second respondent: *because the rains are now irregular, it is difficult to plant groundnuts and the cowpea too, the dry season will soon come when they are not yet matured.* In Gbedembilisi a group member described the rainfall patterns as follows: *The rainfall use to allow reasonable intervals for us to work but now it is not. Now it can stop for a long time and when it comes too it comes heavily and floods the whole place.* In a related group discussion with women at Dogninga, one of them described the rainfall patterns as follow: *when it starts raining in April, we would have been able to plant all the varieties we need but this is not the case. It can start to rain in April and stop for a very longer time (months) before it comes again leading to failure of the crops initially grown. Also, after it breaks in April, it can rain continuously in August and September bringing in a lot of water which destroys the crops.*

6.4 Change in temperature patterns

The entire informants agreed that there were changes in the temperature patterns. The women group at Dogninga described the temperature patterns as high nowadays and this is what one woman in the group has to say about the temperature patterns; *at first there use to be high temperatures but not as these days. What happens was that if the temperature was high, our forefathers use to consult the gods and it will rain but no matter how the gods are consulted the temperature patterns still remains high, so we do not know if God has rejected us or what exactly is happening. Because of this we now rely on planting the "white man's" varieties and do not rely on the varieties our forefathers use to plant.* The peasants experienced that the

long interval between one storm event and the other during the cropping season is often followed by very high temperatures which makes their crops to wilt and die.

6.5 Proxy factors influencing farmer's decisions to grow certain crops

I hypothesised that there are also non-climatic factors that could be responsible for farmer's decisions to grow one crop and not the other and some of these non-climatic factors were identified by peasants during my fieldwork as market and taste, labour, access to extension services, credit, government policy and other global forces as would be presented in the sections below.

6.5.1 Market and Taste

Markets play a significant role in every agricultural system since there is the need for exchange of goods as farmers practically cannot cultivate all the goods they need for their survival. There are several markets in the Builsa district with a major and minor market days. The major market comes once in every six days while the minor markets are once in at least every three days. It is on these market days that peasants sell some of their produce for cash to enable them purchase some other consumable items like salt, sugar, tobacco, spices, dawadawa (a local seasoning ingredient from the fruit of *Parkia biglobosa*), etc. So the value that the market places on certain types of crops could influence peasant's decision to grow more of those crops and less of other crops. For example, during the fieldwork, peasants said they grew less of the local rice, the old variety groundnuts and the old variety of cowpea. The main reason for growing less of the local rice was its low marketability. At Gbedembilisi, the men group noted that the local rice has less market value compared to the improved varieties. They also said the market women complain that the old variety of groundnuts has less oil compared to the improved variety and this can be suggested as contributing to the low patronage in growing some of these crops by peasants. Soya beans, an entirely new crop introduced into the district some few years ago also has low patronage due to the lack of local market for this crop. Related to the marketability of a crop is taste. At Gbedembilisi, they planted less of the local rice because it does not taste good compared to the new varieties. It should be noted that the area under cultivation for maize is increasing gradually not because it tastes better nor has a good market price to millet and sorghum but that it supplements the family food needs. Maize is planted as one of the major crops and has the same maturity period as the early millet (see table 5.1) Thus the women group in Dogninga observed that they planted maize alongside early millet in response to the unfavourable rainfall patterns. In

addition, the market women at Sandema observed that the yield per area of maize is more than millet and maize is also relatively resistant to bird attack. The more yields of maize per area also goes to confirm that there might not be a serious soil fertility problem in the district.

6.5.2 Labour

As noted earlier, labour is one of the major problems in the Builsa district when it comes to crop production. In Gbedembilisi, my informants noted that the old variety of groundnuts in particular is not grown because at the time it matures it had spread all over the ground and needs more labour to harvest compared to the new variety which has an early maturity period. The men group in this same village do not plant early millet around their home because their wives will not protect their crops from birds as they were engaged by their own activities like picking shea nuts. They also noted that the old varieties of cowpea are not preferred although they mature at the time the new varieties mature. Since the new varieties yield more than the indigenous varieties, they like to grow the new varieties. Most of my informants noted the shortage of labour in the cropping season especially during the time of weed control. Out of the total of 51 household members in the six households surveyed, 34 representing 63% were children and could not contribute significantly to the labour needs of the family to ensure that sufficient food is produced. Enrolment figures in the district especially for the years 1998, 1999, 2000 and 2001 shows a steady increase in the number of children who are attending school and this is shown in table 6.1.

Table 6.1: Boys and Girls Enrolment from 1993/94 to 2000/001

YEAR	Primary 1	Primary 2	Primary 3	Primary 4	Primary 5	Primary 6	SUB- TOTAL
1993/9 4	2028	1683	1356	1122	996	841	8,026
1994/9 5	2486	2649	1174	1100	990	940	9,339
1995/9 6	2532	1433	1175	1100	988	922	8,150

1996/9 7	2603	1595	1208	1102	1003	887	8,398
1997/9 8	2700	2389	1491	1146	1035	960	9,725
1998/9 9	2869	2402	2109	1506	1123	896	10,905
1999/2 000	2956	2602	2142	1805	1306	954	11,765
2000/0 01	3478	2309	2145	2028	1426	1031	12,087.

Source: Builsa District Medium Development Plan

Table 6.1 shows a high dropout rate but an overall increase in school enrolment. It should be noted that the district has a population growth rate of 0.82 per annum which is relatively low in the Upper East Region. Even though the legally defined age group for work is 15-64, the District Assembly (2002) observed that children 7 years and above do engage in work for themselves and families. The District Assembly (2002) in addition noted that out of a total population of 58,939 who were 7 years and above, 35,194 were economically active, 23,745 not economically active and 7,383 unemployed. The increase in enrolment thus suggests a shortage of labour at the household level. The District Assembly also noted that “the population structure of the District shows a broad based pyramid which tippers to the top indicating a concentration of the youth at the base” (Builsa District Medium Term Development Plan 2002-2004) and if the youth takes education seriously, it could have implications on the labour supply.

6.5.3 Migration

Closely related to labour availability is the issue of migration. During the household survey, only one household head agreed that one of his sons has migrated to the southern parts of Ghana and a time helps him with some money. The rest had no migrant families living elsewhere. In the group discussions too, farmers accepted that they sometimes migrate for seasonal job during the dry season and return as soon as the rainy season approaches. These assertions if taken at face value, one is likely to conclude that there is minimal migration in

the district. This then makes my case villages exceptional on migration as the 2000 Population and Housing Census indicates otherwise. According to the 2000 National Population and Housing Census, out of the 17,436,937 people born in Ghana, only 118,709 were Builsa's. Out of the 118,709 Builsa's by birth, 64,603 of them, representing 54.4% live in the Upper East Region. Most of these people live in their own home district, Builsa. The remaining 45.6% of Builsa's, totalling 54,106 people live outside their traditional home in the Upper East Region. These statistics reveals to me that perhaps the difficulty with accessing labour for food crop production in the district might be due to the large proportion of Builsa' living outside the district.

6.5.4 Access to extension services

In terms of access to extension services, the reactions were mixed. Some peasants said they have contacts with the agricultural extension officers in the district while others have not had any contact with them. Out of the six household surveys conducted, only one household head in Kanjarga agreed that he has access to the agricultural extension officers and they have been advising him to grow early maturing crops and to plant early during the onset of the raining season. In general, the impression I gathered from farmers was lack of interest in soliciting help from the extension service while the extension service also complains of being seriously understaffed. This notwithstanding, the extension service is still a major path way through which new crops are introduced to farmers in the district.

6.5.5 Government policy

As part of the Agricultural extension service is to research and produce viable seeds and to supply them to farmers, there are also deliberate policies that are geared towards producing earlier maturity varieties of some crops in response to a perceived climate change by some government agencies. One of such agency is the Savannah Agricultural Research Institute (SARI) which produces improved seeds of food and fibre crops such as sorghum, millet, rice, maize, cowpea, cassava and groundnuts. Some of these varieties are often introduced to the farmers at the district level. This was confirmed by an interview I held with one of the extension officers at Sandema where he stated that some of the early maturing crops were introduced to farmers in view of the reduced duration of the rainy season and the increasing temperatures by the extension service.

6.5.6 *Other global forces*

I consider other global forces to be the work of NGOs who work with farmer groups to improve yields. Some of these NGOs are also conduits for propagating the one particular type of crops and not the other and a means by which new crops are introduced into the district. At Gbedembilisi for instance, soya beans according to the farmers was introduced to them by an NGO. But they lamented that they have stopped growing this crop on a large scale because they have no wide usage for it. In addition, they said its local market is not large. The said NGO too did not continue supplying them viable seeds and the terms of the agreement was such that when one farmer losses the rest of the group compensates the NGO for him with their produce.

