

# **Impacts and Adaptation of Small-scale Potatoes Farmers to Climate Change in the Western Highlands of Cameroon.**

A case study of the impacts and adaptation of small-scale potato farmers to climate change in the Western Highlands of Cameroon



Chiankem Bidias Ndemaze  
Department of Geography  
University of Bergen  
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## **Dedication**

This study is dedicated to my research assistant and participants who through their various contributions made possible the realization of this study.

## **Abstract**

Climate change is a veritable challenge to the sustainability of small-scale farmers livelihoods in Cameroon. The impacts of climate change are increasingly becoming a serious threat to the survival of small-scale potato farmers who are highly neglected by the Cameroon government despite their ingenious efforts to respond by adapting to the disastrous impacts of climate change. Adaptation which is considered as a resilience measure to climate change impacts is progressing quite slowly due to a number of constraints. This study examined the perceptions of small-scale potato farmers on the impacts and response strategies of climate change. The study employed an in-depth interview and household survey techniques through a semi-structured interview questionnaires alongside participant observation to acquire data. Key informants interviewed using convenient and purposive sampling, shared their opinions and shed light on potato farming and climate change impacts. Participants through their experiences, perceived and defined climate change as prolonged periods of dry season, late start of the rainy season, increase temperatures, sunshine, and high variation in rainfall.

The findings indicated that a fall in productivity, yield and income of farmers, high incidents of potato diseases, scarcity of water for irrigation, increased cost of production through the high cost of adaptable inputs to the high application of agrochemicals and fertilizers were observed as climate changed impacts on small scale potato farmers. Through participants knowledge and experiences of climate change impacts farmers responded by modifying their farming practices to adapt to the impacts of climate change. Amongst the recurrent strategies adopted include irrigation, constant change of seeds, high application of agrochemicals, fertilizers and change of planting dates. Most of the strategies are spontaneous and individualistic rather than planned strategies of the NAPACC. The findings also revealed that the adaptation strategies have had serious challenges that have rendered strategies very limited thus increasing the vulnerability of these farmers to climate change impacts. Most of the challenges accounted for were related to the government's inability to successfully accompany small scale potato farmers by promoting their adaptation efforts and in turn promote agriculture.

The study recommended the setting up of small-scale affordable irrigation schemes, protection of water catchments to solve the problem of water scarcity, subsidizing of agrochemicals and fertilizers through the increase of adaptation financing and the use of more organic fertilizers and manual than chemical fertilizers.

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# Glossary

Buyam sellam	Intermediate traders (middlemen)
Njangi	Thrift society
Okada	motor taxi (motorcycle)

## **Lists of Abbreviations and Acronyms**

AR	Assessment Report
ATPS	African Technology Policy Studies Network
AU	African Union
CAB/PM	Cabinet of the Prime Minister
CCAFS	Climate Change, Agriculture and Food Security
CIP	International Potato Centre
CO <sub>2</sub>	Carbon dioxide
COP	Conference of the Parties
DOs	Divisional Officers
FAO	Food and Agricultural Organisation
FAOSTAT	Food and Agriculture Organization Corporate Statistical Database
GDP	Gross Domestic Product
GHG	Green House Gas
GIZ	German Agency for International Cooperation
HHS	Household Surveys
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
ILO	International Labour Organisation
IPCC	Intergovernmental Panel on Climate Change
IRAD	Institute of Agricultural Research for Development
IRD	Research Institute for Development
IRGM	Institute of Geological and Mining Research
MINADER	Ministry of Agriculture and Rural Development
MINADT	Ministry of Territorial Administration
MULCUDA	Mmuock Leteh Cultural and Development Association
NAPACC	National Adaptation Plan of Action on Climate Change
NGOs	Non-Governmental Organizations
OCHA	United Nations Office for Coordination of Humanitarian Affairs
PACA	Agricultural Competitiveness Improvement Project
PI	Personal Interviews

PIDMA	Agricultural Markets Investment and Development Project
PNACC	National Climate Change Adaptation Plan (PNACC is a French Acronym)
PSRP	Poverty Strategy Reduction Paper
RCP	Representative Concentration Pathways
ToC	Theory of Change
UNSDGs	United Nations Sustainable Development Goals
UN	United Nations
UNEP	United Nations Environmental Programme
UNFCCC	United Nations Framework Convention on Climate Change

# Chapter 1. Introduction

## 1.1 Background

Climate change is one of the main sustainability crises facing the world today with threat of plunging millions of people in poverty across the world especially in developing countries. The African continent in particular stands out to be the most affected especially countries south of the Sahara. This is probably due to their high dependence on agriculture which is largely rainfed thus prone to climate change. The threat from climate change is increasingly affecting the agricultural sector in Cameroon particularly the potato sub sector, which is the focus of this study due to the high variability in climatic patterns throughout the country. Before discussing the background of the research, it would be essential to look at what is climate change, the causes, different scenarios, changes, and projected changes to guide us through. Climate refers to a long-term weather pattern that describes a region (Nema et al., 2012) and climate change on the other hand refers to “a change in the state of the climate that can be identified by changes in the mean and variability of its properties and persists for extended periods, that is decades or even longer” (Jyoti and Gokarn, 1992; IPCC, 2001 in Nema et al., 2012). Climate change could occur naturally as well as through human action, but popular scientific opinion believe that it is human induced and thus, responsible for the increasing concentration of greenhouse gases (carbon dioxide, methane, and nitrous oxide) in the atmosphere through land use change (Nema et al., 2012; Mngumi, 2016; IPCC, 2019). The IPCC (2014) supported this through its report on a total increase in anthropogenic GHG emissions from 1970 to 2010, with the highest amount noted between 2000 and 2010. Even though evidence shows that it is anthropogenic it is, however, difficult to separate the anthropogenic factors from the natural fluxes (IPCC, 2019).

In addition, evidence from different works suggest that both land and ocean temperatures have increased considerably since the pre-industrial period (i.e., from 1850-1900 and 2006-2015). Meanwhile mean land surface air temperature increased by 1.53°C, global mean surface temperatures increased by 0.87°C (IPCC, 2019). Before this, IPCC (2007), had reported an increase in global earth surface temperatures of 0.74°C from 1906 to 2005 and projected an increase of about 6.4°C on average during the 21st century. Based on the different climate scenarios, the IPCC (2014) predicted that global mean surface temperatures will witness an increase of between 1.5°C to 5.8°C by the end of 2100 if the prevailing trend persists. The predicted increase was attributed

to the alarming population growth. Even though the period 1983 to 2012 was assessed by the IPCC (2014) report cited in (Mngumi, 2016) is arguably the warmest in the last 1400 years particularly in the northern hemisphere (Mngumi, 2016). However, what the future holds remains unknown. The IPCC in the recent 6<sup>th</sup> Assessment Report (AR6) also agreed that since 2011 to 2020, there has been an increase in global surface temperature of “1.09°C (0.95 to 1.20°C) above the 1850–1900 period. The estimated increase since AR5 is believed to be due to further warming since 2003–2012 (+0.19 i.e., 0.16 to 0.22 °C), assessing the different scenarios, there is a 50% likelihood that global warming will reach or exceed 1.5°C in the near-term, even for the very low greenhouse gas emissions scenario” (IPCC, 2022). However, the best we know now is that we do not know yet exactly what the future holds if much is not done to scale down emissions, control the current trend and possibly adapt.

Climate change impacts are varied and have affected different people and their activities directly and indirectly across the world (Nkengla-Asi et al., 2017). Some of the impacts widely discussed in the literature include snow melting and glacier retreat, drought and desertification, floods, frequent fire, sea-level rise, species shifts, and heightened human and plant disease increase (IPCC, 2001; 2007; 2014; 2019; 2022). These impacts are projected to have devastating consequences on the global scale, but the most adverse impacts are predicted to occur in developing countries due to their limited capacity to cope and adapt. This is most likely because of their geographic location and characteristics (highly vulnerable and fragile environments) coupled with their high dependence on agriculture, which is a climate-sensitive sector (Stern, 2007; IPCC, 2007; Omambia et al., 2010 cited in Mngumi, 2016; IPCC, 2019). Indigenous and local knowledge has demonstrated beyond reasonable doubt that climate change (variation in temperature and precipitation) is affecting agriculture and food security in drylands, particularly those in Africa, and high mountain regions of Asia and South America (IPCC, 2019).

The IPCC (2013) report and IPCC special report on land (2019) concludes that Africa is one of the most affected continents due to its high exposure, vulnerability, and low adaptive capacity (Yaro and Hasselberg, 2016). Even though Africa contributes a trivial proportion of global emissions, with future projections suggesting that it will continue to remain low (Collier et al., 2008), little or no assistance comes from major contributors to enable Africa to build resilient economies (AU, 2014). Nevertheless, a lot has changed in terms of knowledge sharing, cooperation, and negotiations among the major world powers and African countries in the last couple of years especially during and after the Paris and Glasgow climate summit (COP21 and COP26).

The impacts of climate change on the agricultural sector in Africa are worrisome since most of the continent's population highly depend on it for sustenance and livelihoods (Collier et al., 2008; Nkengla-Asi et al., 2017). According to FAO and IFAD it is maintained that about 70% of the population in many sub-Saharan African countries live in rural areas and depend on agriculture for their livelihoods (Fraser, 2009; IFAD, 2011a; FAO et al., 2015 in Hasselberg 2017). However, this trend has fallen to about 53% according to ILO and world bank (2019) estimates and many factors may be responsible for this change.

Like any other country in sub-Saharan Africa, agriculture is the main economic activity in Cameroon employing about 43% of the active population and contributing about 17.4% of the country's GDP (World Bank, 2020). Despite the wholesome possession of enormous natural resources including the rich agricultural resources, Cameroon remains as of today a typically poor agricultural country (Hasselberg, 2017). It is thus paradoxical that Cameroon which is considered a major food producer just like many others in Africa is today seen as a net food importer (about 25% of total imports), whereas she like many others in Africa were rather substantial net food exporter in the 1960s and 1970s (Bello, 2009; Devèze, 2011; Fritz, 2011 in Hasselberg, 2017). The price surge in basic food commodities at the eve of the Russian-Ukraine war has demonstrated beyond reasonable doubt that Africa particularly Cameroon depends so much on the importation of food as the agricultural sector remains struggling.

Reports have it that climate change in terms of variation in precipitation and temperatures have devastating impacts on the agricultural sector in Cameroon given that it relies solely on rainfall (PNACC, 2015: 64). This has greatly influenced the agricultural production (both crop yields and crop quality), income levels of farmers, food security, and livelihoods. For instance, Tingem et al. (2008) established that increased temperature and low precipitation have led to decreased yields of farm products in Cameroon notably maize since higher temperatures translate into faster crop development and earlier maturation Defang et al., (2014) also asserts that low yields and fall in incomes of farmers are primary impacts of climate change with resulting secondary socio-economic impacts as poverty, hunger, and other social vices. Although other factors (mostly political) may contribute to the socio-economic impacts emanating from the menacing threat of climate change to farmers, climate change remains a major threat to food security and poverty alleviation not only in Cameroon but in Africa as a whole. Faced with these challenges, farmers are finding new ways to understand, cope and adapt to climate change Adaptation is therefore considered a resilient measure to the negative effects of climate change as it reduces impacts and



gives hope to livelihood (Defang et al., 2014). The IPCC in its Fourth Assessment and in its 2019 special reports pinpointed the climate change threat to agricultural production and generated considerable urgency urging the World Bank to stake out a stronger framing position of its own to address it (Taylor, 2018: 92; IPCC, 2019). To further reiterate the urgency of adaptation and mitigation of climate change, FAO (2009) and World Bank (2008) stressed on the urgency of climate change adaptation and solicited that it shouldn't be separated from other development priorities but rather integrated into development planning, programs, and projects (World Bank, 2008; FAO, 2009 in ATPS, 2013). Since measures or “responses aimed at adapting to climate change may, however, have negative consequences for food security, just as measures taken to increase food security may exacerbate climate change” (CCAFS 2009 in Defang et al., 2017). It is therefore imperative to adapt to effective and sustainable adaptation strategies that can help communities mitigate the impact of climate change. To avoid maladaptation, such adaptation strategies must be environmentally friendly, sustainable, easy for farmers to adapt, and economically viable (PNACC, 2015; Defang et al., 2017, IPCC, 2022).

Cameroon is naturally endowed with a rich ecological system with enormous natural resources as earlier mentioned, characterized by highly fertile soils and distinctive topography (relatively hilly, undulating, and low-lying slopes) favorable for agriculture. The distinctiveness of the topography highly influences the weather and climate in the different regions of the country especially the western highlands with a mountainous topography and one of the highest elevations with a relatively cold climate in the country favoring the cultivation of market gardening vegetable crops like Irish potato, leaks, carrot, tomatoes, cabbages, etc.

Potato farming, particularly small-scale ‘Irish potato’ farming, which is the focus of this study, has not been left out by the impacts of climate variability due to its susceptibility and vulnerability to the environment. ‘Irish Potato’ constitutes the world’s fourth-largest food crop, following maize, wheat, and rice (Mengui et al., 2019). Thus, a significant food crop in the world especially in developing countries grown at a significant scale in more than 130 countries around the world, including Cameroon. Given the significance and wide cultivation of this crop predominantly by small scale farmers, as a cash and food crop in the subtropical regions of Africa particularly in the western highlands of Cameroon, its susceptibility to climate change warrants this research to ascertain the impacts of climate change on the crop and the respond strategies. How then has climate change affected small-scale potato farming, how do these farmers perceive and respond to these changes?

## **1.2 Statement of the problem**

The changes and projected changes in the climate system with associated disastrous impacts on agricultural production in the world, Africa, and Cameroon in particular precipitates not only the need for a reduction in the emission of GHG but the need for total adaptation. The losses imposed by climate change on the agricultural sector in Cameroon are enormous thus, the need for adaptation is not only a major concern for Cameroon but also to many parts of the world. The adaptation of local farmers however depends on their experience, means, perception, and knowledge of climate change impacts.

The increasing threat of climate change on agriculture necessitated action on how to respond. In this light, the government of Cameroon with her partners developed a National Action Plan for Adaptation to Climate Change (NAPACC) known in its French acronym as PNACC with the aims to: “develop an agriculture sector that is resilient to climate change, reduce vulnerability and improve on the adaptation capacities of farmers, bring climate information to farmers so that they can better plan agricultural operations, improve agricultural systems through agronomic research and popularization of research results, promote good practices of adaptation to changes in climate among farmers. For example: the use of adapted seeds, the management and rational use of water, etc. Prioritize adaptation actions in areas and sectors where the risks and vulnerabilities are highest” (PNACC, 2015). In addition to this, the government of Cameroon in the 2010 poverty strategy reduction paper spanned out a plan with aims to emerge by 2035 with a strong and sustainable economy where poverty will be reduced to a minimal level, increase income per head and rise to a medium-income country. In order to achieve this, Cameroon plans to engage in a participatory approach through the bringing together of all development actors and stakeholders throughout the nation in a greater achievement policy of President Paul Biya (PSRP, 2010). How does this translate to the development of the agricultural sector (in terms of helping the farmers particularly small-scale farmers who are the majority and already suffering from high input prices and climate change) to improve and adapt to climate change according to the national adaptation plan and policy on climate change adaptation through a participatory approach.

As previously mentioned, agriculture is a vital sector in Cameroon employing about 43% of the active population as per the ILO and world bank (2019) estimates, predominantly small-scale farmers (about 70% of farmland) located mainly in the rural areas and confronted with a

myriad of challenges among which is climate change. Climate change here is characterized by erratic rainfall and high temperature patterns causing dryness, floods, mudflows, and erosion in certain areas and periods of the year. 'Irish potato' farming which rely mostly on rainfall and relatively cold temperatures has been in difficulties with the current changes in the climate system especially the high variation in temperatures and rainfall patterns in the cultivation areas. Potato farmers have over the years complaint about the difficulties they faced in cultivating potato with different changes observed notably that of high variation in weather. These has thus affected production and livelihoods of small-scale farmers as they depend on it for a living. Irish potato in Cameroon is still grown by some 200,000 farmers, mostly smallholders, with the majority being women (Fontem, 2004). It thus, wonders me what Cameroonian politicians and development actors do to enhance the situation and ensure sustainable adaptation of Irish potato farmers to climate change as enshrined in the PNACC. However, the literature suggests that intervention from these actors is inadequate and weak (Tani and Tume, 2018). Although potato farming has a long history of cultivation in Cameroon, production remains unsatisfactorily low and research on this activity in Cameroon has focused more on the agronomic, technical efficiencies, physical and socio-economic challenges pointed out in the literature section in the next chapter. This research, therefore, intends to investigate and map out the specific impacts of climate change on potato farming, what types and forms of coping strategies, what is feasible, who is involved in what, how, and what is required to facilitate effective and sustainable adaptation of small-scale farmers to climate change given that they control the highest proportion of farmland in sub-Saharan Africa.

### **1.3 Research Objective and Motivation**

Based on the devastating impacts of climate change on agriculture and the urgency of adaptation nowadays, this project seeks to investigate and examine the impacts, perceptions, and responsive strategies of small-scale 'Irish potato' farmers to climate change and whether strategies employed are long lasting and sustainable. Generally, small-scale farmers are confined in the rural setting with not much attention often given to them to meet up with the different agricultural challenges especially in the face of this anthropogenic evil called climate change. The increasing threat of climate change to potato farmers in the western highlands of Cameroon has to a greater extent affected and probably driven a lot of farmers out of activity. In this respect, there is a need to

investigate and establish the impacts of climate change on their activities and adaptation strategies with the hope that this research is going to produce results that can guide them to successfully respond to the climate challenge and increase their potato yields. One important thing to note is that I was personally motivated to pick up this topic for my master thesis because I consider it as a duty since I was born and bred in one of these potato inclined communities where I grew up cultivating, picking, and transporting potatoes on the head with my parents who were smallholder farmers. It is through this activity that money was raised for my well-being and education as well as that of my siblings. Over the years, there have been serious complaints from farmers about the effects of climate change on their crops. Thus, from a reciprocity perspective, giving back to my community through this project is both a duty and a responsibility to contribute to the development of my community and humanity.

#### **1.4 Scope of the study**

The research is focused on understanding the impacts of climate change on potato farmers, that is their perceptions and experiences of climate change impacts, adaptation strategies and if they are sustainable, if not, what can be done to ensure sustainability? The research is mainly based on studying potato farmers in a local potato cultivation area, the support of local authorities, and NGOs in the area. The study is therefore limited to the interview of farmers in the production areas of Mmuock Leteh and its environs, local administrative and development authorities like mayors, D.Os, and NGO staff in the area. The choice of this area was due to its high involvement in agriculture particularly Irish potato farming.

#### **1.5 Significance of the study**

The study is previewed to add to the existing body of literature on climate change adaptation. Hopefully, the study will contribute to the establishment of the impacts of climate change specific to this area especially those particular to potato farming and their adaptation strategy so as to contribute to the literature on the local context. Also, the research seeks to contribute in addressing issues of data inadequacy on local potato farming and climate change adaptation and sustainable adaptation strategies via sound recommendations. In this regard, the experiences that are shared by

informants and conclusions drawn at the end of the study may guide and inform policymakers to review their policies on climate change adaptation. The research could also motivate further study in assessing the long-term development of local initiatives in climate change adaptation and adaptation gap.

## **1.6 Research Questions**

The research questions were:

RQ1. What are the impacts of climate change on potato farming?

RQ2 How do these farmers perceive and respond to the effects of climate change?

RQ3 What are the factors affecting farmers adaptation strategies?

RQ4 How sustainable are farmers adaptation strategies and what does the state and/or NGOs do to promote adaptation?

To better answer the four main research questions sub questions were developed (see appendices for sub questions) to permit the researcher to simplify the questions to get most detailed information and answers from participants.

## **1.7 Structure of the Study**

The thesis is divided into eight chapters. The first chapter dwells on the background information of the study. The second chapter presents the literature review and theoretical framework of the study. The third chapter presents the location and background of the study area. The fourth chapter provides the methodological approach used in conducting the study. The fifth and sixth chapters presents and analyses the research findings which include major changes observed in farming practices, impacts and adaptation strategies to climate change, government role in promoting adaptation. The seventh and eight chapters consists of the discussion of adaptation challenges or barriers, main summaries, and conclusion.

# **Chapter 2: Literature Review and Theoretical Framework**

## **2.1 Introduction**

This chapter presents the state of the art on the topic under investigation. It focuses on what other researchers have written on the topic. The chapter begins with the concept of climate change, on Africa and its impacts on agriculture. It also looks at what other researchers have written on climate change adaptation, farmer's perceptions of climate change, barriers, vulnerabilities, and sustainability of adaptation measures. The chapter further presents some adaptation theories, potato farming with related climate change impacts, and other challenges to potato farming.

## **2.2 Climate change in Africa**

Attempting to understand the effects of climate change on Africa is fraught with difficulties due to diversity in the continent's geophysical characteristics. While a lot is already known and relatively well understood there is still great uncertainty about the key climatic processes and effects (Collier et al., 2008). In this respect, the literature on climate change in Africa shows that the continent has witnessed significant changes in temperature and rainfall trends over the years especially in the last five decades (Ngoe et al., 2019). On the global scale, the IPCC AR5 pointed out and reiterated in AR6 that temperatures have increased since 1950 and will continue to rise until the end of the century; thus, temperatures during the last 50- 100 years have increased by 0.5°C occurring more in most parts of Africa. Current climate scenarios indicate that land temperatures over Africa will likely rise faster than the global average, especially over the arid regions like the Sahel (Figure 2.1) (Stocker et al., 2013 in Yaro and Hasselberg, 2016) although it is argued that observational instruments and data is lacking to verify and determine these trends in several regions of the continent (Yaro and Hasselberg, 2016).