6.5.7 *Credit*

Access to formal and informal credit is hard to come by as most of the informants said they have never accessed any form of formal loans from banks and other financial institutions. Out of the six household surveys only the female headed household agreed to have accessed both types of credit. One household head admitted that there are group loans which farmers can access if only you become a member of the group but he had not access one himself. All my informants agreed that the government had withdrawn subsidies on fertilizers and other agricultural inputs and this is affecting their activities.

6.5.8 *Cultural factors*

Do you think it is only the change in rainfall patterns that has brought about these changes (me)? *Second respondent: no, part of the problem is from us the farmers. Because the time the first rains came if we had planted the crops, we would have been harvesting by now, but we were involved in celebrating funerals and other social things and that have delayed us. Do you think had it not been the social events and the rains came next year like this year could you have grown the traditional crops? Yes, I am speaking for kanjarga, we would have harvested and gotten enough food.* This excerpt suggests that apart from climate there exist some cultural factors that could delay the planting time for some households.

6.6 Capital owned

We do not hire or rent land to farm. Our husbands own the land and we can ask them for a piece of land to plant groundnut and maize. The men have no control over proceeds from these lands but what we only do is to give them something to be sacrificed (traditional belief

system) to the gods for granting us a good harvest. (Except from a woman informant during a group discussion at Dogninga)

If there is anything valuable that the people in the Builsa district can boast of owning then it is an inhibited access to land. Everybody in the three villages surveyed had access to land and in cases where they have to borrow land to grow crops no compensation was paid. Land in the district is communally owned but you have to pay a tribute to the custodian who takes care of the land who could be either a family head or a clan head. What one has to do if land is borrowed was to give just a token of the harvest or a fowl to the care taker of the land for libation to be poured to the ancestors for making the land fruitful for them. Apart from the land, peasants owned houses which are both built with bricks or blocks and roofed with thatch or corrugated iron sheets. A cursory look around the Builsa district seem to suggest that most houses are built with unburned mud and roofed with thatch and this is revealed in the household survey I conducted. Out of the six household surveys conducted, only two households had some parts of their houses built with cement and roofed with corrugated iron and the other parts built with unburned mud. Building houses with unburned mud is an indication of poverty as these houses are not often able to withstand heavy storm events and require continuous maintenance which not only takes away parts of the household labour during the year but some parts of his food as these houses are constructed with communal labour and the labourers need to be catered for in kind.

6.7 Farm output

Even though peasants do not keep records of their farm outputs over the years, attempts were made to document the types of crops grown and the annual estimated output of these crops and this is shown in table 6.2.

Table 6.2: Output of crops grown (Landraces/improved varieties)

Household	Types of crops grown	No. Of bags (1 bag = 50kg)	Family Size		Producer(P)/ Consumer(C)ratio		Conditions
			Adult	Children	P	C	
			50+	15-			
1	Millet	7.0	2		1	1	

	Groundnuts	7.0		8	0	0.5	
	Rice	2.0					
	Maize**	4.0					Not on a large scale
2	Millet	0.5	2		1	1	
	Sorghum	0.5		8	0	0.5	
	Rice	4.0					
	Groundnuts	3.0					lack of funds
3	Beans	1.5	4		1	1	
	Millet	6.0		2	0	0.5	
	Rice	10.0					
	Maize	5.0					
	Groundnuts	10.0					
4	Millet	2.0	1		1	1	
	Rice	1.0		4	0	0.5	
	Beans	1.0					
	Groundnuts	3.0					
5	Millet	5.0	4		1	1	Low soil fertility.
	Maize	2.0		5	0	0.5	small acreage
	Rice	4.0					

	Beans	1.0					
	Soya Beans	1.0					
6	Millet and sorghum	5.0	4		1	1	
	Maize	5.0		7	0	0.5	
	Beans	10.0					
	Groundnuts	4.0					
	Bambara Beans	1.0					
	Rice	5.0					
				Total = 51		P/C = 1:2	

Source: Fieldwork 2010

Demography to a large extent is an indicator of labour availability necessary for an agrarian community like the Builsa district. From the household survey conducted, it is clear that most household members were children of school going age and this has implications on the producer consumer ratio as shown in table 6.2. Table 6.2 suggests that there are more consumers than there are producers in my study villages. The table shows that males and females above 50 years produced 1 unit and consumed 1 unit while those below 15 produced 0 units and consumed 0.5 units. I must state here that the table is simplified to illustrate my case as there were no many cases of household members between the ages of 15 and 50. Out of a total of 51 household members, 17 were more than 50 years and 34 members below 15 years. This then gives as a producer consumer ratio of roughly 1:2. From the farm output figures we can calculate the food needs of households per annum using data from the Builsa district assembly. The Builsa district assembly (2002) in calculating the projected food requirements of the district for a five year period used a per capita consumption per annum for some major crops shown in table 6.3 below.

Table 6.3: Per Capita Consumption per Annum

No.	CROP	PER CAPITA CONSUMPTION PER ANNUM
1.	Millet	45 kg
2.	Sorghum	30 kg
3.	Rice	20 kg
4.	Maize	30 kg
	TOTAL	125 kg/ per person/ year

Source: Builsa District Medium Term Development Plan 2002.

Table 6.3 assumes that the per capita consumption per annum is 125kg. Table 6.2 shows a total output for some major crops of the six households to be 109 bags (50kg per bag). Thus 51 people will need a total of 6375kg (51×125) whilst their total production is 5450kg (50×109) indicating a deficit of 925kg of food per annum for the six households surveyed.

6.8 Ways forward from farmers opinion

The way forward to farmers is very varied but one can categorize them as modern and traditional solutions. These include providing them with early maturing crops as the rainy days have shortened, appeasing the gods for the rains to come, the provision of tractors and regular contacts with those who are well informed with agricultural issues. They also suggested creation of dams for irrigation during the dry season and creating access to loans from the banks and other microcredit facilities.

CHAPTER 7

Discussion of Results

7.0 Introduction

This chapter discusses the findings or results from my fieldwork. It will take into consideration the theories and concepts I outlined in my theoretical framework. Major parts of the work would be discussed using the sustainable livelihood framework. In addition, concepts like climate change, agrarian change and food security would be considered.

7.1 Sustainable livelihood framework

At the centre of the sustainable livelihood framework is the identification of the different types of capital and how these can be combined within a given setting to achieve particular outcomes. Analysis using the sustainable livelihood framework can be done at the contextual level, livelihood resources level, institutional or organisational level, livelihood strategy level and an analysis of outcomes and trade-offs (Scoones, 1998). So I start my analysis in the Builsa district looking at the context within which peasants carry out their activities and moving on to identify the livelihood resource available to peasants and how they combine these resources to ensure their continued survival.

7.1.1 Context

The vegetation of the district is savannah woodland interspersed with grasses and herbs. Claims are made by the District Assembly that the activities of man have degraded the vegetation leading to the visibility of only economic trees likes “baobab, acacia, sheanut and the dawadawa” trees. It is important to note, though arguable that, this type of reasoning about human environment relations where humankind especially the poor are blamed for disrupting a hitherto pristine environment leading to environmental problems is embedded in what is term ‘environmental narratives’ and counter evidence to this line of reasoning now exist (Fairhead and Leach 1995). They espoused the view that the vegetation of a place at a particular time reflects the needs of the people at the time thus the need to recognise the dynamic nature of humans and their environment which could either lead to vegetation enrichment or degradation instead of a linear trajectory along which human actions are seen to be destructive. The soils in the district are noted to be generally low in fertility, especially nitrogen, phosphorous and organic matter (see study area for parent materials from which these soils are developed). It is also noted that the soils in the district are poorly drained and

continuous erosion has led to a significant reduction in soil depth thus reducing the utility of the soils for arable purposes. These observations are by the District assembly in its 2002 Medium Term Development Plan. This notwithstanding, peasants were not explicit in identifying soil fertility as a major barrier to crop cultivation. However, some statements and comments made by some informants suggest a soil fertility problem in the district. The first person to mention infertile soils as part of the problem farmer's face in the district was the retired agricultural extension officer. In addition, the female household head did not state categorically that she faced a soil fertility problem but complained that she has to plant her maize around termite hill as the maize planted around those areas yielded better. In addition, the agricultural extension officer at the district capital Sandema cited the increased use of inorganic fertilizers by some farmers as contributing to the increased yields recorded in recent years in the district. This as stated earlier is suggestive that soils in the district may not be all that fertile to support adequate crops cultivation without application of external inputs either organic or inorganic. I will be quick to point out here that, there might be an inherent contradiction as both the district assembly and the agricultural extension officer's point to a reduced soil fertility problem and at the same time, document an increase in the area coverage of maize which is a nutrient demanding crop. The district is sparsely populated with a density of 34 persons per square kilometre compared to the Regional average of 104 persons per sq km (Builsa District Medium Term Development Plan 2002-2004). This then means access to land is not a problem and this is confirmed by all my informants in the selected villages. From the account of my informants, the free access to land is not limited to only male farmers but also female farmers. There also exist the works of some governmental departments, agencies, and NGOs in the district some of whose aims are geared towards helping farmers in the district. Examples of such departments include the department of agriculture, department of information, health, education, and agencies like the National Commission on Civic Education, etc. The works of several Non-governmental organisations on health, agriculture and education exist in the district. Some of these NGOs include Presbyterian Agriculture, Action Aid Ghana, Oxfam, and some UN agencies like the WHO, FAO etc. In this case, the district cannot be treated as an isolated entity and thus share some common ideas with the global world and can be in turned influenced by policies and ideas at both the national and global level.