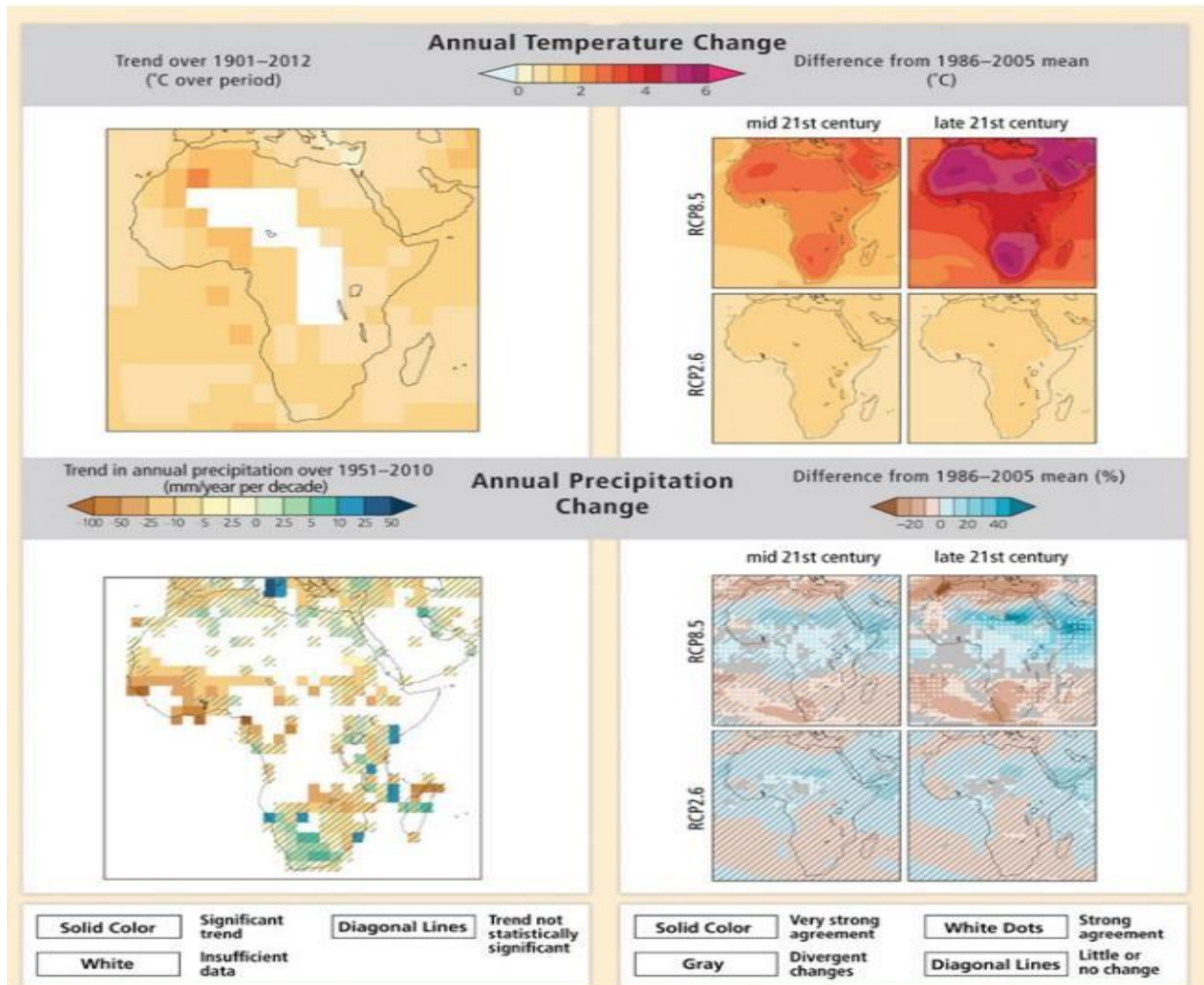


Figure 2.1: The graphic shows the IPCC AR5 observed and projected changes in annual average temperature and precipitation. Source: IPCC WG2 in Yara and Hasselberg, 2016.

The map is adapted from the IPCC AR5 reading from the left shows an observed annual average temperature change from 1901–2012, the bottom panel, left map shows an observed annual precipitation change from 1951–2010 and the top and bottom panel, right indicate mean projections of annual average temperature changes and average percentage changes in annual mean precipitation for 2046–2065 and 2081–2100 under RCP2.6 and 8.5, relative to 1986–2005. White and solid colors indicate areas where trends are significant and diagonal lines indicate areas where trends are not significant (Niang et al., 2014 in Yara and Hasselberg 2016).

The implications of climate change on Africa are therefore highly distinctive (Collier et al., 2008) given that its geographical landmass that stretches from about 35°N to 35°S with varied climate regimes characterized by different degrees of spatial-temporal variability in rainfall and temperature (Collier et al., 2008, Hulme et al., 2001 and Haile, 2005 in Mngumi, 2016). Considering

the variedness of the African landmass and the distinctiveness of climate change impacts, some regions are already getting dry, and more regions are projected to become more drier (e.g., southern, and northern parts of Africa), some parts in other regions like eastern Africa are projected to become wetter (Collier et al., 2008). This may be attributed to the inter-annual fluctuations of the intertropical convergence zone which causes a shift in the annual alternation of wet and dry seasons in tropical Africa. The intertropical convergence zone (ITCZ) is an area of low atmospheric pressure that forms where the Northeast Trade Winds meet the Southeast Trade Winds near the earth's equator determine the annual seasonality and variability of rainfall and temperature across the continent which might either increase the incidence and severity of droughts, floods, and other extreme weather events (Collier et al., 2008; Ngoe et al., 2019). The best projection deduced from the literature is that many regions of Africa will suffer from droughts and floods with greater frequency and intensity (Collier et al., 2008) although it is difficult to separate natural hazards from climate scenarios.

Furthermore, the rainfall intensity during the year may increase between 5 to 20%, although drought conditions may also be exacerbated by 5 to 10% in the dry seasons in cases of extreme climate scenarios as projected by IPCC AR6. This will also depend on the location. In this regard, the changes and impacts in the climate system will not necessary be regular across the continent. Thus, different areas are experiencing and projected to witness different climate change impacts over time and space. For instance, some areas are becoming wetter, and others drier, as well as face acute food insecurity as it is the case in many locations today. Hence varied responses to the impacts of climate change are required between individuals, households, classes, businesses, states, and ecosystems in different places on the continent (Rosenzweig et al., 2001; IPCC, 2007; Thornton et al., 2010; Yanda and Mubaya, 2011 in Mngumi, 2016; IPCC, 2022).

### **2.3 Impacts of climate change on Agriculture in Africa**

The literature on climate change has shown that agriculture is one of the most severely affected sectors with the most vulnerable people notably small-scale food producers and income earners observed to be disproportionately impacted across Africa (IPCC, 2022). Since climate change has been established as a social reality (Bate et al., 2019) with Africa reported to be one of the most severely affected probably due to the distinctive characteristics of the continent and the high reliance of African economies on agriculture (Collier et al., 2008; Bate et al., 2019; IPCC, 2019). The impacts



of climate change have been argued to be more pervasive on the agricultural sector in Africa due to its geographical characteristics and the fact that it is mostly rainfed. This has made it to become highly exposed and vulnerable to climate change (IPCC, 2001; 2007; Mngumi, 2016; IPCC, 2019).

According to the IPCC reports, the situation of chronic hunger is likely to be made worse in most parts of Africa if current climate trends continue as climate change is already reducing crops yields and productivity for instance, agricultural productivity in Africa since 1961 has fallen by 34% more than any other region of the world due to climate change (IPCC, 2022). This scenario is expected to continue further as projections demonstrate that the proportion of arid and semi-arid lands is going to increase (by 5-8% in 2080s) and partly because of depleted water resources. Additionally, yield from rainfed agriculture was projected to reduce by up to 50% by 2020, and about 75 to 250 million people in Africa projected to experience increased water shortages for both domestic and agricultural purposes with small-scale farmers likely to be the most vulnerable (IPCC, 2007; Collier et al., 2008; Mngumi, 2016). Today, things are even worse as IPCC in its latest AR6 report assert that further warming will negatively affect food systems in most of Africa via shortening of growing season and increased water stress (IPCC, 2022). This is already evident in most African countries South of the Sahara like the Camerouns with acute water shortages for both agriculture and domestic use (Ministry of water and energy, 2021). Which of course has also been a nightmare to farmers especially Irish potatoesfarmers who are now facing acute water shortages to irrigate their farms. The climate induced water scarcity has pushed farmers to destroy the water catchments which further aggravates the water crisis (see chapter 5 and 6).

Furthermore, temperature, light, and water are important drivers of crop growth, plant diseases, and pest infestations, as well as the supply of and demand for irrigation water, are all influenced by changes in weather and climate (Molua, 2009; Zhu et al., 2021), any significant changes in these drivers like increase temperatures will have direct effects on agriculture: changes in the length of growing seasons, crop yields and productivity, particularly along the margins of semi- arid and arid areas and may likely force large regions of marginal agriculture out of production in situations of high temperatures and severe droughts (Collier et al, 2008). Additionally, the IPCC AR6 project a yield decline for some crops in different regions of Africa at a global warming of about 1.5°C but at about 2°C it will get worse for all staple food throughout most of Africa irrespective of adaptation and tradeoffs in CO<sub>2</sub> concentration increase. However, it can't be undermined that yield decline in some crops maybe partially compensated by increasing

atmospheric CO<sub>2</sub> (IPCC, 2022).

In addition, increased temperatures are expected to reduce crop yields and increase levels of food insecurity even in the moist tropics. Due to these risks, farmers have been adjusting their farming practices to cope with the changing climate. However, these practices are argued to have both direct and indirect influences on crop productivity (IFPRI, 2009; Innocent et al., 2016). Moreover, Climate change may increase child malnutrition and reduces calorie consumption dramatically especially in Sub-Saharan Africa where food systems are already negatively affected due to increase warming and food security is apparently at stake. Thus, aggressive agricultural productivity investments are needed to adapt and raise calorie consumption enough to offset the negative impacts of climate change on the health and well-being of children (IFPRI, 2009; FAO, 2012 in Filho et al., 2015; IPCC, 2022).

The situation of farmers in Cameroon like many others in the region is not indifferent as climate change continues to exert more stress on the most vibrant sector which employs about 44% of the population per the ILO 2019 estimate although other sources estimate it to be more than that. As a result of the climate threat, there is serious concerns that climatic impacts on agriculture and its costs will be exacerbated in Cameroon and may even extend beyond the Central African sub-region due to increasing global warming (Molua 2009; Mukete et al., 2017; Ngoe et al, 2019; PNACC, 2015). Current climate variation in some regions of the country is already altering the types, frequencies, and intensities of crop and livestock pests and diseases, the availability and timing of irrigation water supplies, and the severity of soil erosion, flood, drought, and food insecurity (Molua, 2003; Molua, 2009; Innocent et al, 2016).

## **2.4. Climate change adaptation**

Considering the inevitability and future uncertainties of climate change, mitigation, and adaptation as response options have dominated the national, regional, and international discourse on climate change in the literature (Scoville-Simonds et al., 2020). Thus, negotiations on mitigation and adaptation via climate change conferences (UNFCCC, COP21 and COP26), treaties and best practices to the UNEP and IPCC reports help countries to develop a national adaptation plan of action (NAPA) to enable them implement sustainable environmental policies and response policy options on climate change. In this regard, adaptation plans have been drafted at the international, regional, and national levels with that, of the African Union and Cameroon, seeing the light of day

in 2014 and 2015, respectively with the objective to: coordinate action, create awareness, monitor, evaluate and report impacts, respond, encourage, and finance farmers adaptation strategies and good agricultural practices (crop diversification, conservation practices, agroforestry, etc.).

Climate change adaptation has been given a wide treatment in the literature but before reviewing the literature, I will start by defining climate change adaptation. Climate change adaptation according to the IPCC(2012), refers to the adjustments in natural or man-made systems in response to actual or expected climatic stimuli or effects. In another dimension, Oluwatusin (2014)and Mukete et al. (2017) referred to adaptation as interventions and adjustments which occur to take advantage of the opportunities or to manage the losses that take place as a result of any external change. Since the impacts of climate change are real and more apparent in poor countries (Scoville-Simonds et al., 2020) and predicted to be more devastating on agriculture in Sahel and other countries south of the Sahara region especially amongst the poorest communities who depend on agriculture for livelihoods (Collier et al., 2008, IPCC, 2019), adaptation is arguably the only way out in the near term. In this regard, major concern in less developed countries particularly in Africa are not directed towards reducing carbon emissions as is the case in other developed regions of the world but how to adapt to this climate dilemma. This is probably why most countries in Africa have invested in adaptation plans than plans on how to cut down emissions. Several studies across Africa have examined farmers' perceptions, vulnerability, and limitations to climatechange adaptation. Thus, it is important to examine farmers perceptions to climate change to understand why farmers have chosen to adapt before diving into adaptation theorists.

#### **2.4.1 Perception of climate change**

Drawing from different scholarly literature, the perception and understanding of climate change by farmers is paramount to adaptation. In this regard, farmers' knowledge and perception of climate change impacts is a precondition for adaptation choices (Innocent et al., 2016; Fadima and Barjolle, 2018; Ngoe et al., 2019). Thus, the observation of climate change based on past and recent climatic eventssuch as long-term changes in temperature and rainfall patterns shape farmer's perceptions, hence adaptive decisions (Ngoe et al., 2019). To further reiterate the importance of farmers perception ofclimate change as a precondition to adaptation, several authors have also focused more attention on perceptions of climate change while dealing with temperature and rainfall anomalies, i.e., amount, annual distribution, start and end dates and meteorological data

often used to confirm people's assessments (Deressa et al., 2009) or refute them (Bandyopadhyay et al., 2011) for long-term perceptions (Innocent et al., 2016). In addition, other studies have dealt with perceptions of seasonality, risks, and threats related to climate variability, local knowledge in forecasting weather and adapting to climate change (Saroar et al., 2012; Bryan et al., 2010; Orlove et al., 2000 in Innocent et al., 2016). Notwithstanding, the farmer's perceptions paradigm posits that the adaptation process starts with the 'adopter's perception' of the problem and technology, or strategy proposed. This paradigm argues that perceptions of adopters are important in influencing the adaptation decisions (Adesina et al., 1993 in Innocent et al., 2016; Ngoe et al., 2019). Even though farmers perceptions are primordial to adaptation, it is argued that perceptions are context and location-specific due to the seemingly heterogeneity in factors (i.e., culture, education, gender, age, resource endowments, and institutions) that influence them (Innocent et al., 2016). This study has therefore examined several studies that were conducted in different contexts and locations as presented in the following sub-sections.

#### **2.4.2 Farmers Perceptions and Adaptation Strategies to Climate Change**

As discussed in the preceding section, knowledge and experience of climate change impact is essential in making adaptation decisions. Perception and knowledge of climate change becomes a precondition for adaptation choices (Ngoe et al., 2019). In this perspective, the IPCC AR6 report estimate that over two third of Africa perceived climatic conditions for agriculture have worsened in the last decade (IPCC, 2022). And urged that local knowledge and action on climate change should be speeded up. Hence, a better understanding of the local dimensions of climate change is essential to develop appropriate adaptation measures that can mitigate long-term adverse consequences of climate change (Innocent et al., (2016). Since all identified adaptation measures do not necessarily translate into changes in all scenarios because different measures and barriers to adaptation are context-specific (IPCC, 2007), local knowledge of past ecological patterns and traditional ecological knowledge of climate change effects on ecosystems, health and species distribution can thus enable the reconstruction of historical baselines and contribute to culturally appropriate adaptation (Green et al., 2010; Thornton et al., 2012; Innocent et al., 2016). In the light of this study, an assessment of local farmer's perception and knowledge of climate change will provide the required information to understand the impacts, risks, and response strategies which according to Mukete et al. (2018a) is necessary if the information is required for managing climate risks,

adaptation enhancement, policy analysis, and implementation.

Furthermore, Ngogé et al. (2019) also associated farmers' adaptation decisions to their past experiences and opined that a farmer must first experience climate change before taking measures to adapt to any change perceived. In this respect, many studies in the literature conducted in different parts of Africa have clearly demonstrated this position. As cited in Ngogé et al. (2019), studies like those of:

Van der Veen (2013), in the Ethiopian Highlands and Tsegamariam (2018) around Abeshege Woreda, Ethiopia, showed that a good number of farmers in the past two decades perceived and experienced a decrease in rainfall with an increase in temperatures and resorted to the application of soil and water conservation techniques, small scale irrigation, changing planting dates, improved crop and livestock varieties as adaptation strategies to climate variability. Additionally, Seid (2016) in another study in Western Ethiopia observed that 96.3% of farmers, had perceived an increase in temperature and a decrease in the amount and timing of annual rainfall patterns. According to the study, over 49.9% of the farmers used approaches like crop diversification, irrigation, improved crop varieties, adjusting planting dates, and various soil conservation techniques like fallowing. In addition, Gadédjisso (2015) in a similar study conducted in Togo, revealed that about 85% of farmers perceived an increase in temperature and 85.58% a decrease in rainfall patterns within the past three decades and applied crop diversification, off-farm jobs, increase in farm size, change of planting date, and planting of cycle crops. Furthermore, Limantol et al. (2016) in another study in the Veve Catchment of Ghana, found, 90% and 94% of farmers have perceived an increase in temperatures, and variation in rainfall amounts. Here, farmers who depended on rain-fed agriculture adjusted to varying crop types, crop rotation without fertilizer. Meanwhile, farmers who had irrigation offset, resorted to greater use of fertilizer (Ngogé et al., 2019: 15042).

However, the different authors observed and identified similar factors such as education and information on climate change, family size (supply of labor), access to extension services and credit schemes as a major influence on farmers' adaptive capacity to climate variability. In sum, the perception of climate change and application of adaptation measures should have as main aim to reduce negative impacts, avoid risks, accept, and share risks, meet basic conditions as well as time scale for adaptation (Mimura et al., 2010; Bryan and Behrman, 2013; Ngogé et al., 2019).

The process of adaptation is complex and involves multiple steps at several scales. Moser and Ekstrom asserted that the different actors should be able to identify and learn about risks, evaluate response mechanisms, create enabling conditions, mobilize resources while implementing adaptation options, and revising choices with new learning as barriers can emerge

at each of these steps thus, there is a need for improved knowledge to limit or avoid barriers (Moser and Ekstrom, 2010). For instance, the best technical solutions may be ignored or rejected if cognitive, behavioral, and cultural barriers exist regarding the perceptions of risk, the need to adapt, and the willingness to accept change as well as, the ability of certain individuals or actors to employ forms of adaptation may be impeded by regulative controls, societal norms, and various forms of institutional inequities (Mimura et al., 2010; Shackleton et al., 2015). In connection to this, adaptation strategies and choices may also vary between men and women as they share different social statuses, experiences, and opinions (Nkengla-Asi et al., 2017). Thus, barriers are bound to occur. What matters then is how to overcome the barriers.

### **2.4.3 Barriers to adaptation**

The literature on climate change has continually emphasized the need for adaptation due to the unavoidable impacts of climate change across the globe (Eisenack et al., 2014; Jones 2010). However, a lot of barriers have been identified and reported in the process of finding ways to adapt and cope with the climate dilemma (Shackleton et al., 2015; Eisenack et al., 2014; Jones 2010)). Apart from the barriers, there are also underlying causes of vulnerability that render adaptation to climate change difficult. In assessing adaptation, it is also crucial to identify and analyze barriers to adaptation to find possible solutions to improve and foster adaptation (Eisenack et al., 2014). The literature on barriers to adaptation make use of challenges, limitations, constraints, and barriers interchangeably (Biesbroek et al., 2013, Mngumi, 2016). Before examining the barriers let's attempt to understand what barriers to adaptation are.

Generally, barriers to adaptation are defined as “challenges, obstacles, constraints or hurdles that may impede adaptation” (Klein et al., 2014 in Eisenack et al., 2014: 867). E.g., limited finances for adaptation projects may constraint adaptation efforts. In addition, IPCC's fifth assessment report characterizes adaptation barriers (synonymous with adaptation constraints) as “factors that make it harder to plan and implement adaptation actions or that restrict options” (Klein et al. 2014:867). Other researchers have applied the concept in relation to the lack of capacity or low adaptive capacity and action-oriented adaptation (Adger, 2009; Næsset al., 2005; O'Brien et al., 2006; Eisenack & Stecker, 2012; Hinkel, 2011).

In sum, Eisenack et al. (2014) appears to have a more refined and realistic definition. They regard barriers as “an impediment to specified adaptation for specified actors in their given context

that may arise from a condition or set of conditions which maybe valued differently by different actors, and in principle be reduced or overcome” (Eisenack et al., 2014: 867). Thus, the conditions here are the attributes of adaptations, i.e., actors, and their context.

Adaptation barriers are therefore context specific and needs to be targeted base on local realities. For instance, Ekstrom and Moser (2014) identify four categories of barriers commonly encountered in the local urban context: institutional, attitudinal, financial, and political barriers. Biesbroek et al. (2013) on the other hand identify seven barrier categories: conflicting timescales; substantive, strategic and institutional uncertainty; institutional crowdedness and institutional void; institutional fragmentation; lack of awareness and communication; motives and willingness to act; and lack of resources (Biesbroek et al. 2013 in Eisenack et al., 2014: 868). In this regard, researchers and the different actors on barriers must consider this and start asking necessary questions on why, how, and where these barriers emerge, how they work together to shape adaptation processes, who they affect most, and what is needed to overcome them. This will in a way guide research and action (Shackleton et al., 2015: 321). Even though the IPCC in her AR5 and AR6 reports has done a lot in categorizing barriers, contextualization and actualization remains a bitter pill to swallow as characterization of barriers seems irreflective of local realities.

In a nutshell, most of these categories of barriers or constraints explored in the literature, span from the perspective of the resources needed for adaptation, factors influencing adaptive capacity, the reasons for not employing particular adaptive strategies or not responding to climate change signals, and the reasons why some groups or individuals adapt and others do not (Bryan et al., 2009; Bryan et al., 2011; Nyanga et al., 2011; Roncoli et al., 2010 in Shackleton et al., 2015). Meanwhile many of the studies recognized that some of the farmers were able to respond to perceived changes as elaborated above, others were limited by a number of factors defined as barriers ranging from financial, biophysical, technological, informational, and governance to the lack of farming assets, inputs, new technologies (irrigation) and improved farming practices (Shackleton et al., 2015; IPCC, 2019, 2022).

In the context of Cameroon, several studies have also pinpointed a number of limiting factors to farmers adaptation to climate change impacts in the country: poor land tenure systems marked with gender inequality, inadequate information and government assistance, under-capitalization, and low financing of agriculture, with only a small percentage of farmers having access to commercial bank loans (Molua, 2002; Azong et al., 2018; Ngoe et al., 2019), the dearth

of inter/intra-sectorial stakeholders' collaboration, highly conservative and protected cultural and traditional practices, etc., (Tume and Tani, 2018).

From a critical point of view, most of the studies have recognized several barriers that cut across all these categories making it seem difficult to distinguish and classify them contextually whereas, in reality, the boundaries between categories are much more “subtle” than those implied by many of the typologies examined in the papers, also, these barriers portrayed to have cumulative effects and appear to operate “heterogeneously” in different contexts and scales (Mukheibir et al., 2013:32; Juhola S, and Westerhoff, 2011:33; in Shackleton et al., 2015). This is highly contradictory given that some factors may or may not hamper adaptation depending on the type of adaptation, the actors involved, their value systems, the regions and contexts covered (IPCC, 2019). For example, the circumstances in which different types of barriers to adaptation emerge can vary according to whether adaptation is planned or autonomous, anticipatory, or reactive, long-term, or short-term, private, or public, and the type of strategies employed also matters (Agrawal, 2008, Thornton, and Manasfi N., 2010 in Shackleton et al., 2015: 34, 35). Nevertheless, the literature on climate change adaptation has contributed enormously to bringing out some of these barriers which could go a long way to guide different actors in redesigning and implementing adaptation plans and strategies. Owing to this, it is also important to identify and map out vulnerabilities of farmers in the system to climate change to enable policymakers to build bridges where they are not to ensure a successful adaptation.