With these brief contextual factors outlined above, it would be safe for me to suggest that the decision of farmers to cultivate some particular types of crops is not solely driven by climate

change but also by other factors such as demography, terms of trade, politics, history, macro-economic conditions, agro-ecology and social dimension as noted by Scoones (1998). There exist evidence from the interview held with the agricultural extension officer at the district level that they have been making efforts to introduce some improved varieties of old crops to farmers. In addition they also encourage farmers to plant early maturing crops in view of changes in rainfall patterns. A farmer at Dogninga who had contact with Action Aid Ghana also confirmed that this NGO has been advising them to plant early maturing plants. Other NGOs and agencies both locally and internationally operating in the district in regards to distribution of improved varieties of crops and offering technical advice to farmers as documented by the District Assembly includes the Adventists Development and Relief Agency (ADRA), the Savannah Resources Management Project (SRMP), the Savannah Agricultural Management Institute (SARI), UNCIEF, and the Village Infrastructure Project (VIP). Within the policy framework of the District Assembly on agriculture, there is evidence that efforts are being made to introduce new varieties of crops to farmers. In 1998 for example, the District Assembly supplied farmers with “Low Risk Rice” varieties (Builsa District Medium Term Development Plan 2002-2004). These “Low Risk Rice” varieties include Thailand, GR18, and GR19, Tox (Sikamo), Jasmin85 mandi and Degan 4. In addition, the District Assembly under the Root and Tuber Improvement Programme (RTIP) promoted the multiplication and distribution of two sweet potato varieties: SAUTI and FAARA to farmers. Farmers did not mention sweet potato cultivation because most of them stopped cultivating it due to pest infestation and there is now an effort by the District assembly and some NGOs at re-introducing more resistant varieties.

7.1.2 Assets and Capabilities

Within the contextual factors are the assets and capabilities of people. The assets and capabilities are seen as the various types of resources (capital) needed for a sustainable livelihood and are categorized into different types of capital which includes natural capital, economic or financial capital, human capital, social capital, political capital, and physical capital (Scoones, 1998; 2009; Adato 2002).

As observed in the presentation of the results, people build their homes from mud bricks and roof them with thatch which they get from the grasses. The trees and shrubs serve as their main source of energy and an income generating activity for some women during the dry season. The climate of the area as observed by the farmers is now changing and it is assumed

that these changes are responsible for the change in crops grown and has the potential of negatively affecting food security. The question I would like to look at critically here is whether it is the perceived increasing temperatures and reducing and irregular patterns of rainfall which is responsible for the changing cropping patterns in the district or the change in crops grown and the food security problems are as a result of climate acting in combination with other factors? Climate forms part of the natural capital in the district and is thus not the only limiting natural factor for farmer's decisions as farmers grew less of certain crops in the district due to soil fertility problems. In addition, a natural factor limiting peasant's ability to cultivate certain types of crops related to moisture is technology. The district has a lot of valleys and areas where dams can be constructed for dry season irrigation but this potential is not harnessed. Peasants in discussing how to reduce their risk of the changing climate patterns did not hesitate to point to the construction of dams as one of the immediate solution to the problem. So climate is not the only limiting natural capital that influences peasant's decisions to change crops as they would have cultivated the same crops if viable seeds, fertilizers and tractors were accessible to farmers at present and dams were constructed to augment the changes in climate in the future and in addition steps taken to enrich soil nutrients.

Physical capital has been described to include "transportation, roads, buildings, shelter, water supply and sanitation, energy, technology, or telecommunication" (Adato 2002). All the villages in my study area have no tarred roads and accessibility becomes a problem in some parts of the rainy season. The houses are built with mud bricks which also need regular maintenance at least once a year and at times compete with women labour for other activities. There is no pipe-borne water in the study villages with peasants relying on wells and boreholes for their domestic water needs. Peasants cannot be said to be free from being affected by these physical challenges some part of their time is spent on fetching water, repairing their homes and in travelling to and from their bush farms.

Social capital is the social resources which people draw on in the pursuit of their livelihoods (Scoones, 1998 pg. 8) and this often requires that, the actions of people are coordinated. Adato and Meinzen-Dick (2002, pg.9) defined social capital to include "any networks that increase trust, ability to work together, access to opportunities, reciprocity; informal safety nets; and membership in organizations". In identifying the types of social capital in the Builsa district, I would start with the social relations of production. It was noted in chapter 5 that the basic unit of production in the district is the household and in times that the household labour

is not sufficient people relied on either communal labour or 'by-day' workers. The former is the modus operandi in the district and the latter used recently as a result of peasant's integration into the global capital economy. It was interestingly observed that communal labour which can be described as a form of social safety net for those unable to control the weeds on their farms during the critical months of the cropping season is fast becoming unpopular among peasants as the number of people who respond to such calls is on the decline. In addition, the list of items that one has to provide during such engagements makes it difficult for me to draw a line between what is communal labour which is supposed to be free of charge to distressed farmers and 'by-day' labour which is paid. Secondly, farmers in the district needed to organize themselves into associations, form or join groups in order to benefit from micro-credit schemes and extension services. My fieldwork suggests that about 99% of farmers even though are aware of the existence of such associations or groups but were not participating as only one farmer agreed to be a member of one such group. With the micro-credit groups, farmers are not interested because of their mode of operation. These schemes are delivered by NGOs whose sole motive is to get their loans back by all means and this attitude scares farmers off as they are not in control of the yields of their labour. For instance, the men group at Gbedembilsi lost interest in the NGO that support them to cultivate soya beans because the terms for repayment was bad according to the group. One member of the group stated that "*the arrangement was bad in that if one farmer in the group loses they compensated for his loss by the proceeds of the other farmers*". In relation to extension services, some farmers saw it as a duty of extension officers to come to them and share their experiences with them but not for them to organise themselves to meet extension officers. *The extension officers come around but do not gather us to talk to us*, an informant from Kanjarga. The impression I gathered from my informants and the retired agricultural extension officer seem to suggest some tension between extension services and farmers in the district. For instance, as some farmers accuses extension officers of ignoring them and down playing their knowledge as regards farming, the retired agricultural officer in turn accused farmers of not soliciting or even listening to advice from them. This no doubt has implications for the knowledge base of these farmers and their ability to access other forms of capital (financial) in pursuit of their livelihoods.

Economic/Financial capital includes savings, credit, state transfers and remittances, production equipment and technology, and any economic asset necessary in the pursuit of a livelihood strategy (Scoones 1998; Adato & Meinzen-Dick 2002). From the view point of my informants, they hardly are able to produce to feed themselves let alone to save. Almost all

my informants have no access to credit both formal and informal and do not receive any form of remittances from the state. Ironically, it was only the female household head at Dogninga who agreed to having received some help from relatives and have joined a farmer group which sometimes give them loans. The difficulty in accessing loans, purchasing improved seeds, fertilizers and other forms of capital inputs in my view contributes to peasant's land use behaviour in the district.

Human capital includes education, skills, knowledge, good health, good nutrition and the ability to labour (Adato & Meinzen-Dick 2002; Scoones 1998). Almost all my informants could not read or write. This disability is shown in their apathy towards all forms of formal and informal associations and groups that gives out loans and advice them on some cultural practices on the field. They have no modern knowledge and skills necessary for improved productivity. In addition, their over reliance on the consumption of cereals could have some health implications as a significant part of their diet in protein could be inadequate. So this could be constraining their physical and cognitive abilities.

7.1.3 Livelihood strategies

The analytical structure of the sustainable livelihood framework assumes that the combination of the different types of capital identified above coupled with certain contextual factors would lead to three main types of livelihood strategies. These are agricultural intensification or extensification, livelihood, diversification and migration. Which of these strategies is mostly used by peasants in the Builsa district is what I would be looking at in the subsequent sessions.

As outlined in my conceptual framework on the theory of agrarian change, Stone extending the Boserupian argument opined in peasant communities like the Builsa district where access to land is often not the problem, agricultural extensification is an option. This is the case in the Builsa district as all my informants relied on own labour for farm work and used less of inputs like fertilizers and insecticides. On their views as to how the changing climatic patterns could be ameliorated there was a clarion call for the provision of tractors to help them plough on a large scale. This shows that the interest of famers is not the output per unit area of land they cultivate but that more output will come from ones' ability to extend the area of land cultivated.

Given the vast literature on household livelihood diversification it is important to make clear here the issues of my discussion. It is not my intension to explore inter-household and intra-

household livelihood diversification but to discuss in general if there are significant changes in the livelihood activities of peasants in the Builsa district. The study shows that not much had occurred in the area of livelihood diversification. Peasants are seriously engaged in the type of farming that was handed over to them by their forefathers. They keep some animals like cattle, sheep, donkeys, goats and poultry within their compounds and grow crops on their bush and compound plots. There was no evidence of a complete shift from farm based to non-farm/off-farm based activities. What was evident is that, household members integrated different types of cropping with non-farm income yielding activities. At Gbedembilisi for instance I observed that women were more interested in collecting shea nuts and trading in fish and other food items instead of always helping their husbands on the plots as it used to be. My field observation did not show clues of capital accumulation by peasants which serves as the foundation for diversification. This is because almost all my informants held the view that the output of their activities during the year was not sufficient to meet even their food needs. Most non-farm and off-farm activities like charcoal burning, hunting, petty trading; shea butter production, weaving, etc were engaged in seasonally or carried out along side growing crops and raising animals. There was also no evidence of the “farmer and farm worker strategy” (Barrett et al, 2001, pg. 21) because all household observed had access to land and used their own labour. There was also evidence of labour scarcity during the critical cropping months (June-September) and even if it existed, evidence of the ability to pay for it was insufficient. This situation, peasants’ say is as a result of everybody working on their own farm during this period and would not like to risk selling their labour as there is no guarantee of off-farm jobs all year round. In this sense, the diversification strategy being pursued by peasants in the district follow what Barrett et al, (ibid pg. 23) described as “on-farm agricultural production, unskilled farm wage employment, and non-farm earnings” which involves non-farm activities such as charcoal burning, ‘pito’ (beer) brewing, petty commerce etc. is often pursued among the youth. The situation in the Builsa district I would like to note differs slightly from this observation as these activities are not pursued by the youth but the elderly especially women as income supplements. The youth in the district are rather vigorously tilling the land and raising animals as they have relatively more energy compared to the adults. Secondly, the district cannot be described as a low niche environment as its agro ecology has potential to support an agrarian economy but is mediated by structural factors like access to markets, improved seeds, fertilizers, extension services etc. However, consistent with this study is the observation that both poor and wealthy households pursued the same diversification strategy outlined above.

My field observation showed only traces of seasonal migration and not permanent migration among peasants. In the six household surveys conducted for instance, only one household had its member residing in the southern parts of Ghana who periodically supports the family. As an adaptive strategy, peasants agreed during the group discussions that sometimes they migrate to the southern parts of Ghana or to remote areas of the country during the dry season in search for seasonal work.

7.1.4 Outcomes

The outcomes within a given context when different types of capital (resources) are combined to pursue certain livelihood strategies are increase in well-being and improved capabilities, more working days created, poverty and vulnerability reduced, improved food security and sustainability of the natural resource base (Scoones 1998; Adato and Meinzen 2002). Scoones reasoning with others (Lipton 1991; 1993 in Scoones 1998, pg.6) suggest that the number of minimum working days necessary for a sustainable livelihood within a year is at least 200 which in itself depend on labour availability. Touching on labour availability in my study villages for instance, all the informants noted that labour is not readily available during the critical months of the cropping season especially during the period of weed control. This could be partly attributed to the fact that there are more children than adults in the households surveyed and also that more children are now attending school. It is important to note here that this figure is relative as there are instances where people could work for fewer days within a year but can earn more than enough for their yearly needs. However, looking at the farming calendar of the Builsa district (see table 5.1), can one say that peasants are able to work productively for a minimum of 200 days within the year? Apart from this question, another issue I have to raise is the question of productive work. One can be said to be engaged in some activities and is often busily doing something, but what is the value of that work in contributing towards the food needs of the household? In the Builsa district for instance the number of months for intensive cropping is 5 (April-September) and this could give you at least 180 days of work for the year. This falls far below the minimum number of days required for a sustainable livelihood as suggested by these authors. In addition, the spread of the activities of peasants throughout the year might suggest that they are often engaged in productive work but the reverse holds true in this case as land preparation which sometimes starts in the first month after Christmas is often not intensive and how productive such an activity will be is contingent on the climatic patterns for a given year, cultural practices and other structural factors. Production data from the household survey show that

households produce far less than they need to meet just the supply side of their food requirements thus the well-being of peasants cannot be enhanced. This situation in addition suggests that there will be a lack of investment in the land as there is no surplus for the acquisition of fertilizers and the adoption of new technologies capable of maintaining the natural capital base. These observations even though not backed by evidence seem to give me the impression that there exist some forms of underemployment in the district during some parts of the year.

7.2 Climate change

Climate change responses are often in two categories- mitigation or adaptation as outlined in my theoretical framework. The interest of my discussion is on adaptation. Given the different interpretation of the term adaptation outlined in my theoretical framework, I would like to use the term here to mean a response to an external stimulus (changing rainfall and temperature patterns) which is perceived to be negatively affecting peasants in the Builsa district. I would subscribe to the consensus among farmers that changes in rainfall and temperature patterns are partly responsible for their land use decisions- growing improved varieties of cereals and pulses but will not submit that these climatic parameters are the only agents influencing their land use decisions. This stand point is supported from the secondary data observed which even though spans over only two decades and cannot give a good picture of the nature of the rainfall and temperature patterns in the district, is useful as it does not deviates completely from earlier observations which suggests that these parameters are at best often deviates slightly from the mean with some years of successful rainfall records above the mean followed by years of rainfall records below the mean levels. The secondary data which I observed also suggests that the upper east region which includes the Builsa district cannot be said to be arid as average annual rainfall is not below 700mm (see figures 4.6 and 4.7).

From my informants, the most important thing is not about the total amount of rainfall received in a year rather its availability during the critical months of the cropping season. My informants also observed that insufficient labour, inadequate extension services, inability to purchase improved seeds and other agricultural inputs, the decline in market for some varieties of old crops, global influence through the activities of markets, NGOs and state departments and agencies ,etc are partly responsible for the types of crops they grow today. It can therefore be said that peasants in the Builsa district are adapting not only to climate but also to the structural factors outlined above and this adaptation comes in the form of

diversification of the types of crops grown and engaging in off-farm activities like haunting, shea nut gathering, charcoal burning, etc. From the secondary and primary data observed in this study it would be unsafe and premeditated to conclude that climate change alone is affecting cropping patterns in the study district. The secondary data which is temperature and rainfall records of some stations (Navrongo, Manga and Zuwurungu) near the district do not show evidence of significant decline in rainfall on the average since the 1990s but rather a slight increase. In addition, temperatures have not increased significantly since the 1990s on the average. However, as I cautioned earlier, these records are averages and should be treated with care as there exist significant variation between the two stations observed. These two stations which are at least 18 kilometres from the study district is quite revealing of the variability of rainfall in the upper east region. Even within my study district there was evidence of rainfall variability among the selected villages. Villages like Dogninga and Kanjarga received earlier rains in 2010 and compared to Gbedembilisi which is located further south of the Builsa south constituency. Peasant farmers observed changes in the rainfall and temperature patterns in the district but they did not think that it is only these factors that are affecting their activities as they cited lack of credit facilities, labour problems at the critical months of the cropping season, etc.

Vulnerability and *adaptation* even though are terms associated with climate change have been captured by the sustainable livelihood framework. My study tries to find out what peasants are vulnerable to and the adaptive measures taken. It is interesting to note that peasants' are not only vulnerable to climate or changes in their natural resource base but in addition to the other forms of capital (resources) needed to pursue a sustainable livelihood. In general, peasants have little or no formal education, are not able to access loans from the banks, do not invest in the soils on which they grow their crops, are incapable of getting ready markets for their produce, do not get any assistance from the state and cannot mobilize financial capital among themselves. It is rather some of these non climate factors that make peasants livelihoods more vulnerable than the slight shifts in rainfall and temperature patterns. It is also noted in this study that little attention is paid to non-farm activities and peasants have the tendency of not considering such activities as important in contributing towards their livelihoods. There is need to diversify farm and non-farm activities as these activities will not only supplement household income but will in addition serve as a safety net in times of crop failure.