#### **2.4.4 Adaptation and Vulnerability to climate change**

The concept of vulnerability to climate change is one of the central elements of sustainability research and global environmental change science with the original aim to understand the effects of hazards and disasters in the society (Kasperson and Kasperson, 2001 in Sonwa et al., 2012; Adger 2006; Bassett and Fogelman, 2013 in Azong et al., 2018). It has been extensively employed by researchers now than ever before to examine the potential impacts of climate change on different nation-states and groups within nation-states (IPCC, 2014 in Azong et al, 2018). In an attempt to understand and deconstruct the climate change adaptation dynamics it is essential to define and conceptualize vulnerability to establish why some communities/groups are easily affected by climate change. Vulnerability is defined as “the state of susceptibility to harm from



exposure to stresses associated with environmental and social change and from the absence of capacity to adapt” (Adger, 2006: 268 in Azong et al., 2018). It could also be defined as a set of conditions and processes resulting from physical, socioeconomic, and environmental factors, which increases the susceptibility of a community to the impact of climate hazards (AU, 2014). Therefore, vulnerability includes physical risk to a person or property as well as the socioeconomic, and political context that results in people experiencing worse impacts from a hazard (Azong et al., 2018).

Climate change vulnerability is determined by several factors including variations in wealth, social equality, food availability, health and education status, physical and institutional infrastructure, access to natural resources, and technology (Brooks et al., 2005 in Westbrook and Davies, 2010). These indicators can help track changes in climate risk exposure and the effectiveness of adaptation strategies over time; indicators can also help to target resources on ‘hotspots’ (Westbrook and Davies, 2010). However, it is important to note that resource-dependent nations are more vulnerable to climate change which is typical of low-income countries like those of sub-Saharan Africa, Cameroon inclusive. Azong et al. (2018) opined that people in these countries especially the women are more vulnerable in a subsistence agriculture-based economy like that of Cameroon due to the implacable gender inequalities. This is further compounded by the numerous challenges facing local people and smallholder farmers such as the lack of adequate inputs, access to land, labor, loans, and grants (Molua, 2009 in Azong et al., 2018; Nchu et al., 2019). Thus, a successful adaptation occurs only by improving coping strategies, reducing vulnerabilities or exposure to known threats.

#### **2.4.5 Sustainability of Adaptation**

While acknowledging the scientific discourse of adaptation and its related challenges as widely exploited in the literature, Ngoe et al. (2019) posited that though agricultural activities are largely affected by climate change particularly rainfall and temperature with varying effects on both large and small-scale agriculture, long-term sustainability initiatives and studies are rare. However, there are a good number of adaptation initiatives, but we must recognize that adaptation is an ongoing process of adjusting to daring changes with no endpoint (Barnett et al., 2015). The question now should be, how can we ensure a sustainable adaptation within this prism? Meanwhile, it is argued that a proper and well-defined successful adaptation should be accompanied by sustainability processes and the principles of fairness and equity, it should be more than just about measuring

outcomes at any given point in time (Stafford-Smith et al. 2011, Hurlimann et al. 2014 in Barnett et al., 2015). In this regard, successful adaptation should be a matter of “socially and environmentally sustainable development pathways, including both social justice and environmental integrity” (Eriksen et al., 2011:8 in Barnett et al., 2015). Even though this is a central issue in development studies, coded and enshrined in the UNSDGs, sustainability remains as challenging as the word resilience which assumes an amoeba status in development studies. This study seeks to bridge the knowledge gap as it tries to assess farmers’ perception of climate change impacts, adaptation choices, and their sustainability.

#### **2.4.6 Adaptation Gap**

Looking at the worldwide treatment given to climate change in the literature and the urgent need to scale down emissions as well as the importance given to adaptation, there exist serious differential adaptation gaps across the globe. Recognizing the vulnerabilities to climate change impacts and barriers to adaptation exploited in the literature it is clear that complete adaptation is far fetch with the IPCC reports estimating a likely increase in temperature above the 1.5°C threshold rather than below in the near term (2021-2040) and a projected average global temperatures to reach 3°C above the pre-industrial levels at the end of this century with severe inevitable deteriorating impacts in developing countries if a better mitigation action is not taken (IPCC, 2021 in UNEP, 2021).

Different reports show that the adaptation gap and impacts keep increasing meaning that adaptation costs and the costs of residual losses and damages will invariably continue to rise and projected severe impacts in developing countries envisaged in the nearest future. However, firm mitigation action would avoid this in future (UNEP, 2021). Therefore, it is critical to increase adaptation finance to limit damages from climate change particularly in developing countries where the burden of adaptation is quite higher than developed countries. Even though it has been proven beyond reasonable doubt that the benefits of investing more in adaptation outweighs the cost of adaptation, the increase in adaptation financing remains low thus adaptation finance gap remains far from being near satisfactory or “closing point” (UNEP, 2020), For instance UNEP reports says adaptation financing is rising with an annual adaptation costs in developing countries estimated in the range of US Dollars 70 billion expected to reach US Dollars 140 to 300 billion in 2030 and 280 to 500 billion in 2050, however, this supposed rising trend in domestic public finance flow is difficult

to identify and justified due to limited data. In this regard, it is therefore difficult to have a clear-cut picture of on cost and finance given that the pace of climate change impacts in the different reports clearly shows that adaptation finance gap is not narrowing as a result of current efforts (UNEP, 2020; 2021). Nevertheless, mismanagement and corruption may be a major barrier here since the local masses haven't felt the effects of such finances. This is sadly typical of many developing countries like Cameroon where corruption, poor governance and mismanagement is at its peak. Apart from this, UNEP posit that the providers and distributors of development funds don't integrate adaptation in their activities as it is required (UNEP, 2020; 2021). Moreover, the covid19 pandemic according to UNEP, is accused to have aggravated the situation and it is expected to further aggravate the financial gap and the adaptation gap due to pressure on public finances (UNEP, 2020; 2021).

Despite, the worldwide discourse on adaptation urgency there is still very limited evidence of climate risk and impact reduction in developing countries thus significant private and public finance improvement is required to scale up and narrow the adaptation gap. In addition to this, nature-based solutions (improve and restore mangroves and flood plains) for adaptation could be encouraged by heavy financing thanks to recommendations and suggestions from LDCs insisting on the need for nature protection as important motivation for adaptation (UNEP, 2020; IPCC, 2022).

## **2.5. Theory of Change**

Theory of change could be referred to as “a process of project planning and evaluation which maps the relationship between a long-term goal of a project and the intermediate and early changes that are required to bring it about. It encourages a project team or group of stakeholders to explain how the project is understood to reach its goals, and the process through which changes will occur, emphasizes the assumptions underlying the pathway of change from the implementation of selected interventions and activities to intended outcomes” (Conservation International, 2013 in Pringle and Thomas, 2019). In addition, Anderson (2005) simply put it “essentially as an explanation of how a group of stakeholders expects to reach a commonly understood long-term goal”.

Conceptually, the ToC is quite confusing and can mean different things to different people based on differences in applications and expectations hence, it should be highly contextual. There is

however some degree of consensus as it is regarded as a planning process which articulates how change can be achieved. Although others view it as not useful term due to its high theoretical and vague connotation (Pringle and Thomas, 2019). It is of course relevant in adaptation theory since it is an iterative process that presupposes continual adjustment. In this perspective, Bours et al. (2014) in Pringle and Thomas (2019) highlights several reasons why ToC is a useful tool for climate change adaptation planning:

ToC encourages contextual analysis (location, sector, or social group) e.g., what are the barriers and assumptions in this context. It can connect diverse projects and programs, enhance linkages across Climate Change Adaptation (CCA) sectors and scales given that adaptation is multisectoral; ToC can be a valuable monitoring and evaluation tool for climate change adaptation as it can help in identifying 'lessons learned', which is a crucial in climate change adaptation; ToC is iterative and flexible since it allows projects to respond to changes in the socio-political, or natural environment. This is reflective for adaptation programs, which need to accommodate dynamic and emerging conditions. This makes ToC a valuable tool for monitoring and evaluation as well as adaptation planning; the flexibility and agility of ToC can better account for uncertainties and barriers that are inherent in adaptation processes by monitoring assumptions and providing evidence of where changes may be needed at key points in the process (Bours et al., 2014 in Pringle and Thomas, 2019).

Despite these advantages, the ToC has received a lot of criticisms due to the difficulty in its applications, however, it remains a highly valuable approach for climate change adaptation issues. In this respect, ToC could be a valuable approach for individuals or group of farmers to monitor and evaluate the impact of climate change on their crops, adaptation strategies and the desired outcome given that there is a strong focus on the assumptions that underlie a programme and thresholds that identify what is needed to advance towards the desired change (Pringle and Thomas, 2019). Figure 2.2 below shows the different stages of the ToC depicting how the theory has to work to bring change from assumption of risks to implementation of strategies, monitoring to evaluation of output and its indicators to expected outcome and if outcome indicators are visible and likewise impact indicators,

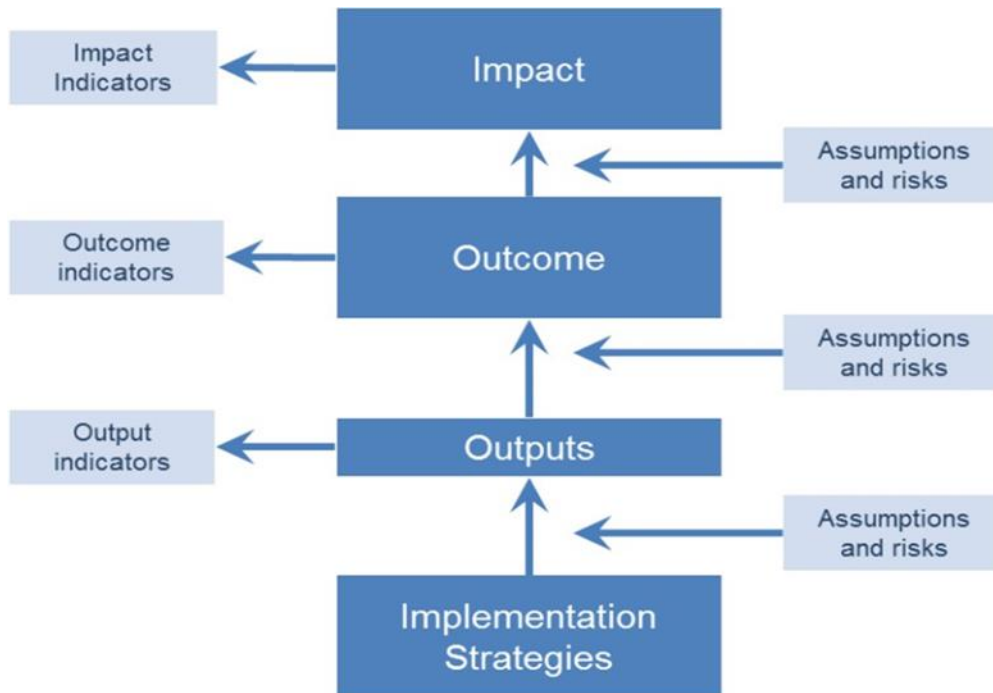


Figure 2.2: Schematic depiction of a theory of change

Source: Peer Review Group Meeting United Nations Children’s Fund (UNICEF).

## 2.6 Potato Farming

Potato is one of the world’s most important root and tuber crops grown in over 125 countries, consumed by over a billion people worldwide (FAO, 2009). It originated from the highlands of equatorial Andes (Gutaker et al., 2019). It constitutes one of the most staple crops and the world’s fourth-largest food crop, following maize, wheat, and rice (Gutaker et al., 2019; Mengui et al., 2019). It covers about 18 millionhectares of land (Struik, 1999 in Mengui et al.,2019) and mostly cultivated in high-altitude areas across the globe (Haverkort, 1990). In developing countries, millions of people depend on its cultivation for survival. It is argued that the ease of potato cultivation and its nutritional content isresponsible for its expansion in developing countries, its added value for food security and cash for millions of farmers in these countries. Although production in these countries is quite lowcompared to developed countries (FAO, 2009). Two main types of potato farming have been identified in the world i.e., intensive and subsistence potato farming (Spencer and Kaindaneh. 1998; FAO. 2009: Fawole, O.P., 2007 in Njomo et al., 2019). According to the FAO (2009), the decision of what type of potato farming to be applied in different parts of the world depends on: socio-economic, technical, policy and institutional factors.

In Cameroon, potato is an important crop and ranks among the major crops in tons produced after cassava, plantain, cocoyam, and maize, with majority production done by small-holder's farmers predominantly women, with most marketing done locally (FAO, 2014 in Njomo et al., 2019). However, one third of what is produced is sold out of the country with the help of local traders commonly known as 'buyam sellam'. In addition, its cultivation in Cameroon, like many African countries, has become quite popular in the last decades because of their versatility and suitability for direct marketing and livelihoods (GIZ, 2019). It is worth noting that the history of potato cultivation in Cameroon is as far back as the time of colonialization introduced in Cameroon during the German colonial rule between 1884 to 1914 but was widely cultivated in the 1940s as new varieties were introduced by other colonial governments like the British and Dutch in the country (Foncho, 1982; Horton 1987 in Mengui et al., 2019). It is widely cultivated in the highlands of western Cameroon because of its suitability and adaptability to high plateaux (FAO, 2009; Mengui et al., 2019).

Irish potato production is an important agricultural activity in Cameroon (both a cash and food crop), estimated to cover about 50,000 to 65,000 hectares of land (Martin et al., 1995 in Mengui et al., 2019). Planting generally takes place in two seasons, firstly at the beginning of the rainy season, usually in mid-March followed by a harvest in June extending to July though others may decide to store it a bit longer in the farms before harvesting due to constant rains that characterizes this period. And the second planting season generally takes place between August and September though other studies talked of November, this depends on the water stored in the soil (Fontem et al., 2004). However, planting seasons vary depending on the region, quality of soil and water availability. Moreover, during drier periods, such as November to January, few farmers plant potatoes along the riverbanks and valleys (Fontem et al., 2004; GIZ, 2019). Contemporarily, potato is cultivated all year round so long as there is irrigation possibility. Potato cultivation is usually confined to one crop (monoculture) in areas with shorter and/or less total precipitation though few farmers with smaller farm sizes practice mixed cropping but to a lesser extent especially with crops that can't shed the potato. Its production is done mostly by local dwellers in small-scale farms of less than two hectares and predominantly women (Fontem et al., 2004; Hasselberg, 2017; GIZ, 2019).

According to the Ministry of Agriculture, it is estimated that about 200,000 farmers grow potatoes in Cameroon with an average annual production of about 220000 to 400,000tons/year far less than the one million local annual demand. However, prior to the introduction of new varieties

in the 1980s by CIP and IRAD and the initiation of research on challenges inherent in potato production and how they could be tackled, the crop has witnessed a tremendous growth with a substantial increase in production from 1980 to 1988 and from 1995 to 2016 with the western highlands accounting for about 75% of total production although the period from 1981 to 1995 and beyond was characterized by erratic fluctuations (FAO, 2002 in Mengui et al., 2019).

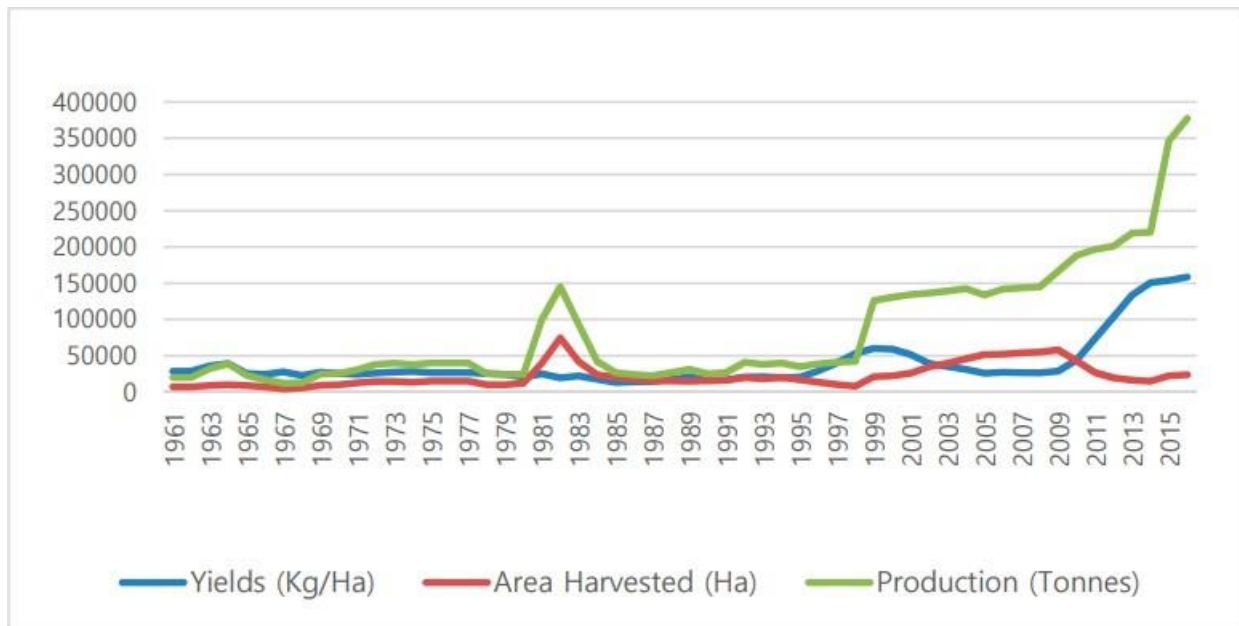


Figure 2.3: Trend in Irish Potato Production in Cameroon (1961–2016).

Source: (FAOSTAT Data, crop production in Mengui et al., 2019).

The figure shows the trend in potato production from 1961 to 1980 was low and relatively stable. From 1981 to 1995 and 1992 to 2016 it experienced a substantial growth with total increase in production.

Potato is cultivated on intensive, small-scale localities in six of the 10 regions of the country predominantly in the West, Northwest, and parts of the Southwest regions which constitute the Western Highlands of Cameroon characterized by cold temperatures, and high rainfall of at least 800mm per annum at altitudes ranging between 900 to 3000 meters above sea level (Business in Cameroon, 2022). The production from these region's accounts for 80% of national production and about 17% is exported to sub-regional countries like Gabon, Central African Republic, Congo, Chad, and Equatorial Guinea. Despite the above trend that shows and an increase in production, the total quantity produced in Cameroon as earlier mentioned remains very low compared to what is demanded due to some of the following constraints: poor farming practices, pests, inefficient use of modern technologies, poor soil fertility, high cost of inputs like fertilizers, seed, and

fungicides, lack of access to credit, and a lot more despite claims of government subsidization. This is probably because not all potato farmers receive these meagre subsidies, thereby causing the deficit in potato production, however, reports say the sector is highly neglected (FAO, 2009; Business in Cameroon, 2022; GIZ, 2019). Irish potato has many different types amongst those identified according to Njomo et al (2019) are Russet, Red, White, and Yellow. This study focuses on small-scale potato farmers with specialization on the white type.

### **2.6.2 Potatoes farming and climate change**

Given that potato is a plant of great plasticity that acclimates quickly and cultivated up to the height of 4000m above sea level (Maho et al., 2019), cultivation under a certain temperature will greatly influence its production. Therefore, climate has a great influence on potato cultivation in different dimensions, firstly potatoes cultivation requires mild and moderate temperature, and does well mainly in altitudes between 1,000 to 4,000 meters above sea level. It is drought sensitive and best adapted to cool climates. Vegetative propagation and tuberization of potato occur under short day conditions throughout and diminishes with increase in temperature (Haverkort, 1990; Hijmans, 2003; GIZ, 2019; Gutaker et al., 2019).

The optimal temperature for potato growth and development is considered to be 15-17°C with soil temperature (crop soil depth of 6-12cm) of above 7-8°C, they will be faster development even when temperatures are slightly higher (Maho et al., 2019). However, potato becomes highly susceptible at high temperatures between 25-30°C and below 0°C. At temperatures above 30°C, “ecological degeneration” may occur especially during tuber formation period, consequently a fall in yield, quality of production (Maho et al., 2019:85). Given that potato has a temperate climate, an increase in temperature will negatively affect potato yields, quality, and planting time. According to Hijmans (2003) a predicted temperature increases between 1 and 1.4°C, will likely lead to global potential potato yield decreases by 18% to 32% in 2050 without adaptation and by 9% to 18% with adaptation in 2040-69 and at high latitudes, global warming will likely lead to changes in the time and places of planting. It was also projected that rainfed potato will decrease by 20-30% under RCP 8.5 emission scenario across the UK due to climate change (Adesina and Thomas, 2020). In addition, Zhu et al. (2021), observed that climate change is causing notable shifts in area suitability of the main regions involved in potato cultivation in China and this has affected the production potential.



The impacts of climate change on agriculture (due to increase temperature and fall in precipitation) has thus compelled small-scale farmers like potato farmers for a mad rush for water to irrigate their farms in the drier periods especially as there are lesser months for farming (Urama and Ozor, 2010; Yaro and Hasselberg, 2016). As previously mentioned, it was projected that by 2020, between 75 million and 250 million people across Africa will be exposed to serious water stress especially for agriculture and will negatively affect livelihoods for the resource poor small holder farmers. This implies that increase temperatures and erratic rainfall with high spatial variations will negatively affect agriculture which is the main source of livelihood for over 70 percent of Africa's population (Strzepek and McCluskey 2007; Njomo et al 2019). However, ILO 2019 estimate shows a fallen trend of about 53%

Some studies have projected up to a 50 per cent decline in agricultural production in Africa relating it to the water challenge due climate change variations (Collier et al., 2008; Ringler et al. 2010). For crop specific situations, Ringler et al. (2010) and Tingem et al. (2009) highlights that in sub-Saharan Africa wheat and maize will have the highest negative yield impacts followed by potatoes. Furthermore, the impacts (fall in quality and quantity of yields) on small-scale farmers have profound direct and indirect impacts on childhood malnutrition levels (Filho et al., 2015; IPCC, 2022). In this light, different studies have estimated that close to a million children and millions of people in developing countries particularly in Sub-Sahara Africa are projected to face severe malnourishment deficiencies by the year 2050 (Ringler,et al., 2010; FAO, 2012 in Filho et al, 2015; IPCC, 2022). Based on the different impacts already observed, with small-scale farmers particularly potato farmers noted to be in continuous state of vulnerability with looming future uncertainties in precipitation and temperature, there is need for both short term and long-term adaptation strategies that can strengthen grower's resilience to climate change (Adesina and Thomas, 2020).

Summarily, the impact could, however, be measured in terms of effects on crop growth, availability of soil water, soil erosion, incident of pest and diseases, sea level rises and decrease in soil fertility which affects Irish potato production. As further explained by UNFCCC, the effect of climate change implies that the local climate variability which people have previously experienced and adapted to is changing and this change is observed in a relatively great speed particularly now that potatoes farmers have increasingly reported continues decrease in quality and quantity of yields, proliferation of pests, insects, and pathogens (Bulus and Nimfa, 2017). In this regard, a good number of studies in the literature have exploited several strategies commonly applied by

farmers though not limited to potatoes farmers, the following are the most cited in the literature: increase irrigation, improved crop varieties, early maturing and low water-use crops, increase capital investment in reservoirs and infrastructure (construction of dam), increase diversification and crop rotation, adjustment in planting dates, agroforestry techniques, use of pest resistant seeds, mixed cropping, change of seed types and planting dates, etc. (Hijmans, 2003; Tingem et al, 2009; Yaro and Hasselberg, 2016; Mngumi, 2016; Ngoe et al., 2019; Adesina and Thomas, 2020; Akugre et al., 2021).

### **2.6.3 Other challenges of potato farming**

The following challenges have been several mentioned in the literature particularly those identified by GIZ and FOA as key limitations to the attainment of potentially high yields by smallholder potato farmers:

- Limited access to quality potato seeds due to local unavailability
- Long distances to the distribution centers of potato seeds and high price of the seeds
- Limited access production input (e.g., fertilizers, fungicides and pesticides) due physical and socio-economic difficulties.
- Limited access to information on good agricultural practices, which contributes to inadequate management of pests and diseases.
- Poor farm to market roads
- Other challenges link to post harvest losses in the value chain,
- Effects of covid 19 on the potato value chain, etc.,  
(FAO, 2009; GIZ, 2019)

# **Chapter 3. Presentation of the Study Area**

## **3.1 Introduction**

The chapter presents and situates the study area in the context of this study beginning with the historical and geographical backgrounds given that it has helped to shape the socio-cultural and geopolitical history and configuration of Cameroon today. The chapter continues with the presentation and location of the study area (where fieldwork was conducted), climate change situation in Cameroon, government action on climate change, agriculture, and adaptation.

## **3.2 Historical background**

Cameroon's history has been characterized by periods of apparent peace and stability followed by periods of often-violent unrest especially during and after the period of colonialism. In brief, the territory Cameroon has witnessed several historical, geographical, and political transformations beginning from precolonial, colonial to post-colonial times. Starting with the appearance of the first European missionaries and explorers at the coast (banks of the Wouri River) in 1472 and naming the territory Rio dos Cameroes (meaning River of prawns). In 1884 the territory became a German protectorate. It was later shared and placed under the care of the British and French as mandated territories of the League of Nations to compensate them following their joint defeat and ousting of the Germans from the territory and Africa during the first world war. Britain and France ruled Cameroon from then until when the two entities gained independence in 1960 and 1961 respectively. The two entities unified through a UN organized plebiscite in 1961 leading to the birth of the Federal Republic of Cameroon. The federal structure was abolished in 1972 by Ahmadou Ahidjo through a one-sided referendum that saw the name of the territory changed to a United Republic of Cameroon and later in 1982 single handedly modified to the Republic of Cameroon by Paul Biya Cameroon's constitutional successor (current president of Cameroon) without the consultation of the Anglophones (the people of the former British southern Cameroon). These successive events of constant manipulation, change of constitution and of name of the country without respecting the constitution and due consultation of Anglophones sow seeds of discontentment, frustration, and feelings of assimilation amongst the English minority population (see Ngoh, 1996; Fanson 1999; Amin, 1999; Longley thoughtco, 2021). This amongst other things

like marginalization that ensued is the genesis of the current armed conflict between the Ambazonian separatist liberation movement (representing the Anglophones) and the Government of Cameroon. It is worth mentioning that a brief history of Cameroon starting from colonial times is important to situate the road of the implantation of potato cultivation in Cameroon. It is thanks to the colonization that potato was introduced in Cameroon and other African countries. Although widespread cultivation only began in the 1940s when new varieties were introduced however, it is reported that it later degenerated probably due to viral infection and late blight which overturned the crops initial inroads (Potatopro.com, 2022; Kemgni, 1973 in Mengui et al., 2019).

### **3.3 Geographic background**

The Republic of Cameroon is located in Central Africa although others believe that it is in West Africa. It extends from the Gulf of Guinea to Lake Chad, between latitude 2° and 13° north and then, longitude 8° 30' and 16° 10' east. The country has an area of 475650 km<sup>2</sup> with a long coastline of 402 km, triangular in shape with a length of about 1,400 km from North to South and a width of 800 km (east to west). The country is bordered to the south by the Congo, Gabon, Equatorial Guinea, and the Atlantic Ocean, to the west by Nigeria, in the North by lake Chad, in the East by Chad, and the Central African Republic. Cameroon is 63% made up of mountains with a rich hydrographic network with several rivers and basins (PNACC, 2015: 23,24). The country has a tropical semi-arid and humid climate in the north and south. Cameroon is divided into 10 administrative regions. The 10 regions are further divided into divisions and subdivisions headed by governors and civil administrative officers all appointed by the head of state. Yaoundé is the political capital and Douala is the economic capital of the country. It has an estimated population of 26,545, 864 (Fanso, 1999; PNACC, 2015; World Bank, 2020)

### **3.4 Culture**

Cameroon is both a multicultural and multilingual society with about 250 ethnic groups and 270 local languages (Eyong, 2007; Mvesso, 2005 and Molem, 2008 in Seemndze, 2016)). Meanwhile a few are alive, documented, and functional most of them are undergoing development and a good number of them are fast disappearing (Lewis et al., 2015). Despite the multi ethnolinguistic and

cultural diversity, Cameroon inherited the cultural legacies of the two colonial systems (British and French) and adopted English and French as the official languages of the country though not spoken by everyone in the country, as they are the official working languages and language of instruction in schools (Chiankem, 2020). Apart from the French and English main divide (French and English Cameroon), the country is largely divided into five regional sub cultural groups: Western highlanders (including the Bamileke, Bamoun, and many smaller entities in the North-west; coastal tropical forest peoples, including the Bassa, Douala, and many smaller entities in the Southwest); Southern tropical forest peoples (including the Ewondo, Bulu, and Fang (all Beti sub groups), Maka and Pygmies i.e. Bakas); Islamic peoples of the northern regions (the Sahel) and the central highlands (including the Fulani; and the 'Kirdi', non-Islamic or recently Islamic peoples of the northern desert and central highlands (Wikipedia, 2022; Country information report, 2008 in Chiankem, 2020). The Republic of Cameroon is a secular state with Christianity, Islam, and African traditions as the dominant religious practices. The Muslims are highly concentrated in the north and the Christians in the south though the three main religious practices coexist together throughout the country (Wikipedia, 2022). Apart from these cultural groupings, the country has four ecological zones: the western highlands (Northwest, West, and parts of Southwest), the southern rain forests (East, Center-south, Southwest, and Littoral regions), the central savannah (Adamawa and southern part of the North region), and the northern arid region (northern part of the North region and the Far North region) (PNACC, 2015; USAID, 1979 in Chiankem, 2020). To better situate the study area, I will present a brief description of the Western highlands in general and M'muock Leteh where the interviews were conducted



Map 3.1: Geopolitical map of Cameroon. source: World atlas

### 3.5 The Western Highland

The Western Highlands is one of the agro-ecological zones of Cameroon which comprises the administrative regions of West, Northwest, and parts of the Southwest region i.e., the part that falls on the slopes of the Bamboutos mountain where Mmuock Leteh is located (figure. 3.2 and 3.3). The Western Highlands constitute the grass field areas characterized by almost the same physical socio-economic and political characteristics (Fonchingong and Fonjong, 2002; Jiotsa et al., 2015).

The Western Highlands is a rich agricultural zone and consist of a chain of volcanic mountains stretching from the Atlantic Ocean archipelago of Sao Tome and Principe, and Bioko (Equatorial Guinea) to the mainland through Mount Cameroon (4095m), the Rumpi Hills, the Bakossi Mountains, Mount Nlonako, the Kupe Muanenguba mountains, the Bamboutos, the Bamenda Highlands containing Mount Oku (locally known as Mt Kilum) at 3011 m, the second highest peak in West Africa, and North-East towards the Mambila Plateau in Nigeria (Carlos et al., 2021). It is located between latitudes 4°54' and 6°36'N and between longitudes 9°1' and 11°24'E measuring a land surface area of 3.1 million hectares, including the West, Northwest, and parts of the southwest regions of Cameroon (Carlos et al., 2021).

The climate of this region is the tropical humid mountainous type with two seasons which are the dry and rainy seasons. The dry season runs from the end of November to March while the rainy season runs from March to the beginning of November. Average precipitation ranges from 2000 to 3000mm with average temperatures of around 20°C. The relief of the area is mountainous with many plains and plateaux. The altitude ranges from 1000m-2500m above sea level. The region houses some important mountains as previously noted particularly the Bamboutos and Oku measuring 2700m and 3011m abs respectively (Jiotsa et al., 2015; Carlos et al., 2021). The area is a “designated grassland as a greater proportion of the area is covered by grassland than forest characterised by common cultural and traditional traits like high socialisation and other distinct physical and economic features” (Fonchingong and Fonjong, 2002). The soils of the Western Highlands of Cameroon are ferralitic, of volcanic origin and highly fertile for agriculture although soil pH is relatively low (Jiotsa et al., 2015). The population density is estimated to be 128.5 inhabitants per km<sup>2</sup>. The inhabitants are mostly rural with a relatively estimated high poverty numbers amongst the population despite this the region is noted for the high spirit of community bond and participation in solution-oriented development (Fonchingong and Fonjong, 2002; Jiotsa et al., 2015). The main economic activity is agriculture with the dominant agricultural type being market gardening. The main crops cultivated here include Irish potatoes, carrots, cabbages, tomatoes, leaks etc. Even though the study was designed to involve small scale farmers in different villages engaged in potato farming in the Western Highlands, the study was finally limited to only the Mmuock Leteh area due to many challenges among which is health (covid 19 security and travel barrier measures) and security (Anglophone armed conflict). The sections that follow present a brief description of Mmuock Leteh where the interviews were finally conducted.



Figure 3.2: The geographical presentation of the Western Highlands of Cameroon

Source: Jiotsa et al., 2015

### 3.6 Description of Mmuock Leteh

Mmuock Leteh is situated on the northwest of the Bamboutos plateau (2000 to 2700 meters above sea level). It is a village in the Wabane subdivision and limited to the north-western part of Lebialem



Division, Southwest region of English Cameroon. M'muock Leteh also known as Leteh is one of the four Mmuock villages in Cameroon. It was part of German colony before WW1 and later became a British protectorate as earlier indicated. It is located at 5.675°N/10.041°E. It has an undulating landscape with several smaller mountains, incisive hills, and valleys with the highest peak at Maleta. Although it presents a spectacular scenery and geographical view, the undulating slopes and hills makes farming in the area quite difficult but not impossible especially to the west and north of the valley (Hasselberg, 2016; Wikipedia, 2022). The height of the area has contributed to influencing the climate which is quite cold during the rainy season. Temperatures vary between 8 and 28°C in altitude beyond 1800m above sea level. Monthly average rainfall ranges between 35mm in January and 605mm in August. The relatively cold climate of the area has contributed to the cultivation of market gardening crops, particularly potatoes. The climate was known for attracting fewer insects, pests, and other diseases for the crops. However, with the increasingly felt effect of climate change in the area characterized by increasing temperatures and decrease in rainfall, different types of plant and human diseases are reported to have multiplied (Chateh, 1972; Hasselberg, 2017; Wikipedia, 2022). The soils are ferralitic in nature but of volcanic origin characterized by high fertility and well suited for intensive agricultural production. Since it forms part of the grassland, the soils are covered by herbaceous savannah grassland dominated by plants, eucalyptus saligna trees, and gallery forest in lowlands. But further interior is found a thick rainforest with a different climate regime and soil type (Hasselberg, 2017; Wikipedia, 2022).

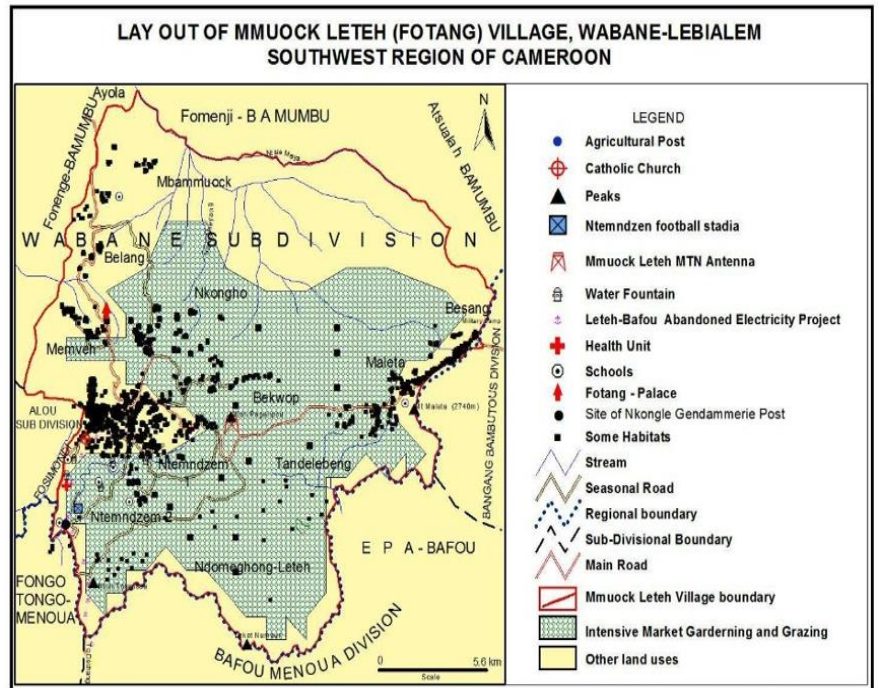
The transport system is poor with seasonal earth roads which are almost inaccessible in the rainy season. Thus, driving a vehicle is very difficult in the rainy season. Agricultural inputs and harvests are transported by motorcycle or head portage and well-adapted four-wheel pickup trucks (Hautala, 2013; Hasselberg, 2017). Agricultural products are only transported by lorries from the village to urban markets when the roads are in a relatively good state and during the drier seasons.

The main economic activity here is agriculture with potato cultivation as the main crop. Potato cultivation is both a cash and food crop to the farmers of this locality. It is cultivated mostly on a smaller scale with relatively small farm sizes of approximately less than 2 hectares. This is typical of the Cameroonian agricultural system that is dominated by small scale farmers (Hautala, 2013). Apart from potato cultivation, there are other crops and market gardening products like carrot, leeks, garlic, cabbages, beans, maize etc. Given that the farm sizes are relatively small of less than 2 hectares with no possibility of expansion due to limited land, the available land is intensively used, with little or no fallowing. Consequently, there has been the heavy application of

artificial or chemical fertilizers and animal manure to enhance the soils because of high pressure on the limited land thus, rapid deterioration of soil fertility recently (Hautala, 2013; Hasselberg, 2017:49). Farming here is carried out by hoe. The farmers work the fields themselves with hired help, often of youngmen and women from nearby French-speaking villages (Hasselberg, 2017). However, a good number of these labourers today are from the Northwest region.

Leteh has a unique culture and forms part of the Mmuock tribe. The dominant language spoken here is the Mmuock local language and English in this area is used as a language of instruction in schools. Mmuock Leteh constitutes part of the Bamilike ethnic group with a similar culture to her neighbours in the west region (Wikipedia, 2022). Like any other part of the country both Christianity and African traditional religion is practiced here with Christianity which in the past was developing at a snail pace is fast gaining grounds now especially with the creation of a quasi-Parish under a permanent priest in the village (ibid). It should be noted that potato apart from being a cash crop, constitute a major staple food prepared in different forms of meals in Leteh.

Furthermore, Polygamy particularly polygyny is a cultural norm in Mmuock Leteh. Succession and inheritance are patriarchal in nature. Thus, land inheritance here is patriarchal just like what obtains generally in Anglophone Cameroon (Fonjong et al., 2013 in Hasselberg, 2017; Wikipedia, 2022). Inheritance of property especially land does not favours the female child and it is through marriage that women can easily have access to land with men allowed to marry more than one wife (Hasselberg, 2017; Wikipedia, 2021). Eventhough most potato farmers in this area nowadays are women, they have limited access to land and inputs just like their fellow counterparts in the other parts of the country where land tenure insecurity constitute a major limitation to rural women progress (Nchu et al., 2019)



SOURCE: Realised from Historical Data, Topographic Mapsheets of Foumban 1913, Bafoussam and Manfe Sheets 1978, Manye Map Extract, Field Surveys and GPS Mapping 2012, Oral and Geographic Research, Quick bird image (2018) and MINADT Reports (2010, 2011) Exploitation: Dr Ojuku Tafack (Senior Lecturer of Geography), Former Chief of Service- Research and Cartography, National Institute of Cartography, MINRESI Cameroon

Map 3.3: The location and Layout of Mmuock Leteh (Fotang) in Cameroon.

Source: [https://en.m.wikipedia.org/wiki/Mmuock\\_Leteh](https://en.m.wikipedia.org/wiki/Mmuock_Leteh); MINADT 2010/2011 reports; Ojuku

### 3.7 Climate change in Cameroon

Cameroon like any other country in the continent of Africa is already facing an abnormal recurrence of extreme climatic phenomena such as violent winds, high temperatures, or heavy and limited rainfall in some periods of the year and in different parts of the country. The extreme climate is reported to have implications for agricultural-based communities, human beings, ecosystems, and the services they provide with over 320,000 Cameroonians estimated to be affected each year (PNACC, 2015: 23).

The reports on climate change in Cameroon indicate a spatial-temporal variation in rainfall characterized by a sharp decrease in rainfall and a high increase in temperatures throughout the country in the last 40 years. According to the PNACC, average rainfall from 1981 to 2000 was 20 to 40% lower than that of the period between 1961 to 1980. Since then, there has been an observed decrease in precipitation of about -2.2% per decade i.e., about -2.9mm per month particularly in March, April, and May. In addition, there is a fall in the length of rainy seasons and amount of rain

across the country characterized by high variation in the different geographical zones through at the year (PNACC, 2015).

In the case of temperature, the country from 1960 to 2007 experienced an average annual temperature increase of about 0.7°C that is an average rate of 0.15°C per decade (UNDP, 2008 in PNACC, 2015). With extreme events like drought, storms, mass movements, erosion, floods etc., reported in the last 50 years to be associated to climate change. These events may even become more disastrous given that some regions are envisaged to experience an increase in precipitation and temperatures before the end of 2035 (PNACC, 2015).

### **3.7.1 Government Policy and Action on Climate Change**

In an attempt to address the issue of climate change in Cameroon, the Cameroon government joined, signed, and ratified a number of treaties and agreements on climate change action at the international level e.g., she became a member of UNFCCC in 1994 and adhered to the Kyoto protocol in 2002. Since then, she has been a major contributor to the IPCC Assessment Report and most recently, was an active participant in the Paris and Glasgow summit on climate change. In 2016, she signed, and adhered to the resolutions of the former climate change summit in Paris (COP21). At the national level, she has taken several engagements through presidential and ministerial decrees establishing structures and institutions in charge of manning and managing climate change issues. e.g., the publication of the first communication on climate change in 2005, second in 2012, and third in 2015 to the creation of “Cellule National des changements climatique” (CNCC) and the ministry of environment, nature conservation, and sustainable development (MINEPDED) in 2012 with the aim to ensure public communication, sensitization, and awareness on climate change and environmental issues. In addition, presidential decree no 2009/410 of 2009 created the organization and functioning of the National Observatory board on Climate Change (ONACC) with the mission to monitor, forecast, and determine climate change indicators and prime ministerial decree no 103/CAB/PM of June 2012 establishing the steering committee for REDD+ charged with the promotion, evaluation, and validation of REDD+ activities in the country (PNACC, 2015; Fosong, 2017).

As previously mentioned, the main preoccupation of most African countries is not to cut down their emissions but to adapt to climate change. Likewise, the Cameroon government's main

objective according to PNACC is to adapt to climate change by reducing the vulnerability of the citizens to the effects of climate change, increase their resilience and quality of life, improve adaptive capacities to create more or new opportunities for a sustainable development of the country (PNACC, 2015). In this perspective, the government of Cameroon spans out a number of policy actions which I will focus on those that are important to this project. According to the PNACC (2015), the government policies were directed towards:

- a) The improvement of knowledge on climate change in Cameroon through research programs and public campaigns with support from meteorological and research centers such as IRAD, IRD, IRGM, etc. as partners to implement this policy.
- b) Inform, educate, and mobilize the population to adapt to climate change via public communication and community mobilization particularly in areas and sectors where women are highly vulnerable. Although we are still to see this happen as women situation remains deplorable.
- c) Reduce vulnerability to climate change in mainstream sectors through climate change adaptation programs and measures, secure funds from international and national partners to fund concrete actions that encourage adaptation.
- d) Integrate adaptation to climate change into national development strategic plans and policies. For instance, the vision 2035 development plan and strategic document for growth and employment. The ministry of Economy Planning and Territorial Development (MINEPAT) was set up in 2014 with the help of GIZ to ensure the implementation of this policy and promote technical studies on vulnerability and adaptation with the aim to integrate the results to local strategies.
- e) Promote high participation in international debates on climate change through active involvement in international conferences to enable Cameroon to share her experience on climate change and negotiate on strategic international financing for climate change adaptation in the country (PNACC, 2015: 62).

### **3.7.2 Policy on Agricultural Adaptation**

Since agriculture is the focus of this project and constitute the base of the country's economy employing about 60% of the population according to PNACC just like other countries in Sub-

Saharan Africa (PNACC, 2015), I will briefly review the government policy on the adaptation of agriculture to climate change. The government policies in the PNACC are more focused on developing an agricultural system that is adaptable and resilient to climate change by improving the adaptation capacities of farmers through the following actions:

- a) Bring climate information to farmers to better plan agricultural operations through the establishment of the national climate warning systems (plans for drought management, flood alert, storm alert, etc.). Through the restoration of the climate observation system (meteorological stations) and making information accessible to farmers.
- b) Promote agricultural research and practices adapted to climate change especially spontaneous good adaptation practices that emerge from rural areas. Encourage applied research projects that identify and disseminate systems that are resilient to climate change (for example, the regular update of the National Plan for Adaptation to Climate Change).
- c) Encourage large-scale promotion of field practices: water management and conservation techniques, soil management, and dissemination of new seed varieties adapted to high temperatures and heat stress (e.g., PACA, PIGMA), encourage irrigation and a recourse to concerted water management in lowlands and in watersheds, develop efficient techniques for water conservation such as the collection of rainwater; soil management practices such as the application of fertilizers, crop rotation, tillage system adapted to the environment; promotion of agroforestry systems, etc.
- d) Promote agricultural diversification to reduce the vulnerability of highly specialized systems. This involves encouraging the planting of several varieties and introducing trees in agricultural systems (agroforestry). Although with priority at the Sudano Sahelian zone with the responsible actor being the Ministry of Agriculture (MINADER) (PNACC, 2015).

The government action and policy on agricultural adaptation per the plan and observation on the ground (see chapter 7) has thus focus mostly on elaborating what the government plans to do without a corresponding strategic road map on how the planned adaptation strategies and policies will be translated into achievable action. This sounds more like recommendations than policies with achievable goals. In this regard, the ToC presented in chapter 2 sub section 4 could guide the government and policy makers to anticipate, monitor, evaluate, implement, observe, and adjust where need arises. However, the lack of climate finance may constitute a major setback to the successful implementation of adaptation policy.