7.3 Food security

Peasants in the Builsa district are not food secured as they could barely produce to feed themselves. From the theoretical framework, my interest is not to look at the nutritional side of food security or to look at the intra-household and inter-household food need of peasants but the supply side of food. Data from the household survey (see table 6.2) on crop output suggests that peasants produce far less than needed for their yearly supply of food. The over reliance on cereal production could also mean that less of pulses are produced and consumed. Data from the 24-hour dietary survey involving school pupils confirms this stance as all the pupils often eat T.Z. (a locally prepared dish from millet, sorghum or maize) and other starchy foods but beans and bambara groundnuts are less frequently eaten. This could have serious implications on the protein and micronutrients needs of the peasants.

7.4 Conclusion

It is clear from the discussion that there exist some shifts in the onset of rainfalls and increases temperature patterns as observed by peasants. However, the decisions by peasants to shift cropping patterns by planting improved varieties of old crops and more of cereals is not influenced by only the changes in these climatic parameters as other non climate factors like labour availability, markets, government policy, access to credit, influence from the global community like NGOs, etc are more important in contributing to a sustainable livelihoods. It is also observed that livelihoods are not diversified in the district and this in a way put peasants at a risk of food insecurity.

CHAPTER 8

Conclusion

8.0 Introduction

This chapter is a summary of my major findings. The main objective of my study is to look at the perceptions of farmers on climate change and how they are responding to it. In pursuing this objective, sub-objectives were identified which included looking at climatic parameters like temperature and rainfall in the district and how these parameters influenced the types of crops grown. In addition, I sought to find out how peasants are vulnerable to these changes and the adaptive measure taken.

8.1 Summary of findings

8.1.1 Rainfall and temperature patterns

Reviews of secondary data do not suggest a downward trend in rainfall over the whole of the upper east region for the past 100 years-1900 to 1993 (Dietz et al. 2004, pg.155). It shows that some years of increased rainfall are followed by years of slight decline in rainfall. There is also no observed steady increase in temperature for the stated period. An observation of rainfall and temperature records from two stations (Navrongo and Zuwurungu for the past two decades (1990-2009) close to the study area do not suggest a decline in average annual rainfall but an undulating pattern with annual averages not below 700mm. The data I observed (see figures 4.1 - 4.5) did not in addition suggest significant increases in average annual temperature for the stated period. Thus the upper east region which includes the Builsa district cannot be described as arid but semi-arid as the rainfall observed for the past two decades (1990-2009) did not show annual averages of 200mm which is assumed by some authors to be bad years (Dietz et al. 2004, pg.155).

8.1.2 Perceptions of climate change

Peasants were quick to identify changes in the onset of the rainy season and increases in temperature as a major reason for changes in their land use decisions (growing improved varieties of old crops). They observed that the planting time have shifted from March to May/June. This observation could probably be a little exaggeration of the memory of my informants of how early they were planting as a monthly observation of rainfall records (see appendix 2) for Navrongo suggests that the shifts are from May to June for the past two

decades (1990-2009). In addition, upon the onset of the first rains, the time interval for the subsequent rains is so wide that sometimes their crops wilt before the next rains come. They described the temperature as more severe than what they use to experience as far back as a minimum of 30 years ago. In general, peasants think the changes in these climatic parameters are as a result of human action. This view is in line with what the UNFCCC holds that the object of interest is not the natural variability in climatic parameters but anthropogenic climate change caused by human actions. However, as the UNFCCC finds the emission of green house gases into the atmosphere to be the principal cause of anthropogenic climate change, peasants find the cause to be within their religious beliefs. They believe that so much wrong doings have been going on in their communities today and these actions have annoyed God and the lesser gods who in a way of punishment have withheld the rains from them and increasing the temperature. *“It is because of a change in the attitude of the generations after our forefathers towards local norms and practices. For instance after land preparation we use to consult the Kanjarga Mountain which will give us rain but they no longer do that”*. (This is an informant from Kanjarga explaining the causes of change in rainfall and temperature patterns). This way of viewing the problem runs through almost all the discussions and interviews I held with my informants. The solution to peasants is to appease the gods so that rainfall will be favourable and temperatures will not be high.

8.1.3 Shifts in cropping patterns

The study revealed a gradual shift in the crops grown by peasants. They are shifting from the growing of old varieties of sorghum, rice, maize, groundnuts, and beans to improved varieties of these crops. There were claims by peasants that there were some shifts in millet but these claims were hard to substantiate. The shifts in cropping patterns were necessitated by the changes in rainfall and temperature patterns acting in combination with non-climate factors like insufficient labour, reduced soil fertility, inability to access loans and other inputs, government policy, and global influence through markets and the work of NGOs.

8.2 Sustainable livelihoods

Using the sustainable livelihood framework for my presentation and discussion, it was outlined that livelihoods in the Builsa district are not affected by only the natural capital of which climate is part. In addition to shift in rainfall patterns and temperature, the district is not able to mobilize the other forms of capital which are necessary for its development. For instance, it is difficult to access bank loans as observed by peasants, most peasants could not

read and write-a necessity for the application of modern technology and methods of farming, agricultural subsidies have been withdrawn, there is a decline in the use of communal labour and paid labour is difficult to access during the critical period of the farming season, etc. It is rather these non-climate factors that need much attention because climate if considered an external stimulus can impact negatively on a social system where the other forms of capital are non-existent or poorly organised. Given the shortfall in the mobilization and use of the various types of capital, the livelihood strategy pursued is agricultural extensification. This is confirmed by peasant's eagerness to clear more land by the use of tractors rather than looking at the yields per unit area cultivated. Livelihoods in the district are less diversified and this has implication for the food needs of the people and impacts negatively on their well-being.

8.3 Conclusion

I hypothesised that climate change and variability are not the only factors responsible for the land use decisions of peasants in the Builsa district (changing cropping patterns). It rather acts in combination with non-climate factors to influence the land use decisions of peasants. It is therefore important to understand that environmental problems are at their core social and political (Neumann, 2005) and to consider the different factors that influence how people will be able to exist in harmony with their environment. This is not to argue that there exist no shifts in rainfall and temperature pattern in the Builsa district as observed by peasants but to say that these shifts are not the sole determinants affecting land use and the food security problem in the district. A careful observation of non-climate factors reveals that the effects of these shifts would have been easily ameliorated if policy makers, NGOs and peasants pay attention to these non- climate factors such as creating and facilitating school enrolment and progression and including school curricula relevant for farming, providing loans to peasants, providing irrigation facilities, household livelihood diversification and specialisation in non-farm activities, etc. Thus, a holistic approach is needed in addressing livelihood problems than singling out one factor among the many and holding it responsible for threatening the survival of the poor and marginalised.

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Appendices

Appendix 1

Question Guide

Section 1

Household Survey

District _____ Village _____ No. _____

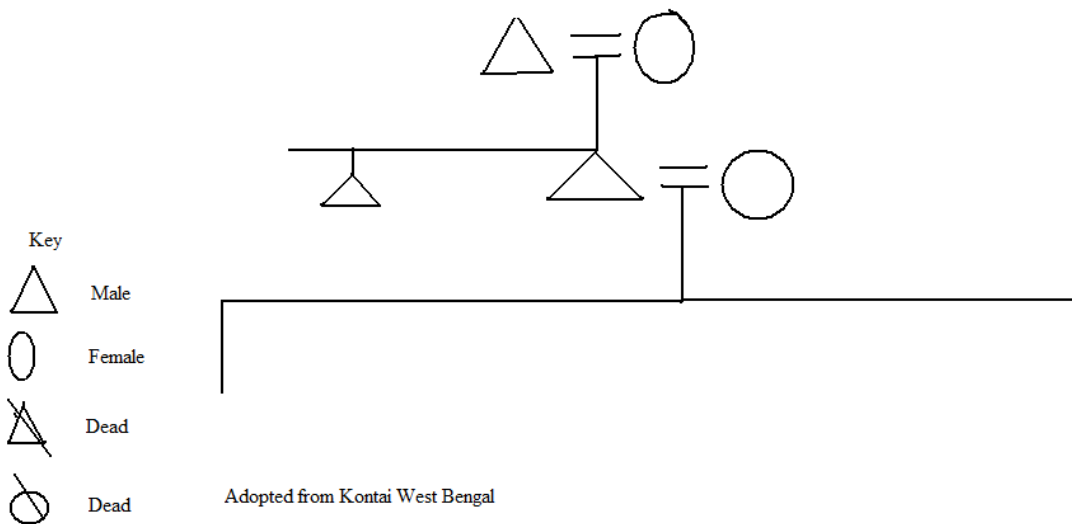
Type of activity _____

Name (Voluntary) _____

Date

Taped _____ Extra notes _____

1 Household Composition



2. Labour

- Do you cultivate your crops on your own? If no

- Who helps you?