# Chapter 4: Research Methodology

## 4.1 Introduction

This chapter focuses on the methodological perspective of the study. It presents the different stages of the study. That is how data was accessed, collected, presented, and analyzed. The chapter begins with an introduction, about fieldwork, choice of methods, access to informants, techniques of data collection and analysis, ethical issues, challenges, positionality, reliability and validity and sources of data. Given that the purpose of research is to create scientific knowledge, it is imperative to conceptualize the epistemological underpinning of a geographic study like the current one.

There are two main research approaches: Quantitative and qualitative. These two main methods are being used by geographers to conduct research and they embraced diverse philosophical approaches to research: from positivism to subjectivity, reductionism, rationalism, realism, structuralism to post-structuralism (Clifford et al., 2016). Meanwhile, the quantitative research method involves the use of physical (science) concepts and reasoning, mathematical and statistical modeling to understand geographic phenomena, qualitative research methods take an epistemological approach that follows a set of techniques such as interviewing, participant observation, and visual imagery to explore subjective meaning, values, and emotions (ibid). Even though quantitative approaches form the basis for most research in physical geography, a positivist epistemology is also adopted in the study of social phenomena. However, this position has long been criticized by geographers particularly humanistic geographers especially with the application of objective scientific methods that conceptualizes people, as rational actors (Cloke et al., 2013 in Clifford et al., 2016). In this regard, they opined that human behavior is subjective, complex, irrational and contradictory (Clifford et al, 2016). Therefore, qualitative methods which are more inductive and follows an interpretivist epistemological approach, allows for the voices of the informants to be heard and make meanings out of them without undermining the positionality of the researcher in the process of knowledge production (Clifford et al, 2016). In a nutshell, quantitative (deductive) methods are ideal for measuring pervasiveness of 'known' phenomena and central patterns of association, including inferences of causality and qualitative (inductive) methods, allow for identification of previously unknown processes, explanations of why and how phenomena occur, and the range of their effects (Pasick et al., 2009).

Although the two ways of doing research in Geography appear in their face value

incompatible, Clifford et al. (2016) advised that it is important not to see the two as “binary opposites” rather as the possibility of mix methods thus, combining both quantitative and qualitative approaches are necessary to gather enough scientific data to understand better why and how the world looks like in a particular setting.

## **4.2 Research procedure**

The research process began with several steps which include reading articles, books, and other materials related to my research topic. This helped me to have first-hand information about existing literature on my research topic. The review of the available data on my topic of interest enabled me to formulate the main research questions that have guided me throughout this project. As a requirement in the geography department of UIB, a research proposal was also formulated and submitted which went through a rigorous process of presentation and feedback from peers, lecturers, and supervisors incorporated into the prestigious innovative three steps milestone research tradition of the department. Before embarking on fieldwork and the process of data collection, I made a choice of participants and where to find them through online contacts. Even though I was finally unable to conduct interviews in the different settings of the western highlands as initially planned, due to the challenges imposed by the dreaded covid19 crisis that impeded my displacement to Cameroon (the study site), I was able to conduct interviews in one of the potato rich villages in this region. Additionally, the armed conflict in the English-speaking regions of Cameroon was another major setback specially to making decisive decisions for the study and the research assistant in the field. As a result of the challenges imposed by the looming covid19 that prevented me from traveling, I resorted to a plan B which was online interviews via WhatsApp and Facebook platforms, and the use of a research/field assistant to interview potato farmers.

Several attempts made to interview participants through online methods were almost futile due to network problems. Internet connection was very unstable and hardly would you make a successful interview on WhatsApp without disruptions. When it was finally clear to me that this technique alone could not achieve a 20% success rate in the data collection process, I decided to recruit a research assistant in the field who through constant collaboration assisted me in conducting the interviews with potato farmers. The negotiation and recruitment took place online wherein I briefed him on a few tips particularly about research ethics. We did the first interview



together with a farmer through a long video call on WhatsApp where I was just a passive observer though internet connection was a real nightmare. After the interview, we identified and addressed what didn't work well. Each interview session started with an introduction of the interviewer and the purpose of the project explained to the participant. This was also strictly followed by consenting and letting the participants declare their intentions and willingness to participate. Interviews were scheduled based on the decision and availability of the participants, the reason why it took a bit longer than planned. Interview scenes were either in the market square, participant's home, or farm. The average time for both household surveys and personal interviews was between 25 to 60 minutes. Notes and audio recordings were taken in accordance with ethical rules. The recorded data and notes were transcribed and expanded upon. Both transcripts and recorded data were stored on my restricted private coded computer.

### **4.3 Sampling Technique and Sample size**

Furthermore, the targeted sample size for personal interviews was envisaged to be 50 participants but only 27 was attained. Meanwhile, a convenient sampling is easy and convenient to use, the sample size is important in ensuring appropriate representation. In this regard, a large sample size provides more precise information for addressing a research problem (Clifford et al., 2016). However, a large sample size also demands more work and resources in terms of time and money spent to produce questions, collect data, interview, and analyses the data (ibid). Thus, it is imperative to consider the benefit of tradeoffs in the process before making a final decision on what sample size to choose. For convenient and purposive sampling, the sample size is based on the availability of participants and theoretical saturation i.e., when new and emerging themes no longer appear and the same materials keep repeating when the research questions are been asked (Tuckett, 2004; Mack et al., 2005 in Prisca, 2016). In this direction, interviews with the NGO workers and government/local authorities were determined by their availability which was not an easy task to get them interviewed. Even though it was not easy to meet up with their tight and busy schedule to interview them, I cannot conclude here that the pointof saturation was attained when only 2 local authorities and a single NGO participant (an NGO worker) was interviewed

#### **4.4 Recruitment of Participants**

The research participants (farmers) were recruited using onsite recruiting or what is known as ‘recruiting on location’ (Krueger, 1988:98 in Clifford et al., 2016:149). Social media platforms like WhatsApp were also used to recruit and conduct online interviews although the internet connection in Cameroon was horrible, hardly could a single interview be completed without interruptions due to poor internet connection. With ‘on-site recruiting’ potato farmers were recruited based on availability and convenience. This was quite challenging as some farmers accepted to be interviewed the first time of contact and others had to schedule a convenient date for the interviews. The ‘onsite recruiting’ technique was used for the lone NGO official who connected the next participant, that we unfortunately couldn’t succeed to interview him. To an extent, the few local authorities interviewed as the first contact facilitated the process by enabling the recruitment of the next participant. In a nutshell, social scientists called this strategy ‘snowballing’ given that ‘one contact can be used to recruit another contact who can, in turn, put you in touch with someone else’ (Valentine, 2005:17 in Clifford et al., 2016:149). It is important to point out that both face- to-face field interviews and online interviews were conducted. Meanwhile, the research assistant used the ‘onsite recruiting’ technique to recruit potato farmers on the field, on the other hand, I recruited participants via online platforms like WhatsApp and Facebook. A total of 27 and 91 participants were recruited and interviewed using both onsite recruiting and online recruiting techniques for semi-structured interviews and household surveys respectively.

#### **4.5 Choice of methods**

For a research project to attain its objectives, an appropriate research method that confirms the requirements of a scientific study must be chosen. This study employed a mixed-method approach. According to Clifford et al, (2016: 6), the process of combining qualitative and quantitative methods in research design is known as mixing methods. In addition, applying multiple methods embedded in both approaches and different sources of information maximizes an understanding of the research question (Clifford et al., 2016: 9). Therefore, mixing both methods enables the researcher to better answer the research questions, minimizes discrepancies, and strengthen the result findings. This is reflected in the argument that better results could be attained if the blending of research practices becomes iterative, reflexive, and integrated (Knigge and Cope, 2006 in Cope

2010:10). In addition, qualitative and quantitative data collection and analysis techniques might be used together to highlight discrepancies in data or interpretation (Eyles and Smith, 1988; Phillip, 1998; Cresswell, 2003 in Delyser et al., 2010). They may be used together to enhance the explanatory power of research, as different data types and modes of analysis interrogate different processes and interactions and possibly the production of new knowledge (Delyser et al., 2010). Given that this study is focused on the study of farmer's experiences in relation to climate change impacts and adaptation choices, both qualitative and quantitative methods were adopted. Since each method has its challenges and shortcomings, a mixed-method approach was a better option as an "open, methodological pluralism is increasingly being championed" in research (DeLyser and Sui, 2014 in Clifford et al., 2016: 5). Therefore, the study draws on different techniques from both approaches to gather, interpret and analyze data.

## **4.6 Data collection techniques**

The study adopted a mixed-method strategy as discussed above. Primary data was collected using both qualitative and quantitative research methods. Under the qualitative technique, data was collected using semi-structured interviews and field observations. On the other hand, the main quantitative technique used was household surveys.

### **4.6.1 Semi-structured interviews**

Semi-structured interviews were the main techniques used to gather primary data in the field through the interview of potato farmers. Before discussing how semi-structured interviews were used to collect data in the field, I will present a brief definition of interviews for clarification purposes. According to Dunn (2005:79) cited in Clifford et al, (2016), interviews are "verbal inter exchanges where one person, the interviewer, attempts to elicit information from another". Semi-structured interviews, on the other hand, refer to a predetermined and standardized order of questions asked in a sequential way but allow and ensure flexibility in the way the informant addresses the issues (2005:80). Hence, it allows the participants to respond in his or her own words rather than a kind of 'yes' or 'no' answer (Clifford et al., 2016).

The semi-structured interview guides were used to conduct in-depth interviews face-to-face with potato farmers to capture an in-depth meaning and understanding of their experiences of

climate change impacts and how they respond to it in their own words. During interviews, questions were posed in a neutral manner, listen carefully to participants' responses, and proceeded with prompt-up and follow-up questions. This permitted the researcher to improvise and probed more deeply to the topic while tuning and guiding the participants towards the issue under investigation. However, this was mostly done when the participant's responses were somewhat general and to an extent out of topic. Here, the interviews were conducted using a semi-structured interview guide produced in English but administered in 'pidgin English' and Mmuock peoples mother tongue (Mmuock local language). The questions were often asked in 'pidgin English' and local language, and the enthusiasm and dynamism of participants' responses determined and reoriented the research questions especially the semi-structured interview guides. Since interviews were conducted in the local language that both the interviewer and interviewee were familiar with each other, there were no issues of cultural misunderstanding and interpretation. Even though the researcher/research assistant during the interviews could improvise when confronted with stuff that needed prompt up questions as the participants responded to the main questions in varied ways, semi-structured interviews were the basis of questioning. However, it is the main qualitative method used for this project, since it serves as a guide to the interviewer and provides flexibility in participants responses (Clifford et al., 2016).

Despite the challenges that hampered the interview process i.e., from the covid19 barrier measures to the armed conflict in English Cameroon, and to the poor internet connection, a total of 27 personal interviews were conducted. The participants during the interviews were quite dynamic in their responses with different themes and new things coming up at every interview although at a certain moment the same themes if not similar themes kept resurfacing. It occurred to me that this was probably the point of saturation. During interviews, audio/voice messages were tape-recorded, images and notes were also taken. This was done in accordance with the participant's consent, in strict respect of research ethics. The notes and the tape-recorded data complemented and helped me to sort out things during transcription especially in situations where the notes or summaries were not clear enough since most were taken by the research assistant. During transcription, I had no choice but to play and listen to the tape to the end. This helped me matched up the notes and the audio recording. Audio recordings are important in that they enable the researcher to get every bid of the discussion since audio recording provides an opportunity to fully focus on the discussion and interaction with the participant while limiting the pressure to get every bid of the discussion written down during the interviews. All the data was put together

immediately after the interviews with the key themes that emerged regularly, personal feelings, and challenges noted and documented with the help of the research assistant who did most of the fieldwork.

#### **4.6.2 Participant Observation**

In participant observation, the researcher tries to learn by both participating in behavior from within and observing it from without (Fife, 2005:71). Hence, participant observation has to do with the researcher being with people, observing and assisting them, taking part in their activities to understand the hidden meaning as opined by Aase and Fossåskaret (2007), field researchers should look behind the scenes to understand the hidden processes related to the topic under investigation. Participant observation in this study was done formally by the field assistant since I participated mostly via the online platform but my previous knowledge as one who grew up as a member of the Mmuock Leteh community, planted and harvested potato with my parents was paramount in getting data even though from without. It was quite difficult to gain access to information at the beginning about farmers and their activities as they were suspecting that we were probably working for the government by collecting their information for either political and financial gains, covid19 vaccinations, or in the context of the armed conflict in the Anglophone regions. As this continues, the field assistant decided to accompany some of the farmers to their farms and partake in their activities such as harvesting, transporting, planting, etc. this is how the field assistant/researcher was able to gain access to some informants and data. It was also an added advantage as the researcher/research assistant was part of the community and informants who didn't know the research assistant as a member of their community later realize that he is part of them, that is when they trusted and gave him confidence. According to the field assistant, the informants became so happy as he participated in helping them in their activities. That is how he gathers a lot of information while being with them which couldn't be gotten through the interviews. Meanwhile some farmers could be seen praying to commit the day and their farming season to God before starting the day in belief that God will overcome the multiple challenges, others were seen carrying loads of bags on their heads and either returning or going to the farms. Information was also gathered through informal scenes and means like during drinking and relaxing time in off licensed and village council meetings where he mingled and drank together with the villagers.

### **4.6.3 Household surveys**

Household surveys were one of the main quantitative techniques used to gather primary data. This method is important in the acquisition of information about characteristics, behaviour, and attitudes of the population via the administration of a standardized questionnaire to a sample of individuals (Clifford et al., 2016). Household surveys were therefore used to assess the perception of a wide number of farmers to climate change impacts, their behaviours, and responses towards climate change adaptation. And since this constitutes the main economic activity which depends primarily on households, household surveys as stated by (Aase, 1986) was an important tool.

This method also enabled me to minimize power relations as most questionnaires were simple and straightforward with both fixed and open-ended questions. The household surveys proceeded with the design of survey questions which were both fixed and open-ended questions. The questions were designed to provide fixed responses while the few open-ended were meant to provide detailed insights and farmer's viewpoints. The household surveys adopted a face-to-face interview strategy which was administered with both fixed and open-ended questions. This strategy was used to study the adaptation of potato farmers to the impacts of climate change since most farmers in the study area do not own a smartphone. Participants were often excited to answer the fixed question with fixed responses. In the interview assistant's own words, "this type of interview was very interesting and generated a lot of important responses from participants as survey questions were simple with easy to go questions and answers and it took less time than the personal in-depth interviews". This is reflected in the argument of Clifford et al. (2016:134) that personal contact between interviewer and respondent results in more meaningful answers and generates a higher rate of response, it, however, requires careful planning, time, and high cost. Even though this survey strategy is time-consuming, expensive, and known for interviewer induce bias, it is nevertheless, useful for eliciting people's attitudes and opinions about socio-political and environmental issues such as environmental problems and risks (Clifford et al., 2016). A total of 91 participants responded to the surveys. This gave me an opportunity to have an overview of participants responses while assessing a good number of people in the study area.

## **4.7 Challenges**

The study had some major limitations such as the armed conflict in the English regions of Cameroon (Northwest and Southwest) and the covid 19 pandemic barrier measures that made life difficult through measures that restricted physical meetings of a certain number, movement of people and goods. In this case, many people were hesitant to be interviewed because they were afraid that information acquired during interviews may be used for political reasons (may become victims of the armed conflict) or for covid 19 vaccinations. There was general fear and suspicion. Most participants complaint that the questions were many and consumed most of their time especially aged people. In addition, some of them wanted to be motivated monetarily and others were simply afraid to get involved in anything interview because of past experience from political actors who often come and collect information for elections without consent.

Another major challenge was the bad roads. The interviews were conducted in the rainy season and the heavy rains rendered most of the roads inaccessible thus hindering the smooth running of the interviews as the field assistant couldn't travel to all the areas planned. There was also instability as far as electricity and internet connections are concerned for the charging of phones for recording, assembling of data and communication in the study area. Even though covid 19 and the armed conflict were top tier challenges to this study, the complexity of the Norwegian immigration system (UDI) had a fair share as it couldn't deliver my travel documents on time to permit me travel.

## **4.8 Positionality and power relations**

Given that the positioning of a researcher in relation to others (participants) positionality in research shape how the world is viewed, interpreted, and represented, it is crucial to present how positionality and power relations were managed by the researcher. Positionality refers to the “notion that personal values, views, and location in time and space influence how one understands the world. In this context, gender, race, class, and other aspects of identities are indicators of social and spatial positions and are not fixed, given qualities. Positions act on the knowledge a person has about things, both material and abstract. Consequently, knowledge is the product of a specific position that reflects places and spaces” Sánchez (2010). Thus, positionality is characteristics of a person's unique mix of race, class, gender, sexuality, nationality and other identifiers (Mullings, 1999:337). In simple terms, “Positionality can be understood as a consideration of how the relative

position of the researcher may affect the process of research” (Smith in Clifford et al., 2016).

The position of the researcher and that of the field assistant who are both male students and members of the same community as the research participants who grew up with their parents as potato farmers is believed to have influenced the results of this study. As a member of the same community and considered as a farmer, the researcher was seen as an insider and could be trusted to gain access to certain information that an outsider couldn't have access to. However, a researcher is considered an insider if he/she studies a group of people he/she belongs and an outsider if he/she studies a group he/she does not belong to. Although whether insider or outsider, it is not a fixed and static attribute thus it would be beneficial for the researcher to either switch the two positions or seek shared spaces (Mulling:1999). For instance, in the context of the armed Anglophone crisis and the covid 19 vaccination, people in the study area were hesitant to accept to be interviewed unless they identify and trust you before they could grant access to certain information. Even though my assistant and I were members of the same community at a certain point we were also regarded as partial outsider and suspicion looms as some informants came to discover that I was living and doing the research from abroad and they considered me to be more educated and richer. As a result, I found myself in the position where I had to continuously build trust by negotiating my position and assuring the participants that I was only a student, and my research was purely academic and not for the government or for political reasons. This can be reflected in what Mulling termed positional spaces where the situated knowledge of both parties in the interview encounter engenders a level of trust and cooperation (Mullings, 1999).

It was also apparent that power relations were also something that couldn't be avoided given that I was studying abroad and coming home to conduct the research it was obvious that I would be seen by participants as being more powerful (more educated, influencer and better informed). Following Mullings advice, that researchers should seek shared spaces that are not informed by identity-based differences when confronted with issues of power in research (Mullings, 1999), I used a research assistant who was a part time farmer himself and a member of the same community. By virtue of this fact, he was able to penetrate and gain access to information that I as the main player couldn't. During interviews, he appeared as part of the community and formally in some cases when need arises. Through this means he was able to gain access to certain informants. As a member of the same community and considering the sensitivity of the armed conflict in Anglophone regions it was obvious that I became sympathetic at a certain point with personal biases coming to play but I managed to avoid this by taking note of such instances and



dealing with them by being reflexive and self-conscious to avert its effects on the results.

## **4.9 Ethical concerns**

Being ethical in research is crucial as research involves putting people's private lives in public spaces. Hence, the researcher must be sensitive enough to the expectations of the participants who maybe from diverse moral backgrounds and the webs of socio-physical relationships within which the study is conducted (Hay in Clifford et al., 2016). Moreover, being ethical in research, protects the rights of individuals and communities involved, this enables the researcher to take full responsibility of his actions and avoid causing harm to the informants (Clifford et al., 2016). Ethical issues in the study were informed consent, power relations, anonymity, and confidentiality.

All interviews started with the reading of the informed consent statement. It is the procedure in research that informs participants of the reason d'être of the research, their rights, i.e., limits, awareness, and potential risks involved (Wiles et al., 2005). The study was unfortunately conducted at a time when the Anglophone crisis was at its peak and covid19 vaccinations was flooded with all kinds of conspiracy theories and suspicion. In this context, each interview started first by consenting and explaining to the participants the purpose of the interview and what information was going to be collected from them and for what purpose it was going to be used for. It was made clear to the participants that it was voluntary and free will to participate and they reserve the right to withdraw at any time without any justification. All interviews started only when all participants understood the purpose of the interview and declared their willingness to participate. Some participants were very excited and eager to be interviewed after understanding the purpose of the study, "like a farmer and tutor, I am very excited to hear about such a topic on something that is affecting us," said a participant. Pictures, videos, and audio recordings were only taken after seeking permission from participants.

Participants were also assured of their confidentiality in the research by explaining to them that all information obtained from and about them will be treated carefully and discreetly for research purposes only. In this regard, all data collected from the interviews was kept in private coded and protected computer. In addition, transcripts were assigned fictitious names. Before this, participants were made to understand that their real names will be anonymized throughout the study. Ethically, trust wasn't something to come by easily in the field in the context of the deteriorating armed conflict which we had as a duty to ensure protection and trust to avoid any

form of harm be it physical or psychological thus, it was important to continuously build trust among participants via the principles of informed consent, confidentiality, and anonymity. However, some participants went as far as asking for remuneration before they could participate in the interviews given that they knew that the researcher was schooling in a foreign university and must have money. This was managed by letting them know that the research was purely academic, and I was only a student and couldn't pay them to get information as participation was declared to be voluntary and free. Permission was also sought and granted by some participants for their images to be used for demonstration in the study.

#### **4.10 Data analysis**

Data analysis here included the transcription of audio or recorded data expansion and interpretation of field notes, organization, and coding of field data. I started the data analysis process by transcribing the audio records, expanding, and interpreting field notes. Transcription involves listening to the tape and simultaneously writing down what is in the tape (Mack et al., 2005). It was quite tedious and time consuming to listen and transcribe the audio records since it was in pidgin English and local language (Mmuock language). After transcribing the audio records, field notes were also expanded upon to complement the transcripts from audio records and pictures since it is often difficult to listen and write at the same time during interviews.

Data was however analyzed using an inductive analysis approach. It is a method that uses detailed information from raw textual data to derive concepts, themes and categories via interpretations drawn from raw data (Thomas, 2006). It therefore provides the researcher a systematic and simple straight forward approach to deduce and analyze data envisaging reliable and valid findings. Through the reduction of aggregated data to summarized themes, create meanings and relationships from the complex data to derive final themes or categories from the available data (Thomas, 2006). Through this approach, data was interpreted and analyzed using thematic coding. Coding is a way of evaluating and organizing data in order to understand meanings and identify categories, themes, and connections in data. Thus, it is an interpretive process that generate themes, elicit meanings, and identify participants own framing of experiences (Cope and Kurtz in Clifford et al., 2016). Since the coding process is 'fluid' and 'dynamic', I repeatedly read transcripts and notes, to identify themes that were related to the research topic and

continuously developed them while consulting the field assistant who doubles as my main informant to clarify doubts until when the final manuscript was ready. A lot of anonymous illustrative quotes from participants opinions and expressions were also used in the analyses.

#### **4.11 Reliability and validity**

Reliability and validity are important aspects of research as it ensures trustworthiness, credibility, and relevance of the research findings (Merriam, 1995). Reliability can be thought of as the trustworthiness of the procedures and data generated (Stiles, 1993 in Roberts P. et al., 2006). Therefore, it has to do with the extent to which the research findings are repeatable in different circumstances (Bryman, 2001 in Roberts P. et al., 2006). Validity on the other hand refers to how accurate the research tools measure the phenomena under investigation (Punch, 1998 in Roberts P. et al., 2006).