-Do you pay for the services of those who help you? If yes

- Land owned.....
- Means of transport.....
- Animals.....
- Tree crops.....
- Farming tools.....

5. Credit

- informal credit.....
- formal credit.....
- subsidies.....

6. Bush meat/ common pull resources

- Do you have access to some types of food from the wild? If yes
- what kinds of wild food?
- what percentage does food from the wild contribute to your yearly food needs?
- Has the supply of wild food been affected negatively? If yes
- What are some of the factors responsible for this negative outcome?

7. Farm output

-crop grown	number of bags
.....
.....
.....
.....

8. In times of affluence how is the money spent?

-

-
9. In times of need how is the household supplied for?

-

-

10. Has your crops been affected by some natural disasters? If yes

11. What kind of events?

12. How many times in a year.....

13. How often does this happen (less than five years more than ten years)

14. Do these events affect the types of crops you grow? If yes

15. How?

16. What do you think is responsible for these events?

17. Have you heard of the term climate change? If yes

18. From whom or where?

19. Do you think climate change is responsible for these? If yes explain

20. Do you have access to enough land to grow all the crops you need? If no how do you get the land.

21. Do you get some support from the agric extension officers? If yes what type of support?

22. What do think can be done to help improve you farm yields?

Section 2

24 hour dietary recall form

I would like to complement the household surveys with a 24 hour dietary recall. This method would target school pupils in the area where a household is selected for the survey. My aim is not to measure nutrition but only to capture the type's food eaten and to relate that to crops

grown and to find out whether crops types are changing over the years. I would therefore like to modify the 24 hour dietary recalls.

1 CHILD ID NUMBER

--	--	--

2 Location

3 Date (day month year)

--	--	--

4 Parents occupation

5 Was this food intake usual? Specify if no.

24 hour dietary recall form

Time	Place of eaten (1=home, 2=outside)	Type of food eaten(1=rice, 2=T.Z,3=porridge,4=others)	Food made from (1=millet, 2=sorghum, 3=maize,4=cassava, 5=beans, 6=others)	Remarks

Adopted from the Fostin Dietary Survey 2007

Section 3

Interview guide for oral histories

1. Farmer ID Number.....

2. Date (day month year).....
3. Name of farmer.....
4. Sex (1 =male, 2=female)
5. Location.....
- 6 How long have lived in this area?
7. What have you been doing for a living all these years?
8. Can you tell me something about the types of crops you use to grow thirty years ago?
9. Since then has there been any significant changes in the crops grown today?
10. What use to be the rainfall pattern that supported those types of crops?
11. Has the rainfall reduced or increased since those times?
12. What do you think is responsible for the rainfall patterns?
13. Can you tell me something too about the temperature of the area?
14. Were there natural disasters at the time you were a child?
15. Have their frequency increased or decreased?
16. Has crop yields increased or decreased over the years?
17. What do you think can be done to better live with these changing conditions?

Section 4

Question Guide for group interview

Village Name.....

1. Can you give me a list of the crops grown in this area over the past ten years?
2. What of crops grown within the last thirty years?
3. Are there changes in the types of crops you grow? If yes
4. What do you think is responsible for these changes?

5. Has there been changes in the rainfall pattern over the last twenty years?
6. Are there changes in temperature too?
7. Has these affected the farming system? If yes explain
8. Have you heard of the term climate change? If yes
9. Tell me all you kwon about this term.
10. Do you think climate change is affecting the types of crops you grow? If yes explain.
11. What about other issues like access to land and the withdrawal of subsidies from the government?
12. Do everybody have access to enough land to grow crops?
13. Do women own land?
14. Access to land and the changing rainfall pattern which of these do you think affect crop yield more?
15. What other income generating activities do you engage in apart from farming?
16. What do you think can be done to improve the farming system in light of these changing conditions?

Informed consent form:

Perceptions of Climate Change and adaptation: A case of peasants in the Builsa District of the Upper East Region of Ghana.

This study is part of my M'Phil programme in Resources and Human Adaptations at the University of Bergen-Norway and it is to know how farmers in the Builsa District perceive and respond to climate related issues.

If you agree to participate in the study, your name will not used in the written report and it will not be possible to trace who said what. Whatever is said in interviews or activities will not be passed on to other people in the community. Recordings of the interviews or group sessions will be destroyed after they have been transcribed.

If you agree to participate in the study, please read and sign the statement below.

Thank you for your co-operation,

Awen-Naam, Michael Ben

Written consent:

The purpose of the study has been explained to me and I understand what it is about. Participation will involve a household survey, six group interviews and oral histories.

It has also been made clear that if I agree to participate in the study, my own name will not be used and, in the written report, it will not be possible to trace who said what. Whatever is said in interviews or activities will not be passed on to other people in the community. Recordings of the interviews or group sessions will be destroyed after they have been transcribed.

I am free to withdraw at any time or may refuse to answer any of the questions asked of me.

Name:

Signature:

Date:

Appendix 2

Climate Data

Max temp.(°C) Navrongo												
Year	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
1990	20.8	21.7	24.5	26.5	25.2	23.9	22.8	22.4	22.1	22.7	22.5	21.1
1991	21.4	24.3	26.0	26.2	24.3	24.3	23.1	22.9	23.2	22.2	20.2	19.6
1992	19.8	22.8	26.3	26.3	24.7	23.2	22.5	22.5	22.1	22.5	20.5	19.2
1993	19.1	23.1	25.5	26.9	26.0	24.7	22.7	22.8	22.3	22.8	22.9	20.5
1994	20.6	22.7	25.7	27.2	25.3	23.7	23.1	22.9	23.1	22.7	19.2	19.5
1995	18.6	21.1	26.2	27.0	25.9	24.5	23.2	22.5	23.0	22.7	20.5	20.1
1996	19.9	23.6	26.1	26.5	25.7	23.2	22.8	22.6	22.5	22.1	17.6	18.1
1997	20.2	22.2	25.6	25.7	25.1	23.6	23.1	23.0	23.3	23.3	21.1	19.3
1998	20.1	23.3	25.4	28.1	26.5	24.5	23.6	23.1	22.9	23.1	20.5	19.9
1999	21.4	21.8	25.9	26.1	25.3	23.9	23.0	22.7	22.3	22.4	20.5	18.7
2000	21.8	21.0	24.3	27.2	25.5	23.5	22.5	22.4	21.9	22.3	19.6	18.4
2001	18.6	21.3	24.4	26.0	25.8	23.4	23.0	22.4	22.4	22.5	20.6	20.1
2002	20.9	22.1	26.5	27.4	26.1	24.2	23.7	22.9	22.5	22.4	20.3	19.6
2003	20.8	23.6	24.9	26.6	26.2	23.6	23.2	23.0	22.7	23.6	21.3	19.1
2004	20.7	22.6	24.2	25.6	24.2	23.2	22.7	22.8	22.7	23.0	21.7	20.7
2005	20.4	25.7	27.5	28.3	26.1	24.1	22.9	22.8	23.1	22.4	20.9	20.7
2006	21.9	23.6	26.0	26.9	25.2	24.5	23.3	23.1	22.5	23.5	19.4	19.4
2007	19.4	22.5	25.4	26.0	24.8	24.3	23.1	22.3	22.9	23.4	21.8	20.3
2008	18.1	22.0	24.7	26.0	25.6	24.3	23.1	22.7	22.7	22.7	19.0	20.7
2009	19.3	24.0	26.5	26.2	25.7	23.9	23.0	22.9	23.0	22.9	21.0	19.1

Min temp.(°C) Navrongo												
Year	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
1990	20.8	21.7	24.5	26.5	25.2	23.9	22.8	22.4	22.1	22.7	22.5	21.1
1991	21.4	24.3	26.0	26.2	24.3	24.3	23.1	22.9	23.2	22.2	20.2	19.6
1992	19.8	22.8	26.3	26.3	24.7	23.2	22.5	22.5	22.1	22.5	20.5	19.2
1993	19.1	23.1	25.5	26.9	26.0	24.7	22.7	22.8	22.3	22.8	22.9	20.5