Meanwhile validity describes whether the research results are relevant, accurate and can be trusted. Reliability denotes repetition of the same results in any research even if it is done by different people, the result should be consistent and credible (Roberts P. et al., 2006; Clifford et al., 2010). Thus, to what extent are the findings consistent with the reality. To ensure reliability in the study, the researcher resorted to iterative and reflective questioning during interviews. This also enabled the researcher to reduce personal feelings, biases, and nuances from influencing the results. Triangulation was used to enhance the results of the study and ensure validity. Since triangulation is argued to be the best way to ensure validity in qualitative research (Merriam, 1995; Roberts P. et al., 2006), I employed different sources to acquire data to ensure validity and enhance the results of the study. Thus, different methods such as interview of key informants (in depth interviews), household surveys, field observation and secondary sources were the different methodologies used in the research to collect data. Hence, variation of methods in data collection in a single study leads to greater validity (Roberts P. et al., 2006; Rusten, 2020). Moreover, the researcher and field assistant were members of the same community as the participants, thus, they possessed a good mastery of the culture and the environment. In addition to this, the field assistant who doubles as my main informant was a farmer himself which instill some trust in participants and made things easier and advantageous to the researcher as he could improvise and use probing questions to elicit details to acquire trusted relevant and more accurate information. Even though

it is opined that researcher's familiarity with the field maybe both advantageous and problematic as his attitude towards the 'subjects' may overlook certain nuances and ambiguities of data due to their implicit understanding of the field which may obscure any ambiguous issues that others, from outside the field, might question. However, such insights remain useful in authenticating responses and findings (Roberts P. et al., 2006). Thus, researchers' familiarity to the study area and the people's way of life helps to enhance validity of the findings in this study.

#### **4.12 Sources of Data**

Data was collected using primary and secondary sources. Primary data was collected using in-depth interviews, participant/field observation and household surveys as presented in the preceding sections. Prior to any research is the consultation and review of secondary data to guide the student/researcher to better formulate and plan the study. Secondary sources used in the study include books, journal articles, social media, and the internet in general. Since secondary data is vaster, varied and readily available than primary data, it could be valuable in generating research hypothesis or research questions which can help the researcher to better investigate and collect primary data (Clifford et al., 2016: 521). Thus, this study made high use secondary data.

## **Chapter 5**

# **Potato Farming, Knowledge, and Perceptions of small-scale potato farmers to climate change**

### **5.1 Introduction**

This chapter presents the findings and analyses of the study particularly those related to discussions and responses from research question one and two beginning with the presentation of demographic characteristics of participants, assessing the changes observed in potato farming, perceptions, knowledge, and experiences of small-scale potato farmers on climate change. The chapter further presents and analyzes the personal insights of participants captured during interviews through changes observed by participants over the years which were regarded as local indicators of climate change. The last part of the chapter draws on the perceived impacts of climate change by small scale potato farmers.

### **5.2 Major Characteristics of Participants**

The study comprises of potato farmers residing in Mmuock Leteh who were conveniently selected as key informants purposely for this study. The demographic features of participants who responded to both in-depth personal interviews and household surveys of this study include age, sex, marital status, level of education, household size. The study interviewed both men and women with most of the interviewees above the ages of 25. The least age range of participants interviewed was between 5 to 10years but the majority of farmers interviewed have been in the activity for more than 10 years. The study, therefore, assumes that participants who have been practicing the activity for 10 years and above should have gained enough knowledge and acquainted themselves with possible environmental challenges affecting their farming activities, especially the unprecedented climate change. Also, the majority of participants had at least a basic/primary education certificate. What this study could not ascertain is if the level of education influenced the findings of the study as most interviews were done in the mother's tongue and pidgin English by the researcher and research assistant. The assumption is that farmers through their indigenous knowledge have experienced some degree of climate change. About 62% of participants for Household Surveys (HHS) and 30% of participants for Personal Interviews (PI) were female and 37% of participants for HHS and 70% of participants for PI were males respectively (see able 5.1 and 5.2). The household sizes range from 2 to 20. This study believes that the gender,

marital status, and household sizes influenced the results of the study as some participants gave large family sizes in anticipation of a handsome reward should in case a reward was to accompany the survey. Moreover, most people especially female-headed households who responded to the HHS had large family sizes. Although women in this area are charged with a lot of household responsibilities, their socio-economic status and situation is not determined by their husband as they are permitted to own and manage their own plots likewise their own incomes. However, their socioeconomic situation remains deplorable given the load.

The socio-economic diversity of the inhabitants of the study area is believed to have influenced the adaptation choices of farmers as agriculture is the main economic activity here and the crops cultivated especially potato is a high value crop constituting the main income crop to farmers here. In addition to this, the farmers here can boost of a local market (the biggest market in Lebialem Division) where they can sell their crops and equally trade in other income generating activities. Nevertheless, their socio-economic status remains a major concern due to government neglect of the sector.

**Table 5.1: Characteristics of Participants (HHS)**

<b>Variables</b>	<b>Mmuock Leteh</b>	<b>Marita</b>	<b>Variables</b>	<b>Total</b>	<b>Percentage</b>
No. of Households	<b>80</b>	<b>8</b>	<b>3</b>	<b>91</b>	
<b>Sex</b>					
Female	<b>49</b>	<b>8</b>	<b>0</b>	<b>57</b>	<b>62.6</b>
Male	<b>32</b>	<b>0</b>	<b>2</b>	<b>34</b>	<b>37.4</b>
<b>Age group</b>					
20-29	<b>5</b>	<b>0</b>	<b>0</b>	<b>5</b>	<b>5.5</b>
30-39	<b>15</b>	<b>0</b>	<b>0</b>	<b>15</b>	<b>16.5</b>
40-49	<b>14</b>	<b>3</b>	<b>0</b>	<b>17</b>	<b>18.7</b>
50+	<b>47</b>	<b>5</b>	<b>2</b>	<b>54</b>	<b>59.3</b>
<b>Level of Education</b>					

Unknown	2	0	0	2	2.9
Primary	38	1		39	42.9
Secondary	43	1	0	44	48.4
University	5	0	1	6	6.6
<b>No. of Households</b>					
0-5	41	1	1	43	47.3
6-10	45	1		46	50.5
11-15	1			1	1
16-20	1			1	1

**Table 5.2: Characteristics of Participants (P.I.)**

<b>Variables</b>	<b>Mmuock Leteh</b>	<b>Dschang</b>	<b>Total</b>	<b>Percentage</b>
No. of personal interviews	24	3	27	100
<b>Sex</b>				
Female	8	0	8	29.6
Male	16	3	19	70.4
<b>Age group</b>				
20-29	3	0	3	11.1
30-39	8	0	8	29.6
40-49	5	0	5	18.5
50-59	5	2	7	25.9
60+	4	1	5	18.5
<b>Occupation</b>				
Farmer	24	0	24	88.9
Employee	0	3	3	11.1
Business/driver	2	0	2	7.4
<b>Marital status</b>				

Single	5	0	5	18.5
Married	19	3	22	81.5

Table one and two shows the data for both HHS and PI with the first column indicating variables, the second place of interviews, the third total number of participants and fourth percentage. In the data obtained from Household surveys about 5% were between the ages of 20-29 and 59% were above 50years old. Of those interviewed, about 48% had secondary and high school education, about 42% had primary education and only about 2% had an education that was unknown. The average family size ranges between 6-10 households (table 5.1). The findings portray that almost every participant had acquired a certain level of education and the household sizes are indicative of how large the family sizes are in a typical traditional Cameroonian society. About 89% of participants in PI were potato farmers, about 7% were potato farmers with other part-time activities like business and driving and about 11% were employed either with the NGO or with the local/municipal council. About 82% of participants were married.

### 5.3 Assessing the nature of Potato farming

As mentioned in chapter two, potato farming in Cameroon like many other African countries has become quite popular recently and ranked amongst the major food crops. Its cultivation in Cameroon is mostly done by women on smallholder farm sizes. Even though majority of those who participated in the study were men. The small-scale farm sizes ranged between 1-5 hectares, but most potato farmers own less than two hectares. It is mostly cultivated in the rainy season between the altitude of 1000 to 3000m above sea level. Although with irrigation it can be done all year round. Potato farming in Cameroon has been challenged by several problems among which is climate change (FAO, 2014; GIZ, 2019; Ngek et al., 2019). The study was able to identify two types of potato farming in the high lands of western Cameroon particularly in Leteh where most of the interviews were conducted: subsistence and intensive potato farming.

Subsistence farming generally refers to the type of farming where farmers grow crops mostly for family consumption although surpluses may be sold in the local markets while intensive farming is described as a system where high inputs, labour, and capital is applied on a small piece of land in order to get high yields (Tony, 2007; Bruntrap and Heidhues, 2002 in Ngek, 2018). The choice of the farming type here depends on a number of factors amongst which are institutional, socioeconomic as well as technical (FAO, 2009). Even though the findings indicate that both



subsistence and intensive potato farming is practiced in the Mmuock Leteh area, it is however argued that intensive agriculture including potato farming is not yet common in developing countries (Bruntrap and Heidhues, 2002; Garnette and Geofray 2012 in Ngek, 2018). Reflecting on the definition above we can agree to a certain extent since potato farming in the western highlands is mostly subsistence although most of what is produced is not only sold in the local market but to urban markets and neighboring countries. Even though majority of participants were subsistent farmers, the findings suggest that small-scale potato farmers in Cameroon especially in the study area are gradually shifting to intensive potato farming due to increased demand and the current policy of the ministry of agriculture that promotes intensive agriculture (MINADER, 2014; 2015 in Ngek, 2018). Nevertheless, intensification poses serious environmental concerns as heavy application of chemicals destroys the soil organic content thus a decline in organic carbon (Duncan, Osborne, Horton, and Sinclaire 2015 in Ngek, 2018).

During interviews, a few participants revealed that they now practice more of intensive potato farming and opined that the soil fertility declines faster and to meetup, they must apply more fertilizers and manure to enhance the soil quality. For example, Noradinho said, “I have to apply fertilizers twice in one season i.e., during planting and during mulching followed by a lot of spraying”. Basing on the current debate on sustainability, more conservation and sustainable agricultural methods could be encouraged rather than intensification which is catastrophic to the environment. In a bid to assess the impacts and adaptation strategies of climate change on small-scale potato farming, I have chosen to look at how it was practiced before and how it is being practiced now to understand what has changed due to climate change and the responses to these changes.



Picture 5.1 Potato field on a good weather in M Leteh. Source: Leteh daily WhatsApp group 2022

### **5.3.1 How potato farming was practiced before**

The potato was first introduced in Cameroon by the colonial masters during the period of colonialism as discussed in chapter two. Prior to its introduction, it was first resisted by local farmers with fears that it was poisonous (Williams, 2007 in Ngek, 2018). Not much is known about potato cultivation in the study area prior to its introduction in the country but the results of the study show that when farmers finally embraced and started farming potato, its method of production was traditional and subsistence in nature just like other small-scale farming activities in the country although most farmers depended on them for a living. Most of the participants who have been cultivating potatoes for over 30 years asserted that potatoes were grown using traditional methods with rudimentary tools such as machetes, hoes, and sticks. Seeds were nursed and multiplied by the farmers themselves. This was done by selecting the bigger and smallest ones for marketing and consumption purposes and retaining the sizable (the size in between the smallest and bigger ones) ones as seeds. Labor was mainly done by household members and close friends. It was argued that the *raison d'être* for men getting married to many wives and giving birth to many children was to assist them in their farms (Hasselberg, 2017). However, high infant mortality was justified as the reason for large family sizes since there was low chance of children surviving before a certain age. Transport was done by head portage over long distances of several kilometers either

to the farms or from the farms to the markets.

In addition to this, they depended on nature and particularly on indigenous knowledge to produce their crops and not on artificial or chemical fertilizers and modern technology as is the case today. Jovet was quoted saying that: “my farms were cleared with machetes without spraying with chemicals (herbicides), big ridges were made using big hoes, seed planted, mulched, harvested, and crops transported by my wives, children, relatives, and friends by head to the market”

Comparing the past with the present, Noradihno shared his experience:

“40 years ago, we used to clear our fields with cutlasses or soften with hoes before tilling, after that, we gathered the grass and burnt it. After that, very big and vertical ridges were made. Planting and harvesting were done with hands or small, short cutlasses by a group of family members. The harvest was done and transported on the head to the market by my family and close friends on daily basis until everything was empty in the farm” In reference to the changes observed today because of climate change, he added that “most of the potatoes were not sprayed like today because of limited pests. We used our hands to pick up caterpillars because there were no insecticides here”.

In the same light, Gizeline said:

“In the past, we started the farming season by preparing and nursing the seed, collect manure from the pig fence and wood ash. Prepare the farm with hoes, plant these seeds with sticks and machetes, apply the manure and wood ash when the first rain falls. We also used our hands to pick caterpillars, and later sprayed the farms manually with buckets and branches of trees”.

In discussing how the product was marketed in the past, participants argued that:

“Harvesting and transportation to the market were done by my kids and I, products were exposed in 15 litre containers in a place for potatoes in the market and sold following the market price” (Gizeline)

“Selling was done only on market days. We used to put it in small buckets, placed it on the ground and buyers will come and negotiate prices. If the prices were not favorable, I would return home with my products,” (Ebongeh).

The majority of participants in the personal interviews alluded to the fact that the farming of Irish potatoes in the past depended on traditional methods i.e., from the preparation of the fields, seeds, planting, mulching, harvesting, and transportation to marketing. However, few people were able to use external laborers and equally transported their crops with hand trucks and few adaptable

vehicles that existed at that time. But then they depended so much on indigenous knowledge, nature, and traditional methods which permitted them to better understand and manage their farming activities, and to a certain extent the day-to-day environmental challenges. Ngek (2018) confirms this in his study on indigenous knowledge and local farming practices. Over the years a lot has changed, and they are improved ways of farming potatoes thanks to the modernization of agriculture although numerous environmental implications are bound to among which is climate change which has propelled some of these changes.



Picture 5.2 How seeds are nursed left, prepared and get ready for planting. Source: Fieldwork, 2021



Picture 5.3 Left, mulching and right, spraying of potato against blight using family labor. Source: fieldwork, 2021

### 5.3.2 How it is practiced today

Potato farming in the Western highlands particularly in the Mmuock Leteh production area from all indications has evolved. The practical evolution of potatoes farming is welcomed by farmers with mixed feelings. All the participants agreed to the fact that they no longer practiced potato farming the way they did a few decades back. They argued that everything has changed from the type of tools used to cultivate the farms to the seeds and the marketing process of the product i.e., the way the farms are prepared, the type of seeds and chemicals applied, mulched, sprayed, harvested, transported, and sold. During interviews, it was revealed that farmers are now able to use modern tools like tractors, knapsack sprayers, etc. Although only a limited number of farmers can have access to tractors since it is expensive, and the nature of the farm sizes too is major limitation. Also, farmers are now able to hire labor, use modern resistant and productive seed types. Although participants complaint that it is not productive to use these high yielding seeds twice or many times as it was the case before. Thus, they have to change the seeds more often than not. The products are transported to the market with the use of motobikes (locally known as ‘okada’) and four-wheel pick-ups, more farm-to-market roads (earth roads) have been constructed, and products are no longer transported and sold only in local marketsbut to urban markets and sometimes even in the farms.

In addition, the pricing and packaging system has changed with a great improvement thanks to the village council, farmer's Common Initiative Groups and Farmers' Cooperative Society present in the study area although most farmers are still reluctant to join. On the negative side of it, participants lamented that they need more capital than ever before to produce potatoes as the prices of inputs (fertilizers, fowl manure, fungicides, pesticides, and insecticides) have skyrocketed and they lack the necessary technology. Additionally, farmers must apply a lot of fertilizers as much as twice per season, spray their potatofields for uncountable times against blight and pests before they can even think of a good harvest. Also, more water is required for irrigation (increase demand for already scarce water). Similarly, the new seeds were noted to be very scarce and at the same time expensive since the farmers cannot produce it themselves as opposed to the old seed types locally called 'mabekeng', 'dorsal', 'cipiral' etc that were easy to nurse and multiply by the farmers themselves. Discussing how the potato was cultivated before and what obtains now, Noradihno said: "I apply fertilizers twice and mulch my farm twice before the end of the season, I also have to spray the potato when it grows many times before it is ready and have to change the seeds after using it for the second time" He went further and added that "with modern technology, it is possible to use tractors in our farms now although I have never used it."

Summarily, potato farming in the western highland via the case study of the Mmuock Leteh area and environs witnessed a lot of changes in the whole production process with more farmers gradually engaging in intensive potato farming. The majority of the participants pointed to those changes (like high application of chemicals and high use of water through irrigation channels to high and recurrent variation in weather and climatic conditions) as the main cause of an increase to the cost of farming.



Picture 5.4 Left, Hilux truck and middle 'Okada' transporting crops and right a villager loading potato in bags to be transported by standby lorry to urban markets. Source: Fieldwork, 2021

**5.4 Changes observed by small scale potato farmers**

Describing the changes observed according to participants experiences and their dynamism in the field, it was observed that:

“Farmers generally get up as early as 5am prepare and get farm tools ready, pack their food, and embark on the farming journey which takes approximately 45minutes to 1hour 30minutes to get to far off farms. Breast feeding mothers could be seen with babies on their backs alongside packed lunch walking with a lot of determination and hope to their various farms. Others could be seen with loads of bags on their heads probably inputs or those returning from the early morning farms. Motor bikes and pickup trucks could also be seen transporting products from and to the farms Lastly, labourers were seen in market square preparing and packaging potatoes in bags of 100kg ordered by intermediary traders (locally known as 'buyam sellam') and lorries were spotted loading and transporting for urban markets and neighboring countries” (field assistant). See picture 5.4

Flashing back to the experiences shared by participants in the previous sections on how potatoes were grown in the study area, few years back we can come to terms that a lot has changed since the crop was introduced in the country. During personal interviews with potato farmers in

study area, all the participants reported the following as common changes observed:

- Increased tilling of the soils
- Potato is grown all year round with irrigation availability
- High use of modern seeds and frequent changing of these seeds
- Increase application of fertilizers and other agrochemicals
- Increase incidents of blight and pests
- Transportation by moto bikes and vehicles
- Mulching of crops twice per season
- Increase prices of inputs
- Increase use of water for irrigation
- Changes in planting date
- Late start and decline in rainfall
- High weather variation
- Increase sunshine/temperatures
- Increased scarcity of water

From small scale potato farmers observations, a lot of changes have taken place in their farming practices even though from a critical point of view all these changes are not only related to climate change, but the literature has however demonstrated beyond reasoning doubt that climate change is real and has caused untold damage to agriculture and it is responsible for most of these changes (Collier et al., 2008; Yaro and Hasselberg, 2016; Ngoe et al., 2019; IPCC, 2022). The changes observed by potato farmers in the study area, have also been observed in other regions of the world particularly Africa and attributions directed to climate change as discussed in the literature chapter (cf. chapter2). The impacts of these changes observed could be attributed to the high vulnerability of farmers to climate change due to socio-economic inequalities, notably the lack of education on climate change, necessary resources, and the capacity to adapt (Adger, 2006; Azong et al., 2018, IPCC, 2019; 2022).



## **5.5 Method of Land Acquisition**

This section is mainly to demonstrate if land acquisition methods do influence adaptation choices. According to Mngumi (2016) in his thesis, land constitutes one of the most important resources for rural livelihood since rural dwellers depend on it for survival as its ownership describes the wealth and status of the family. This could also be true with climate change adaptation choices and degree of adaptation as the perceived method of land acquisition and level of farmland tenure security significantly influence farmers' adaptive responses (Akugre et al., 2021). The findings show that farmers in Mmuock Leteh acquired and owned farmland through inheritance channels, purchase, and rent (lease). Here, participants who were women revealed that they only acquired land through purchase, rent and gifts from their husbands and other relatives as well since the land inheritance rights of the community do not favor them (see Hasselberg, 2017:50). Only a few men interviewed revealed that they acquired land through purchase and rent as the land inheritance rights are in favor of men. This study assumes that land acquisition method has a strong influence on farmers' adaptation choices. However, the study could not examine the land tenure system and why it favors men than women.

## **5.6 Potato Farmers Perception and Understanding of Climate Change**

This section dwells on the knowledge and experiences of small-scale potato farmers to climate change. It, therefore, presents their perceptions and understanding of the concept of climate change. Participants during interviews demonstrated a good knowledge of the concept of climate change through their perceptions and responses. The findings portray that the participants perceived and understood climate change differently i.e., from their responses to the definition, causes and impacts. Even though their responses showed that they perceived and experienced climate change differently, the results revealed that all participants have experienced some degree of climate change impacts on their potato farming. About 90% of participants in both in-depth interviews and household surveys demonstrated a good knowledge and understanding of climate change notably via what could be described as the causes and perceived effects on their farming activities. While some participants first started by attributing it to prolonged periods of dry season, late start of the

rainy season, increase temperatures intensity, sunshine, and high variation in rainfall. Others demonstrated their knowledge of climate change by first defining climate change and then associating it to what they believe are the causes of climate change: deforestation, poor farming practices (e.g., high use of chemicals), industrial pollution, bush fires, ozone destruction etc. In a nutshell, an increase in the number of days of sunshine, intense and unexpected rainfall was reoccurring in participants responses.

Some participants associated climate change and the causes to the sacrilege and non-sanctification of their gods through continuous disrespect of traditional norms and institutions which they believe are the makers and protector of the people and their land. As a consequent the gods can no longer protect humanity but rather chose to punish them with climate change. Only a few participants, about 10% of respondents were unclear about their understanding of climate change but related it to culture and/or religion. For instance, Marianna argued that it is caused by the “abomination on our land that makes the gods and our ancestors angry”. Jovet also related the cause of climate change to religion and argued that it is caused by “man’s disrespect of nature, traditional norms of the land which makes the gods to be angry and unleash his wrath on man via climate change”. Relating climate change and its causes to religion may hinder or make adaptation to define or set measures difficult. The results further revealed that participants who have been in potato farming for more than 10 years had a high knowledge and experience of climate change. This high understanding of climate change amongst potato farmers maybe a clear indication of the significance of climate change impacts on their activities and the need for adaptation. Could this high knowledge of climate change amongst participants be regarded as proof that the government and private actor’s sensitization and awareness campaign channels are working to their best to educate farmers on climate change? this will be answered and elaborated in chapter 6. The next section shall continue with the perceived impacts of climate change by small-scale potato farmers.



Picture 5.5: A typical family shrine in Mmuock-Leteh where family member/villagers go to worship, offer sacrifices, speak, and get connected with their gods and ancestors Source: Wikipedia, 2022

## 5.7 Perceived Impacts of Climate change

As previously discussed, participants were conversant with climate change expressed via their understanding and perception of its indicators. This undoubtedly showed that farmers are gradually becoming more conscious of climate change and its impacts on their farming activities.

The result of the study demonstrated that the majority of the participants interviewed cited variation in days and months of dry and rainy seasons, increased incidents of wind and torrential rainfall, a decline in rainfall, weather variability, increase incident of pests and blight, shortage of water, shorter planting time, delayed germination or growth of seeds in the ground and wilting of crops, increased temperatures and dryness of farmlands as indicators of climate change in their community. The heads of households surveyed also highly alluded to variation in months of rainy and dry seasons, changes in the number and length of dry and rainy days, and a decline in rainfall. The participants during the discussions lamented and cited some of the above indicators as major challenges to potato farming. These local indicators were of course enough proof that climate

change had serious impacts on their livelihoods. The findings also shows that climate change is real and affecting small scale potato farmers. Research participants perceived climate change impacts based on the experiences they have had throughout their numerous years of potato cultivation. The following were perceived as impacts of climate change on potato farming: Fall in productivity, yield and income of farmers, increased incident of blight and pests, shortage of water for irrigation, high erosion, increased migration, increased cost of production, and high application of chemicals

Participants related the fall in productivity and yield of potato as an impact of climate change. Almost all the participants in the household surveys and personal interviews identified increasing temperatures and variation in rainfall patterns as the main indicators of climate change which were directly related to the fall in productivity, yield, and quality of Irish potato production in the study area. This implies that, frequent changes in climatic conditions have significant consequences on Irish potato farming (Bulu and Nimfa, 2017). In this respect, rising temperatures and changes in temperatures patterns have direct effects on crop yields as well as indirect effects through changes in irrigation water availability (IFPRI, 2009). Potato farmers just like other farmers are therefore compelled to apply new farming techniques and inputs adaptable to the prevailing climatic conditions. Thus, making the cultivation of potato quite demanding as it requires more investment than before likewise other farming activities (Molua, 2011). Participants lamented that there was a general fall in yields as the output was not commensurate to the cost of production. Nirkatan said: “I spent more on potato production, yet little is obtained from it, I may quit if things don’t change”. About 95% of respondent’s complaint that despite the high spending, they had a fall in production that is a fall in quantity and quality of their products as the late start of rains delays germination and growth of seeds, dead and wilting of already growing seeds. For instance, participants like Nirkatan, Jordan and Sangeh argued that:

“Climate change delays growth of seeds in the soil, causes crops to wilt, frequent appearance of pest and diseases including those we have never seen before this makes us to over spray the potato, which is very costly, but we are neither sure of a good output nor good quality of harvest”.

In addition, participants also associated the multiplication of blight and the appearance of some unknown types of pests and potato diseases to have added more cost and work to them through constant spraying as an indicator/impact of climate. In an attempt to fight against it, farmers have to increase their spraying capacity through the application of fungicides and pesticides particularly

for those who have the means. The high application of pesticides and fungicides tends to affect the quality of the products. However, only a few farmers who were practicing intensive potato farming could satisfactorily corroborate that they had higher output/returns after investing more on modern techniques and adaptable inputs (resistant seeds and agrochemicals). Elvarine one of the participants asserted that:

“In addition to the new seeds I buy every season, I apply more fertilizers, manure, and other chemicals to protect the potato. I spray my farm about twice a week in times of high rainfall.....with all these I am sure of a higher output”

Another impact of climate change on small scale potato farmers was a fall in income. A fall in income according to participants was directly linked to fall in productivity and yield. Participants associated a fall in their income to increase spending on production due to increase prices of inputs yet low productivity and yields however, this according to them depended on a particular farming season. For example, seasons of the year with longer dry season and erratic rainfall increases farmers expenditure and the consequent maybe be a fall in income as output may not compensate the cost of production. Participants voices can be complemented with the study of Molua (2011), who argued that climatic impacts were going to exacerbate the cost of food production in Cameroon. The increasingly felt impacts of climate change in the highland of western Cameroon contributed to an increase in the cost of farming and relative fall in yield. This has affected the incomes of farmers particularly that of Irish potato farmers. Consequently, forcing some of the farmers out of activity and subsequent migration to the cities and becoming ‘okada’ riders (motor bike riders) and petit business traders. The fall in the incomes of small-scale potato farmers also forced others to embrace mixed farming alongside petit businesses such as mobile money transfers, buying and selling of potato locally known as ‘buyam sellam’ etc., four out of the 26 respondents were practicing mixed farming alongside petit business and the justification given was that Irish potato cultivation became so expensive to grow such that they had to add other crops and small businesses that could survive them.

Water shortages was another reoccurring problem that emerges from the interviews. The shortage of water as a result of a decline in rainfall and prolonged period of the dry season which makes the soils to become dryer and the need for irrigation. Irrigation was almost impossible as there is a constant fall in the water table with all the streams appearing dried up. Majority of participants alluded to the increasingly drying up of streams as a strong indication of climate change and associated the water shortages as an impact of climate change. To these participants,

water shortages for the growth of potato through irrigation was a major concern as their crops are usually seen wilting when the streams become dry at the middle of the farming season. The shortage of water for irrigation due to climate change has also ignited the destruction of water catchments as these farmers go as far as searching water to irrigate their farms from the various water catchments. The increase in the number of sunny days and the period of the dry season or the fast approaching of the dry season according to participants come sometimes as early as Mid-October. This has pushed more farmers to go into the irrigation option to survive their crops through these changes in the study area. Since the streams are already drying up as a result of climate change, farmers have no choice than to encroach the water catchments for irrigation and freshwater purposes.



Picture 5.6: How water catchments are exploited for irrigation. Source: fieldwork 2021  
The First picture to the left showing farmer digging to increase the depth of water table, second and third pictures showing how tens of rubber pipes are being placed in water catchment to channel water to the plots with the use of canon pipes and fen plants to filter the dirt or mud from getting into the pipes.

Furthermore, participants also mentioned erosion as an impact of climate change and attributed the poor soil fertility and high degradation of farm to market roads to erosion. In sharing their opinions and understandings of climate change impacts on potato farming, they narrated that the erratic and torrential rains which falls sometimes unexpectedly for quite a long-time wash away the roads and fertility of the soil. One of the participants emphasized that when the rains fall heavily for a long time, they overflow the furrows and wash away the topsoil including the planted seeds

and fertilizers. In this regard only pickup trucks can manage to access some of the farms during good weather conditions. As a result of the reoccurring erosion, farmers are obliged to apply more manure and fertilizers to enhance the soils without which you are only going to labor in vain. Molua (2011) also found increased soil erosion and nutrient depletion to be associated with climatic variability which possess a threat to food security and the sustainability of agricultural production in parts of sub-Saharan African. Faced with these impacts participants narrated that they have developed multiply ways to cope with the looming changes observed in their day-to-day activities.

# **Chapter 6: Adaptation Strategies of Small-scale Potato Farmers to Climate Change**

## **1.1 Introduction**

Since climate change is something that happens gradually and its impacts become felt and severe after a long period of time, small-scale potato farmers in the Western highlands like their counterparts in other parts of the world have been experiencing and gradually responding (through the modification of farming practices) to the changes observed at each level of their farming activities. The farmers have over the years developed adaptation strategies alongside those prescribed by the government to aid reduce the impacts of climate change on their farming activities. However, some of these strategies are simple improvements in the existing farming practices to meet up with the reality of current environmental changes. This chapter focuses on the findings pertaining to response strategies adopted by small scale potato farmers to meet up with the challenges imposed by climate change. The chapter begins with the presentation, analyses and discussion of adaptation strategies adopted by small scale potato farmers to scale down the impacts of climate change and meet up with the changes observed in the farming practices, it critically assesses the government's role in ensuring effective implementation of adaptation and conclusion.

## **1.2 Adaptation strategies of small-scale Potato farmers**

The current and projected situation of climate change is enough reason for researchers to have recognised and continue to reiterate that climate change is a societal, ecological as well as socio-economic threat (Collier et al., 2008; Bate et al., 2019; IPCC, 2022). And the paradigm shift has been how to cut down emissions, mitigate and adapt the different systems particularly the agricultural system to climate change. According to Mngumi (2016:185), the current situation of climate change has forced farmers to change some of their farming practices in order to cope with the ever-changing conditions. In this regard, the impacts of climate change experienced over the years by farmers especially potato farmers, compelled them to change their farming practices to cope with the alarming environmental changes. Some of the frequently cited coping strategies by participants during interviews are shown in table 6.1. The findings indicated that participants



referred to irrigation, change of seeds, high application of agrochemicals and planting dates as the most applicable strategies in the study area. The majority of participants in the surveys also agreed that they have changed the seed types, planting dates and are increasingly applying the irrigation option during drier periods and in the dry season (see table 6.2).

Table 6:1: Adaptation strategies cited by participants during personal interviews

<b>Adaptation strategies</b>	<b>No. of Participants</b>	<b>Percentage (%)</b>
Changes in planting dates and times	25	92.6
Increased use of irrigation during drier periods	19	70.4
Spray the crops regularly to prevent blight and pests	22	81.5
Change to modern hybrid seeds that are drought resistant	17	63
Make horizontal ridges to control erosion	15	55.6
Pray and depend on the grace of God for adaptation	6	22.2
Apply special fertilizers that can retain water	5	18.5
Switch to marshy/wetlands during drier periods	4	14.8
Reduce the number of farms cultivated.	3	11.1
Abstain or break on farming and switch to business.	3	11.1
Depend on nature for survival	3	11.1

Table 6:2: Frequency of adaptation strategies in Household surveyed

<b>Adaptation strategies</b>	<b>Frequency</b>	<b>Percentage (%)</b>
Changed of seed types to modern seed	78	85.7

Changes in planting dates	78	85.7
Using irrigation in drier periods	69	75.8
Consulting the gods of the land	30	33
Inter cropping	18	19.8
Crop rotation	18	19.8

Table 6.1 shows the adaptation strategies, number of participants and percentage of application of measures in descending order and table 6.2 depicts the frequency and percentage of adaptation strategies

### 6.2.1 Changes in planting date

The majority of participants in the interviews highly agreed that they have changed the planting dates as a strategy to adapt to the impacts of climate change i.e., about 93% of participants in personal-in-depth interviews and 86% of households surveyed. During interviews, most of the participants stated that they have changed their planting dates and no longer follow the traditional planting time and dates as was the case before given the high variation in rainfall patterns and period of the year. Participants further argued that the variation in climate has distorted the traditional planting season that begins in March with serious planting of potato seeds when the first rains fall or are expected to fall. According to the research participants, the experience of the first rains was a signal that the planting season has begun, and you could see every farmer busily planting but nowadays no one is sure of when the first rains are going to fall. In this regard, most farmers just anticipate and either plant their seeds with the aid of irrigation until the rains start or plant at any time before or after March with the hope that rain can surprise them and fall at any time. Jabatta one of the participants during interviews explained:

“I don’t have a particular time to plant my crops since the weather has become unpredictable, what I do nowadays is that I commence planting immediately my farm materials are ready, especially the seeds and fertilizers, but I sometimes apply irrigation or use heat/drought-resistant seeds if I have the means”.

The findings of this study indicate that farmers have changed their planting dates to planting at any time or plant crops when they project the rains are going to fall. Another category of farmers plant

when they feel convinced that seeds can adapt to the high variability in climatic conditions that have either caused seeds to get bad in the ground when planted due to high temperature and prolonged dry period or plants are forced to dry up or wilt when there is no water or rain for the potato to grow and mature. Different studies in Africa and other parts of the world also found change of sowing time and date as an adaptation means to the resilience of climate change impacts (Mngumi, 2016; Nkengla-Asi et al., 2017; Maho et al., 2019; Adesina and Thomas, 2020) Noteworthy, the planting and harvesting of potatoes take place in the study area particularly in Leteh at any time of the year as opposed to traditional two times per year wherein, it was only possible to plant following the two seasons of the year. However, participants complaint that despite the fact that they have changed their planting dates following their own personal calendars and not the official agricultural calendar, they are not guaranteed a good harvest due to the high variability in rainfall and temperature.

### **6.2.2 Change of seed types**

The frequent change of seed types has become a normal phenomenon for small scale potato farmers in the Mmuock Leteh agricultural hub as opposed to what obtains a decade ago. Based on the data obtained from fieldwork, majority of farmers have abandoned the old potato seeds commonly known in Mmuock Leteh as “mabekeang”, “cipiral” “mou mbie” etc. that were highly used in the last two decades to new and more productive hybrid seeds locally known as “wozang” “nkemesob” “africana” etc. According to some of these farmers, these new breeds are resistant and could withstand high adversities from climate change. Although I couldn’t corroborate this assertion with Agricultural Research Centre (IRAD) and how these new varieties stated above are related to those from central Europe such as “Marabel, Jelly, Juwel, Bavapom, Sevim and Kronen with a short growth period of 90 days, high yield potential and resistant to diseases” (GIZ, 2019). About 86% of participants in the in-depth interviews and 63% of households surveyed agreed to the fact that they have regularly changed from the old seed types to new and modern seed types to adapt to the changing climate in anticipation of a better harvest. One of the participants stated that the old seeds are no longer productive and additionally, you can’t use the seeds many times given that the modern seeds are easily destroyed by high heat/sun and rainfall in the nursing and multiplication process. Thus, they are forced to change the seeds as regular as possible. Moreover, the heavy application of agrochemicals on potatoes was also cited by participants as one of the

reasons why seeds easily get rotten and can't be used many times. It was also observed that the high variability in rainfall and temperature especially in the case of heavy and prolonged periods of rainfall accompanied by high temperatures of a certain degrees may cause some seed types e.g., "africana" to sprout and flowers develop faster making the potato tubers to form immaturity and the consequent is poor harvest in the rainy season but does well in the dry season due to limited water in the ground or when the farmer has the possibility to control the wetness of the farm via irrigation. Maho et al. (2019) found out that high temperatures above 30°C during tuber formation especially at night leads to "ecological degeneration" and the consequent is a decrease in quantity and quality of production. However, this was not based on a particular seed type. Well, for proper adaptation to occur, it is advised that a broad context-based solution should be developed on a national level in collaboration with CIP wherein the production of site-adapted resistant seed varieties must be supported (GIZ, 2019:32).

However, the findings portray that most potato farmers adapt to climate change by regularly changing their seeds to new hybrid seeds believe to be more productive and resistant to adversities while hoping for a better harvest in the following season. Nevertheless, participants complaint that despite their steadfastness and willingness to change their potato seeds as regularly as possible to adapt to climate change, they face difficulties having access to these new seeds given the exorbitant prices and the distance covered to acquire the seeds in the production centers like the Agricultural Research Centre (IRAD). Participants revealed that the problem of accessibility was further aggravated by the armed conflict in the Anglophone regions and the covid19 crisis which limited the movement of people. Frequent change of seeds however increases farmers cost of farming likewise their incomes.

### **6.2.3 Irrigation**

The use of irrigation for potato farming was reported by participants as one of the most important inputs to them not only for climate change adaptation but as an essential resource for agriculture in their community. Given the importance of irrigation, this study assessed the use of irrigation as an adaptation strategy to the impacts of climate change and findings shows that majority of farmers that is about 76% of households surveyed agreed to the fact that the irrigation option was used to adapt to climate change in response to a decline in rainfall and prolongation in the dry season or when the rains go earlier than expected. On the other hand, about 70% of participants in the

personal in-depth interviews also associated the increasing use of irrigation as a way to respond to the changing climate. Most of the participants argued that they are increasingly experiencing a high variation in the dry and rainy season with persistent decline and late start of rainfall and a sharp increase in the days and months of the dry season. This variation has compelled potato farmers in Mmuock Leteh and environs to go the extra mile in search of water for irrigation. Making a retrospect of how regular potatoes were grown per year, we see that it was traditionally grown twice a year (at the beginning of the rainy season in March and towards the end of the rainy season beginning in mid-August) but most participants reported that with the help of irrigation it can be grown at any time of the year given the fluctuations in rainfall and temperature. Some participants opined that they use irrigation to either plant their seeds or water their crops when there is a late start of rains and an early start of the dry season. For instance, Jabatta said: “I start planting when the planting season is approaching and use irrigation to grow the seeds especially when I project a late start of the rains to avoid seeds being damaged in the ground by the sun”. Given that proper water management is essential in potato farming, frequent irrigation in addition to addressing the issue of water shortages also reduces the occurrence of tuber malformation since the “critical period for water deficit is during tuber development” (FAO, 2009:54).

From field observations, plastic pipes and water sprinklers were spotted sprinkling on several potato fields. Farmers use an electric motor pump and plastic pipes to channel or canalize water from nearby or far-off streams to irrigate their potato fields using a locally made water sprinkler called “asaht” where it’s positioned and placed on the field and its position shifted every morning and evening (picture 6.1). It was also observed that most water catchments in the village have been invaded and destroyed, tens of pipes could be seen crisscrossing each other and injecting in a little watershed with a water table far below. When I sought to understand the mad rush for watersheds the only answer was that all the streams have dried up due to increase temperatures and secondly because of the increase demand of water for irrigation. The constant search of water in the highly elevated Leteh topography was in a bit to water potato fields and adapt to climate change has led to the over exploitation water catchments. This has contributed to the shortage of freshwater for domestic use in the village. However, the hilly nature of the study area makes irrigation quite difficult as participants did not hesitate to lament the difficulties, they go through to acquire irrigation materials like plastic pipes, pumps, etc. to transport water to their farms. Summarily, the results indicate that with the increasingly felt effects of climate change in this area, the majority of small-scale potato farmers are increasingly using irrigation as an adaption strategy,

but they risk getting out of business as water shortages are inevitable and there are no water reservoirs to supplement the water shortages.



Picture 6.1 Irrigating potato fields using different types of water sprinklers (asaht). Source: Fieldwork, 2021

#### 6.2.4 Regular Application of Agrochemicals

Agrochemicals here include pesticides, insecticides, and fungicides. As previously discussed, blight, pests, insects, and other diseases are quite common in the study area today but was not the case two decades ago (see Hasselberg, 2017). To respond to this, small scale potato farmers are said to have doubled their efforts in the application of agrochemicals notably fungicides, pesticides, and insecticides to counter the frequent attacks from early and late potato blight, pests, and insects. During fieldwork, farmers could be seen carrying sprayers on their backs. Others were also spotted applying fungicides and pesticides to the already sprouting and flowering potato fields. Participants reported that the unpredictability of the weather which sometimes favors too much rainfall or sun makes potato diseases, especially blight and pests more frequent and need constant treatment, as a result, they have to apply different types of agrochemicals as many times as possible. Noradinho a participant argued that:

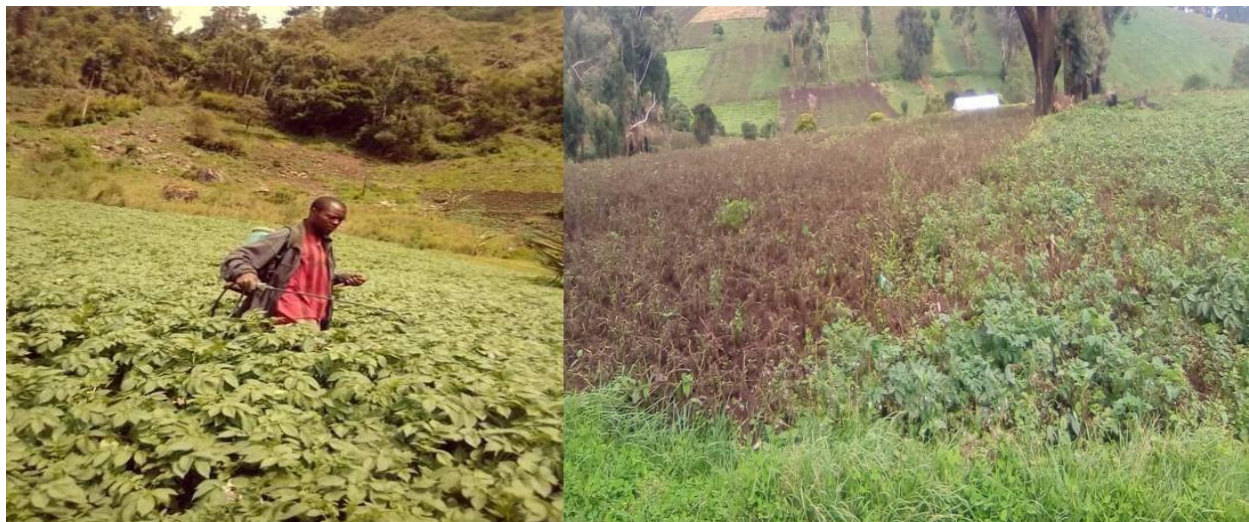
“Even though it is becoming very difficult for us to cultivate potato today because of blight from the new changes we see now, I manage to cope by spraying the potato many times per season i.e., about 2 to 4 times a week”

Another participant further argued that:

“Irish potato is so blight sensitive and the intensity has increased, and we are being told it is as a result of climate change. I adapt by spraying it against blight and other pests as many times as possible to survive ..... although I have back pain at the end” (Jovet).

The latter quote is in line with FAO argument that pesticides are widespread and intensely used in most developing countries to control late potato blight where in some countries farmers have to spray their potato fields more than 10 times during a single growing season of 4 to 6 months to combat this disease (FAO, 2009:54). Although the intensive use of fungicides may show some positive results, its natural efficiency is challenged by regular rains during the production season that may wash off the fungicide coating soon after application hence, improper use of agrochemicals in potato farming is a major threat to the environment as well as human health (GIZ, 2019; FAO, 2009). Therefore, “diseases tolerant varieties, healthy potato seed, appropriate crop rotation, suitable cropping periods and effective plant protection are thus vital for prevention of pests and diseases” rather than intense application of such agrochemicals (GIZ, 2019:5).

The findings, therefore, portray that the potato farmers have more than doubled their capacity in the application of agrochemicals (e.g., pesticides and fungicides) to protect their potato crops and manage the impacts of the increased occurrence of blight, pests, and other potato diseases. However, the erratic nature of rainfall remains problematic to small scale potato farmers as they are not often sure of the amount and how long they have to apply these chemicals particularly fungicides and the repercussions of these chemicals on their health. It is even argued that smallholder farmers do not commonly use commercial pesticides, mainly due to its unavailability in local outlets (GIZ, 2019:5). But the issue is not its unavailability but the high prices since there are locally made types in the local markets.



Picture 6.2 Farmer spraying the potato field against blight with knapsack sprayer on his back and another field attacked and destroyed by blight. Source: fieldwork 2021

### **6.2.5 Horizontal Ridges**

The use of horizontal ridges to control soil erosion by farmers was one of the adaptation strategies reported by participants who stated that this permitted them to control soil erosion and nutrient loss which was a major threat to them as heavy rains were reported to often wash away the topsoil including some of the seeds planted and fertilizer applied, thereby rendering the soils infertile. During interviews, some participants reported that they have managed to control erosion by constructing big and small horizontal ridges as opposed to the big vertical ridges used in the past that were prone to erosion. One of the participants explained that they have to first clear or spray the field with chemicals to destroy the grass, plough the soil, followed by creating horizontal ridges and furrows using a small manual handmade hoe, seeds are planted in them, fertilizers/manure are applied and covered with the soil. Even though the use of horizontal ridges according to participants is effective in managing soil erosion it is capital and labor intensive as it requires more fertilizers, manure, and hired labor as in most cases the grass is burned or cleared, and residual taken away before ploughing the land. Although some participants noted that they no longer burn or cleared away the grass as they are becoming aware of the importance of the grass residuals to the fertility of the soil.