1994	20.6	22.7	25.7	27.2	25.3	23.7	23.1	22.9	23.1	22.7	19.2	19.5
1995	18.6	21.1	26.2	27.0	25.9	24.5	23.2	22.5	23.0	22.7	20.5	20.1
1996	19.9	23.6	26.1	26.5	25.7	23.2	22.8	22.6	22.5	22.1	17.6	18.1
1997	20.2	22.2	25.6	25.7	25.1	23.6	23.1	23.0	23.3	23.3	21.1	19.3
1998	20.1	23.3	25.4	28.1	26.5	24.5	23.6	23.1	22.9	23.1	20.5	19.9
1999	21.4	21.8	25.9	26.1	25.3	23.9	23.0	22.7	22.3	22.4	20.5	18.7
2000	21.8	21.0	24.3	27.2	25.5	23.5	22.5	22.4	21.9	22.3	19.6	18.4
2001	18.6	21.3	24.4	26.0	25.8	23.4	23.0	22.4	22.4	22.5	20.6	20.1
2002	20.9	22.1	26.5	27.4	26.1	24.2	23.7	22.9	22.5	22.4	20.3	19.6
2003	20.8	23.6	24.9	26.6	26.2	23.6	23.2	23.0	22.7	23.6	21.3	19.1
2004	20.7	22.6	24.2	25.6	24.2	23.2	22.7	22.8	22.7	23.0	21.7	20.7
2005	20.4	25.7	27.5	28.3	26.1	24.1	22.9	22.8	23.1	22.4	20.9	20.7
2006	21.9	23.6	26.0	26.9	25.2	24.5	23.3	23.1	22.5	23.5	19.4	19.4
2007	19.4	22.5	25.4	26.0	24.8	24.3	23.1	22.3	22.9	23.4	21.8	20.3
2008	18.1	22.0	24.7	26.0	25.6	24.3	23.1	22.7	22.7	22.7	19.0	20.7
2009	19.3	24.0	26.5	26.2	25.7	23.9	23.0	22.9	23.0	22.9	21.0	19.1

Max temp.(°C) Manga-Bawku												
Year	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
1990	35.5	37.4	40.2	39.5	37.2	34.5	31.6	31.6	32.5	36.5	38.0	36.7
1991	36.6	39.5	39.3	37.9	33.7	33.5	31.7	31.2	33.0	34.4	37.2	35.4
1992	34.2	38.2	40.2	39.2	35.8	33.2	31.6	30.8	32.0	35.3	36.2	36.7
1993	34.1	38.4	39.8	40.0	37.5	34.8	31.7	31.5	32.2	36.0	37.9	35.7
1994	35.3	38.0	40.5	39.4	36.7	33.9	32.0	30.8	31.9	33.2	36.3	35.1
1995	34.5	37.3	40.4	39.3	37.2	34.6	32.4	30.7	32.4	35.6	37.4	37.5
1996	38.6	39.8	40.5	39.0	36.7	33.1	33.1	31.7	31.7	34.5	37.4	57.4
1997	37.8	36.9	38.6	38.5	36.0	33.5	32.2	32.1	33.0	35.9	38.7	37.3
1998	36.3	39.7	40.0	40.2	37.3	34.2	32.4	31.1	31.3	35.2	38.8	37.0
1999	37.0	37.2	40.9	39.4	36.8	34.3	31.9	30.4	31.0	34.1	38.1	35.9
2000	37.0	35.6	39.8	40.4	37.4	33.5	31.2	31.2	32.1	35.0	38.4	36.5
2001	36.7	37.3	40.9	39.8	37.1	34.2	32.2	30.9	31.7	36.1	38.6	38.6
2002	35.0	38.1	41.1	39.8	38.4	33.7	32.7	31.3	32.6	34.3	38.4	37.3

2003	36.9	39.8	40.2	38.3	38.3	32.9	31.5	31.0	32.0	34.6	37.8	36.3
2004	36.5	38.5	39.0	38.8	35.0	32.8	31.5	31.3	32.0	37.2	38.5	38.8
2005	35.0		41.2	40.5	37.6	33.0	31.0	31.0	32.2	38.2	39.3	38.5
2006	38.1	39.0	41.1	40.5	35.7		32.2	31.3	31.4	34.1	37.6	36.6
2007	35.5	39.5	40.6	38.5					32.2	35.4	38.3	36.7
2008	33.5	38.1	40.2	39.7	37.2	33.6	31.2	30.5	31.6	34.1	38.3	37.4
2009	35.3	39.7	41.0	39.1	36.3	34.7	32.8	32.1	32.7	34.8	35.9	38.6

Min temp.(°C) Manga-Bawku													
Year	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	
1990	19.3	20.4	22.9	26.9	25.3	23.6	23.1	22.8	22.6	23.3	22.0	20.1	
1991	19.6	23.2	25.4	26.3	24.5	24.2	23.2	22.8	23.1	22.3	19.5	17.5	
1992	18.8	21.3	24.2	27.2	24.8	23.2	22.8	22.5	22.4	22.4	20.4	17.3	
1993	17.6	21.2	25.2	27.3	26.7	24.6	23.0	23.0	22.4	23.4	23.0	19.4	
1994	19.3	21.1	25.8	26.7	25.8	23.8	23.3	23.0	22.9	22.8	19.1	17.3	
1995	16.7	20.1	25.1	27.0	25.8	24.7	23.4	22.5	23.1	22.9	19.6	19.2	
1996	18.9	22.6	25.8	26.5	25.3	23.2	23.5	22.8	22.5	22.1	17.8	17.0	
1997	19.0	20.8	24.9	25.9	24.9	23.6	23.3	23.3	23.2	23.7	21.2	18.0	
1998	19.2	22.1	24.4	28.5	26.6	24.5	23.7	23.1	22.7	23.6	21.1	19.2	
1999	19.5	21.2	26.2	26.4	25.8	23.9	23.0	22.6	22.1	22.4	20.7	18.1	
2000	21.5	19.8	24.4	27.7	26.3	23.5	22.9	22.5	22.3	22.7	19.8	17.3	
2001	17.6	19.9	24.0	27.3	26.2	23.6	23.4	22.7	22.6	22.6	20.1	19.0	
2002	19.4	20.7	26.1	27.9	26.5	23.6	23.6	22.8	22.8	22.3	19.8	18.8	
2003	18.8	23.3	24.4	26.1	26.6	24.0	23.3	23.2	22.8	23.5	20.9	18.0	
2004	19.5	22.0	24.7	26.7	25.5	23.6	22.8	22.8	22.6	23.6	22.1	19.7	
2005	17.9		28.0	28.5	26.6	24.2	22.9	23.0	23.0	22.4	20.4	18.6	
2006	20.1	22.1	26.2	27.5	25.6		23.2	23.3	22.5	23.2	18.9	18.1	
2007	18.5	21.2	25.0	26.8					23.1	23.4	21.7	19.3	
2008	16.9	20.8	24.4	26.4	26.0	23.8	23.1	22.6	22.8	22.5	18.8	19.7	
2009	17.9	22.9	26.6	26.7	25.5	24.3	23.8	23.0	22.9	23.1	19.7	18.1	

Max temp.(°C) Zuarungu												
Year	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
1990	34.1	37.0	38.3	38.4	36.3	35.0	31.7	30.1	31.6	35.5	37.2	36.4
1991	35.2	39.2	39.2	37.7	33.0	33.5	31.2	29.9	32.4	33.7	35.6	34.5
1992	32.8	36.6	39.2	39.2	35.0	33.3	31.0	29.9	30.9	33.8	34.2	35.3
1993	32.7	37.3	39.0	39.7	38.0	35.0	30.4	30.8	30.8	34.7	36.7	34.7
1994	34.0	37.2	40.1	39.7	35.8	33.2	31.3	29.7	30.9	32.3	35.3	34.1
1995	34.4	36.9	40.1	39.7	36.5	33.5	31.6	30.5	32.0	33.3	37.1	36.6
1996	37.5	39.0	39.7	38.2	37.3			30.2	30.7			37.3
1997	37.2	36.4	38.3	37.9	36.2	32.2	31.6	31.5	32.6	34.5	37.2	37.1
1998	36.5	39.1	40.2	40.0	36.3	32.8	31.3	30.7	30.5	33.9	37.4	36.5
1999	36.7	36.5	41.2	39.4	37.3	34.1	30.7	29.6	30.6	33.6	37.4	36.0
2000	37.3	36.1	39.9	40.7	37.6	32.1	30.7	30.3	31.0	33.9	37.6	36.0
2001	36.5	37.4	40.8	39.5	37.3	33.8	31.2	30.0	31.1	35.5	37.9	37.4
2002	34.7	38.5	41.0	39.6	36.6	33.3	33.1	30.6	32.1	33.5	37.2	36.7
2003	36.5	39.3	40.4	39.7	38.1	32.5	31.4	30.9	31.8	34.8	37.3	36.8
2004	36.4	37.9	38.3	37.6	34.7	32.7	30.7	30.7	31.3	36.2	37.2	37.6
2005	34.5		40.9	40.0	36.9	32.8	31.3	30.6	31.8	34.5	37.5	37.0
2006	37.2	38.8	40.4	39.9	34.6		32.1	30.8	31.0	33.6	36.4	35.9
2007	34.6	38.8	40.0	37.4					32.6	35.3	37.4	36.3
2008	33.7	37.7	39.5	39.2	36.3	33.3	31.2	30.1	31.8	33.9	37.5	36.7
2009	35.2	39.1	40.1	38.7	36.6	33.8	31.7	30.9	31.7	33.6	35.2	37.3

Min temp.(°C) Zuarungu												
Year	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
1990	19.7	20.5	24.0	25.1	25.5	23.3	22.2	22.2	22.8	24.1	23.3	20.8
1991	19.2	22.9	25.8	25.7	22.6	24.4	22.7	22.2	22.8	23.2	21.0	18.6
1992	17.5	20.8	23.9	25.1	24.7	23.6	22.6	22.5	22.4	23.3	20.2	18.2
1993	18.6	22.8	24.7	27.2	25.8	23.8	22.3	22.3	22.7	24.0	23.0	18.5
1994	18.3	21.9	25.7	26.8	24.4	23.2	22.9	22.8	22.6	22.4	19.5	18.1
1995	17.1	20.9	26.0	27.5	25.1	24.3	22.9	22.3	22.7	22.7	20.2	20.4
1996	20.7	23.8	26.2	25.9	25.4			22.5	22.8			18.0

1997	20.5	21.1	25.2	26.1	25.2	23.4	23.2	23.1	23.3	23.8	22.1	19.2
1998	19.2	23.2	24.9	27.5	26.3	24.2	23.4	22.4	22.4	23.3	21.6	18.8
1999	19.8	21.6	25.9	26.0	25.3	24.2	23.0	22.2	22.4	22.6	20.6	17.3
2000	21.1	19.4	24.8	27.1	25.3	23.4	22.9	22.6	22.6	22.7	21.0	18.4
2001	18.3	20.3	25.7	27.2	25.9	24.2	23.4	22.6	22.5	23.1	21.6	19.0
2002	19.3	21.7	26.9	27.2	24.9	23.3	23.4	22.6	23.0	22.7	21.4	19.3
2003	19.4	23.4	25.2	25.7	26.1	23.2	22.9	22.5	22.6	23.8	22.0	19.0
2004	21.1	23.3	25.7	26.2	25.4	23.4	22.5	22.6	22.1	23.0	22.0	21.1
2005	19.3		28.1	27.2	24.6	22.9	22.0	22.9	23.1	22.7	21.3	19.6
2006	21.5	23.4	26.4	26.8	24.3		22.3	22.0	21.2	22.1	18.7	17.7
2007	17.3	22.5	26.3	26.1					23.0	23.4	22.7	20.9
2008	17.6	21.8	25.1	26.4	25.4	23.6	22.7	22.2	22.4	22.2	19.2	20.5
2009	19.3	23.9	27.1	26.6	25.7	24.2	23.0	23.1	22.7	23.0	21.7	19.8

Rainfall (mm) Navrongo												
Year	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
1990	0.0	0.0	0.0	19.7	136.1	48.9	233.0	249.7	126.1	9.9	13.7	33.6
1991	0.0	0.0	34.0	43.1	148.0	64.7	164.7	357.4	83.5	81.1	0.0	0.0
1992	0.0	0.0	0.0	58.8	153.4	152.7	243.7	211.5	154.1	58.6	0.0	0.0
1993	0.0	0.0	TR	46.5	75.2	137.0	172.5	170.4	173.5	12.5	1.6	0.0
1994	0.0	0.0	32.3	12.7	115.8	62.4	164.3	428.2	100.8	84.7	0.0	0.0
1995	0.0	TR	5.7	41.6	44.6	141.5	94.0	231.1	55.7	72.5	0.0	0.9
1996	0.0	0.0	1.1	47.4	194.6	207.2	108.2	300.5	206.6	38.4	0.0	0.0
1997	0.0	0.0	7.5	34.8	155.5	204.0	91.3	194.7	178.9	73.3	0.0	0.0
1998	0.0	19.7	0.0	20.8	134.8	77.0	127.5	281.9	146.0	47.9	0.0	0.0
1999	0.0	4.1	1.5	29.6	117.9	108.1	312.6	455.5	258.1	77.9	0.0	0.0
2000	1.0	0.0	0.0	2.8	53.7	228.7	237.9	282.2	158.2	22.6	0.0	0.0
2001	0.0	0.0	0.0	30.3	125.1	131.1	176.9	336.2	155.9	4.2	0.0	0.0
2002	0.0	0.0	0.0	65.1	105.3	94.0	192.9	211.2	122.2	85.3	20.2	0.0
2003	0.0	1.8	0.9	22.3	95.8	207.2	182.8	284.4	238.6	100.1	6.1	0.0
2004	0.0	0.0	28.0	176.6	74.3	139.8	259.9	210.4	118.5	34.7	2.2	0.0
2005	0.0	4.5	tr	20.7	13.7	226.1	179.0	189.3	88.3	28.7	0.0	0.0
2006	0.0	3.8	4.0	82.4	55.6	117.8	193.6	183.4	153.1	83.2	0.0	0.0

2007	0.0	0.0	TR	155.0	92.0	138.5	284.7	405.9	113.5	13.7	0.0	0.0
2008	0.0	0.0	7.8	92.1	31.9	120.8	288.1	248.2	169.6	64.2	0.0	0.0
2009	0.0	15.4	18.6	30.6	70.7	176.7	124.4	234.2	177.2	72.6	0.0	

Rainfall (mm) Manga-Bawku												
Year	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
1990	0.0	0.0	0.0	2.1	115.0	91.7	200.0	270.9	107.8	14.0	39.1	23.2
1991	0.0	0.3	73.9	66.3	215.3	64.4	125.2	281.0	155.8	91.3	0.0	0.0
1992	0.0	0.0	0.0	15.9	133.1	159.0	161.2	190.3	168.3	37.4	3.0	0.0
1993	0.0	0.5	4.6	30.7	57.2	114.2	256.7	184.2	138.8	20.8	0.0	0.0
1994	0.0	0.0	0.0	44.6	84.1	64.9	138.3	333.7	206.8	232.8	0.0	0.0
1995	0.0	0.0	35.9	26.5	101.2	155.0	190.2	330.6	90.5	47.6	0.4	3.1
1996	0.0	0.0	0.0	75.9	138.5	148.8	71.3	256.9	260.9	75.8	0.0	0.0
1997	0.0	0.0	12.1	22.0	104.8	236.1	115.0	215.7	201.4	44.9	0.0	0.0
1998	0.0	0.0	0.0	34.7	82.0	125.1	425.4	179.6	209.1	22.0	0.0	0.0
1999	0.0	11.9	7.9	64.4	199.2	152.9	263.6	303.8	236.4	61.8	0.0	0.0
2000	0.0	0.0	0.0	8.9	86.1	183.8	126.8	287.5	146.2	41.1	0.0	0.0
2001	0.0	0.0	0.0	21.3	56.9	142.2	188.7	262.5	186.2	54.4	0.0	0.0
2002	0.0	0.0	0.0	25.6	135.7	144.1	275.1	235.9	91.8	88.6	0.0	0.0
2003	0.0	0.1	11.2	61.4	68.2	126.0	237.7	338.8	315.6	82.6	0.0	0.0
2004	0.0	0.0	3.5	29.6	124.2	155.9	181.2	183.4	66.8	16.5	8.6	0.0
2005	0.0	3.7	8.8	12.5	101.8	165.7	305.6	238.4	123.0	38.2	0.0	0.0
2006	0.0	8.0	0.0	42.0	101.7	148.2	226.9	211.8	178.0	62.8	0.0	0.0
2007	0.0	0.0	0.0	108.3	32.5	110.4	574.6	570.0	135.1	27.3	4.5	0.0
2008	0.0	0.0	23.1	25.5	54.7	163.7	136.5	217.7	112.0	62.5	0.0	0.0
2009	0.0	12.2	1.0	43.4	87.1	179.4	93.3	307.7	297.8	141.5	0.0	0.0