Furthermore, field observations also captured potato fields with both the big and small horizontal ridges in the hilly landscape of the study area thus, this could be an effective way for farmers to control soil erosion in areas that are relatively hilly and prone to runoffs from heavy rainfall. This practice could be reflected in the traditional terrace and contour farming practice which is known for reducing and controlling soil erosion hence increasing soil fertility (Gebremedhin et al., 1999 in Mngumi, 2016:194).





Picture 6.3 Smaller size adaptable horizontal ridges with empty vertical lines for rainwater to flow down.  
Source fieldwork 2021

### 6.2.6 Application of special Fertilizers

The application of chemical fertilizers is a common practice to potato farmers but its application in the last decade has increased. Farmers apply different types of fertilizers from different fertilizer companies (*sam-sam*, *sam-sam complex*, *Yara*, *Adle*, *Urea*) for different purposes. However, some participants during interviews reported that special fertilizers like Urea are used as one of the strategies to adapt to the impacts of climate change, especially that which is related to the dryness of the soil. One of the participants said they apply special fertilizers like “urea” to plant seeds at the beginning of the planting season in spring and mulching towards the end of Autumn especially when the soils appear very dry maybe because of the late start of the rainy season in spring and early start of the dry season by the end of autumn. According to this participant, he believes that this special fertilizer retains more liquid than other types and may enable the seeds to germinate with ease when the soils are relatively dry and may equally boost productivity when applied during mulching towards the start of the dry season. Nonetheless, Urea ( $\text{CO}(\text{NH}_2)_2$ ) is argued to be one of the most commonly used nitrogen (N) fertilizer. The high N content per unit material (46%), lower cost, eases storage, alongside solid and liquid formulation options make it a popular choice for farmers (Gardinier et al., 2013). Moreover, the time of application matters thus, Urea should not be applied on saturated soils, and when temperatures are low with a possibility of a kind of high rainfall as higher levels of rainfall can result in additional N loss (Gardinier et al., 2013).

The study also observed a high application of chemical fertilizers and fowl manure by small-scale potato farmers as a means to enhance the growth of seeds, soil fertility, and boost

productivity. The high application of chemical fertilizers was corroborated as a coping mechanism to the effects of climate change emanating from erosion, erratic rainfall, and increase dryness of the land. It is argued by GIZ that fertilization has somewhat mainly relied on high-cost mineral fertilizers in the last decades. Even though their use shows some positive results in terms of yields, a significant portion of the nutrients are lost through leaching and erosion. In addition to this, organic fertilizers like chicken droppings are also highly used in the western highland zone of Cameroon. However, its price increases every year because of high demand and limited supply. (GIZ, 2019).

### **6.2.7 Inter cropping and crop rotation**

Inter cropping here has to do with the simultaneous growing of selected varieties of crops alongside Irish potato on the same piece of land during the same season. The findings show that some farmers practiced inter cropping as a means to manage the impacts of climate change. About 20% of participants in the households surveyed agreed to the fact that they practiced the mixing of crops as an adaptation strategy to the impacts of climate change. Interviews and field observations portray that while some farmers grow potatoes together with maize and beans others grow it with cabbages, but a greater majority of the people practiced monoculture. Crops like maize with a height taller than the potato were planted at intervals spacious enough not to shade the potatoes and other crops like cabbages, beans etc., with the same height as potatoes are planted side by side the potatoes. However, only few farmers do practice intercropping due to the fact that potato is characterized by low tuber formation when shaded by taller crops thus, majority of farmers especially medium scale farmers prefer monoculture. Using indigenous knowledge, participants believe that mixing different crops with potato could limit the growth of some potato bacteria which might have gotten used to the crop (e.g., potato) by planting different crops alongside potato, improve soil fertility and performance through plant foliage as opposed to monoculture which is less beneficial. Nkengla-Asi et al. (2017) found out that farmers through indigenous knowledge mixed perennial crops like cassava with leguminous crops like beans, pumpkins, and sweet potato with the notion of enriching the soils with their leaves. Additionally, Mngumi (2016:203) discusses how mixed cropping benefits rural farmers in different ways: balancing soil nutrients, inputs, and output, lowering the rate of weed growth, minimizing the catastrophic effects of insects, pests, crop disease, and resisting climate extremes.

### **6.2.8 Crop rotation**

The study also attempted to assess if potato farmers were practicing crop rotation as an adaptation strategy to the impacts of climate change and the findings indicated that about 20% of participants were practicing crop rotation to counteract and limit the multiplication of pests and diseases and enhance the soil quality. Farmers practiced crop rotation with crops like maize, beans, carrot, leeks, cabbages, garlicks etc. One of the participants during interviews reported that he practiced crop rotation whenever potato easily wilt and get rotten in the ground, and he suspects there may be a possibility of the soil been contaminated by chemicals used and certain types of soil diseases. He will either plant maize, carrot, beans, or cabbages for about one or two seasons before going back to potato depending on the size and location of the plot. According to FAO (2009:26), rotation can contribute enormously to the “fertilization of the following crop, to the maintenance of soil fertility, and to the control of soil-borne pests, diseases, and weeds”. However, this will only depend on the manner which crops are arranged i.e., “grouping of crops based on nutrient needs. It can be grouped based on their nitrogen (or nutrient) demand, distinguishing heavy feeders, moderate feeders, and fertility builders” (FAO, 2009:26).

### **6.2.9 Reduction in Farm Size**

The findings showed that participants perceived farm size as a major determinant to productivity and adaptation to climate change. Some participants during interviews reported a reduction in the number of plots or farm sizes as one of the strategies that could enable small-scale farmers adapt to the current environmental changes particularly the changing climate. They revealed that the impacts of climate change have rendered cultivating potatoes quite difficult and expensive due to the stress from applying the different coping mechanisms and the increase in the prices of inputs. A reduction in farm size was perceived by participants as a way to permit them have control and manage the one cultivated. Given the expensive nature and difficulties encountered in acquiring the high-cost climate adaptable inputs e.g., water and irrigation materials, some farmers decided to reduce the number of plots or farm sizes they used to cultivate before to allow them to maximize the available resources and direct its focus on a limited plot. The study observed that a lot of farmers had reduced the number of plots they cultivated before and either rented part to other farmers or allow them to

follow. According to some participants, reduced farm sizes and or a limited number of plots allow them the opportunity to better manage their potato farms and were able to have a good harvest. For instance, Rosette one of the participants was a bit reticent but revealed that:

“Hmmmm only the able cultivate Irish potato nowadays..... anyways I adapt to the change we see now by reducing either the size or number of farms I used to cultivate before to have better control over the ones cultivated. This makes the others to rest before going back to them later”

Another participant also supported a reduced farm size as response strategy arguing that:

“When you reduce the number or size of farms you can better manage it and in the end get something better from it than cultivating a large or many plots with not enough capital to manage it. That is how I try to cope in my own way” (Vivianna)

Since the tendency is that land productivity declines with farm size, reduced farm sizes may be a realistic strategy for small scale potato farmers to adapt to the changing climate in order to concentrate the available resources on a limited farm size for better results, especially in cases where they have limited access to capital. However, smaller farms are based on more intense use of family labor, because of its higher efficiency and motivation than hired labor, and the fact that the supply of working capital is related to farm size (Savastano and Pasquale, 2017). Nevertheless, reduced farm size may give the farmer the possibility to have control of what is cultivated but it is not a guarantee as frequent variation in climatic conditions is the main concern here. In addition, land productivity declines with farm size (Savastano and Pasquale, 2017).

#### **6.2.10 Depend on nature and God for adaptation**

A typical traditional African society still believes so much in attachment to societal values and nature for survival likewise in the situation of climate change. Participants particularly those above 60 years reported that they believe and depend on God and nature for adaptation that is consulting and invoking the gods of the land to protect their community and their farmlands against human evil on earth which according to them has made the gods to be angry thus, unleashing His anger to man in the form of climate change. Therefore, it is only by going back to appease the gods especially when there is either too much rainfall or longer periods of no rainfall accompany by severe sunshine that affects crops.

While participants who believe in traditional religion argued that in the past when there were

accumulated complaints of poor harvest due to bad weather conditions, and when it continuously get worse with accumulated complaints, traditional authorities in the village will assemble the chief priest to consult the gods of the land and perform rituals to appease them so as to reverse the situation and protect the land, others who belief in Christianity argued that they sow their seeds and pray to God. Although, this claim couldn't be scientifically substantiated, Andersson and Giller (2012) however, provides some justifications that believing on nature and God for adaptation can actually work through their research on conservation agriculture where 'Oldreive's' Faith-based approached to conservation agriculture was used in conjuncture with "Gods blanket" recommendations after haven prayed in the wilderness for a while (Andersson and Giller, 2012).

#### **6.2.11 Break on potato farming and switch to other sources of income**

In an attempt to adapt to the impacts of the changing climate, some participants during interviews stated that because of the current situation, they have to take a short break or stop potato cultivation for some time since it is no longer profitable to depend on it as a means of livelihood and move to other alternative sources of income for some time before coming back to it in future. About 11% of participants in the interviews indicated that they had to change or plan to change to alternative sources of income when yields continue to decline and are still projected to decline further. A prominent and outspoken farmer at the market square opined that he prefers to adapt by abstaining or taking a break:

"I adapt to the current situation by abstaining from potato farming when the harvest is bad because of potato diseases and blight attacks, especially when I project a poor harvest again in the next season since I may not have enough capital.....I move into business or something else to survive and may only return when things get better and must have gather enough capital" (Tankor).

Thus, providing an adequate cultivation break may help to control pest and disease build up in the soil, and to a certain extend control soil nutrient depletion (FAO, 2009:21).

Based on field observations, some farmers especially the youths were observed to have stopped farming and switch to other activities like petit trading or buying and selling of potatoes and other crops commonly known as "Buyan Sellam" either in the village or to urban centers. Given that farmers in the highlands of western Cameroon are increasingly becoming vulnerable to impacts of climate change due to the increase in the length and months of the dry season and erratic

rainfall which of course are unfavorable conditions to agriculture, especially to potato farming, many farmers specifically the youths are forced to go out of farming and move to urban centers with the hopes of getting a job or starting up a small business. Such hopes are often seen shattered upon arrival as there are no available jobs and a lack of capital or credit for start-up businesses. As a result, some end up in activities like ‘okada’ (motorbike riding). However, more and more small-scale farmers in Sub Sahara Africa are increasingly switching to non-agricultural activities as a resilient measure to climate change impacts (see Mngumi, 2016: 220).

### **6.3 The role of the Government in Promoting the Implementation of Adaptation Strategies**

The government of Cameroon through local authorities notably that of the Wabane Municipalities (where interviews took place) have been involved in some catchy activities first, to promote agriculture and sensitize the population of the study area on the impacts of climate change and the need for adaptation. In an attempt to promote agriculture and adaptation to climate change, the local authorities in the Wabane municipality engaged in campaigns and distribution of new hybrid seeds donate farm tools and inputs to farmers, subsidies inputs (agrochemicals) which according to some participants (who were beneficiaries) help them to adapt to climate change as it aided them in reducing the cost of farming. The assistance was done exclusively through campaign sessions, political meetings, municipal agropastoral shows and cooperative society. In addition to this the government equally sensitize the farmers on the protection and rehabilitation of water resources, encourage and promote the creation of agricultural groups (CIGs) and cooperative societies where farmers can easily receive assistance from the government and NGOs. Interviews with one of the deputy mayors of Wabane municipality in Dschang, the mayor revealed that the government is actively involved in promoting adaptation of farmers to climate change through the provision of assistance to farmers and through sensitization campaigns on best practices.

However, majority of participants in the interviews recognized the fact that government representatives have been coming around with assistance but a greater majority of them testified that they have never received anything from the authorities. Those who even managed to receive complaint that it is often too insignificant to their agricultural needs. Meanwhile those who managed to receive complaint that it was too little, others described it to be entangled with political manipulations and corrupt practices. In decrying the corrupt nature of government officials often

in charge of such assistance, participants reported that they are fun of organizing campaign sessions and presenting aid to the population, take pictures and show it to the public and the media and later return with it or store it for next time. For instance, Mariana said: “the government has organized sensitization meetings on the promotion of agriculture and adaptation, share farm tools and inputs to some farmers but it was too little and short lived”.

In order to describe and decry the corrupt nature of such assistance destined to farmers another participant also reported that:

“The government people are fun of coming here with meetings, gifts and aid but we never see when it is shared, we have the impression that they only bring show it to the population take pictures and return with or store it for next time” (Etombe).

Furthermore, the lone NGO worker interviewed also stated that they have been in the field prompting agriculture and sensitizing not only potato farmers on the impacts of climate change and the need for adaptation but all the farmers in Mmuock Leteh and other areas. In addition to the campaign and sensitization meetings, they also offer financial assistance and farming inputs to assist farmers adapt to climate change. One of the participants reported that he has been a beneficiary of financial aid and farming inputs from the NGO twice and it has helped him to continue potato production despite the challenges from climate change. However, the role of the state and other development partners like NGOs, using the lens of the ToC as suggested by (Bours et al., 2014 in Pringle and Thomas, 2019) is yet to be seen yield fruits in sensitizing, monitoring, and promoting climate change adaptation in the study area and the whole country.

In chapter two, I presented and discussed the engagement of the Cameroon government in the global and national fight against climate change which included a policy document spelled out in the National adaptation plan of action. The effective implementation of the policies in the document is sporadic and very slow. Through the lens of ToC as proposed by (Pringle and Thomas, 2019), the ineffective implementation of adaptation policies is essentially due to the lack of demarcated plan of action, monitoring, and evaluation means and the high corruptness of the authorities in charge of its implementation. Thus, the case of corruption and poor management of assistance to farmers reported by research participants in the Wabane municipality is not a surprise but just a tip of the iceberg compared to what happens to other sectors in the country. In this respect, majority of the small-scale farmers are often neglected by authorities and left to struggle on their own to cope and survive the impacts of climate change. In addition to this, local entrepreneurship is lacking not only in Cameroon but in many developing countries (FAO,

2009:17). This in addition to other challenges, account for the reasons why farmers particularly small-scale potato farmers are unable to compete and produce in large quantities to meet up with the local demand in the country (GIZ, 2019).

## **6.4 Conclusion**

From the above findings, analysis, and discussions, it is observed that small scale potato farmers have sufficiently employed different adaptation strategies, but they appeared to be far from being a success due to the challenges which have limited their adaptation efforts. Even though some of the adaptation measures according to the research participants have been practiced for quite a long time, they are only slightly sustainable given that, climate change has become more severe in the last 10 years according to their experiences. Given the increasing challenges imposed by the current and projected future changes in climate it is apparent that the above measures could be termed to be temporal if much is not done in a well-coordinated manner to accompany small-scale farmers in their effort to adapt to the current threat from climate change as most adaptation decisions and choices in this area are based on individual means and the government's role appears almost absent. Hence, if the above employed measures are not examined and setbacks experienced by these farmers addressed then there are high chances of maladaptation to occur. Revisiting the ToC presented in chapter 2, it could be useful here in monitoring and evaluating the outcome or impact indicators of adaptation strategies while identifying the challenges and spanning out a plan on how to address them. The chapter that follows focuses on the major challenges of adaptation encountered by small-scale potato farmers.



# Chapter 7: Challenges of Adaptation of Small-Scale Potato Farmers to Climate Change

## 7.1 Introduction

The current chapter presents the major limitations of small-scale potato farmers particularly those cited by participants during interviews in the study area. These limitations were both physical and socio-economic. No participant could barely speak without pointing to a kind of limitation to their farming activities and the capacity to cope with the current climatic conditions. Before presenting, analyzing, and discussing the limitations, let's consider defining limitation to adaptation as those conditions that render adaptation ineffective as a response to climate change (Adger et al., 2007). These limitations by nature depend on the values of a particular society and their vulnerabilities to the rates of climate change over time (Adger et al., 2007). In this chapter challenges, limitations and barriers are used interchangeably to mean the same thing.

Table 7.1: Summary of adaptation strategies, desired benefits, and barriers

<b>Adaptation Strategies</b>	<b>Desired Benefits</b>	<b>Barriers</b>
Change in planting dates	To adjust and meet up with variation in climatic conditions	High climate variability characterized by high uncertainty
Change of seed types	Modern high yield seeds varieties that can withstand current conditions and boost	High prices and seeds can't be used and reuse for

	productivity	long
Irrigation	Irrigate to avoid dryness and wilting of crops to increase productivity.	High scarcity of water, and high prices of irrigation materials
Regular use of agrochemicals	Combat potato blight, pest, and other diseases	Increase prices, heavy and erratic rainfall
Horizontal ridges	To control erosion	Capital and labour intensive (more inputs and labour)
High use of chemical fertilizers	Enhance growth of seeds in adverse conditions and boost productivity	High prices and erosion of fertilizers by rain
Intercropping and crop rotation	Reduce development of bacteria in the soil, improve soil fertility	Limited land, and capital to acquire land and inputs
Reduce the farm size/plots	Possibility to manage the limited plots cultivated	High climate variability and post-harvest losses
Depend on nature and God	Hoping that via prayers, sacrifice and nature protection God's mercy can turn things	No scientific bases as challenges are inevitable
Abstain or take a break from farming	To have alternative sources of income than just farming	Limited capital to grow business

## **7.2 Barriers of adaptation**

The participants during interviews did not hesitate to mention the different challenges that were facing them in their efforts to adapt to climate change. The barriers presented are global, national, as well as individual level. Table 7.1 summarizes the different adaptation strategies, desired benefits and barriers to the strategies adopted by small-scale potato farmers. The different barriers are presented, analyzed, and discussed in detail in the following section.

### **7.2.1 High climate variability**

The high climate variability and frequent poor weather forecast by farmers were frequently mentioned by participants as a major limitation to the effective application of adaptation measures. Variables such as erratic rainfall increased temperature and dryness and increased incidents of pests and diseases constituted participant's perception of climate variability as a major limitation to adaptation. Participants reported that the erratic nature of rainfall, high sunshine, and the prolonged or unexpected appearance of the dry season makes adaptation too difficult as farmers who depend on rain planted their crops in anticipation of the early start of the rains in March, but it ended up not been the case. In addition, the erratic nature of rainfall makes farmers to be unsure when to spray their crops against blight and other plant diseases. The high variability in climatic conditions makes small scale potato farmers become more vulnerable to the impacts of climate change as they are unsure of when to apply what measure. Other studies conducted in different parts of Africa have also perceived climate variability as a major limitation to the adaptation of farmers to climate change (Mngumi, 2016; Nkengla-Asi et al., 2017; Ngoe et al, 2019). Quoting from participant's opinions, Jordan opined that:

“Although we have changed seed types, planting dates and multiply the number of times we spray our crops against blight, pests and diseases to cope, we are not sure to succeed given the high changes that we observe occur every day...as we often expect rain to fall at a particular period and it may not and when it comes it falls unstoppable for a long while, the weather nowadays is so confusing and difficult to predict. This makes us very confuse”

Similarly, Vivianna also argued that:

“Hmmm the problem we have with adaptation is that the weather is very confusing these

days as we don't know when to expect the rains. Sometimes it starts and falls continuously and brings a lot of blight that is usually difficult to control. At times the sun also starts too early, and the crops may be forced to wilt and dry up just like this year that the sun started too early we don't know what will happen to the crops in the days ahead if the sun continues like this”.

Participants also perceived the shortage of water for irrigation as a fallout of high climate variability. According to them, the increased sunshine and prolonged period of the dry season contributed to the fast drying up of the streams as most farmers have embarked on the irrigation option to water their potato farms to adapt to the changing climate. According to the IPCC 2022), “the effectiveness of most water-related adaptation options to reduce projected risks declines with increasing warming”. Since potato is known to be a water thirsty crop (Adesina and Thomas, 2020), shortage of water becomes a major barrier to its growth.

The few available water points with apparent water scarcity due to increasing temperature and warming have thus, become a source of resource conflict for farmers as they compete over it to survive their crops. Farmers argued that they sometimes fight over water sources:

“Many water points have dried up leading to water scarcity and ensuing of fighting between farmers as others claim ownership of water sources that are located closer to their farms and may disconnect or removed the pipes of other farmers from the water to prevent them from exploiting it” (Tankor).

The unpredictability of the weather which compelled farmers to make the wrong weather forecasts and the continuous variability in climatic conditions constitute a major barrier to smallscale potato farmer's adaptation efforts to the impacts of climate change. However, these barriers also occur due to the high vulnerability in the study area which is first in terms of shocks of seasonality and second in socio-economic terms (Hautala, 2013).

### **7.2.2 Inadequate Financial Resources**

Capital is as important to an entrepreneur as well as it is to a farmer. During interviews majority of the participants did not go without mentioning the lack of the necessary financial resources to acquire adaptation materials (inputs) such as improved seed varieties, canon pipes for water transportation, chemical fertilizers, and other agrochemicals such as pesticides, insecticides, and fungicides which of course plunged them to an unsuccessful farming season. Despite the inadequate capital, participants also reported a high increase in the prices of these inputs

particularly fertilizers which have been worsened by the Russian invasion of Ukraine in February 2022. As a result of the difficulties faced by farmers in acquiring inputs, many of them anticipating a catastrophe (what the IPCC termed “soft limit”) in the next farming seasons. In addition to this, is the poor socio-economic status of farmers coupled with low prices of potatoes in the market which renders small-scale farmers highly vulnerable to the impacts of climate change. In this regard, limited financial resources and poverty amongst other things can also limit adaptation, leading to the IPCC “soft limits” of adaptation trajectory, thus, a disproportionate exposure of most vulnerable groups to climate change impacts (IPCC, 2022).

Participants explained that cultivating market gardening crops, particularly potatoes which is capital and labor intensive in such a hilly topography requires a lot of resources, especially in the case of irrigation as farmers have to traverse the hills to fetch water in far off places with the use of canon pipes which are quite expensive. The findings portrayed that the lack of capital is related to the poor socio-economic situation of farmers due to poor crop prices, limited access to credit facilities and little or no government assistance to assist farmers to meet up with the adaptation exigencies. Benicette had this to say about the measures: “The measures are good but need a lot of capital to improve upon it which we don't have”. The IPCC AR6 edition argues that financial constraints are important determinants to adaptation limits in what she terms “soft limits” to adaptation across all sectors and regions but further argues that current global financial flows from public and private sources are insufficient hence a constraint to the implementation of adaptation options, especially in developing countries even though global tracked climate finance has shown an upward trend since AR5 (UNEP, 202; IPCC, 2022).

### **7.2.3 The method of land acquisition**

The findings indicated that land tenure arrangements influenced farmer’s adaptation choices. Most participants especially women reported that limited access to land for the expansion of their farms was a major barrier to their adaptation efforts as the money meant to be invested in the acquisition of adaptable inputs like improved seeds, fertilizers, agrochemicals, and irrigation materials are instead used for the acquisition of land either through purchase or renting (leasing). This, therefore, reduces the farmer's capacity to adapt to climate change. Participants held the view that access to land is marred with inequalities since access to land is mainly restricted to family lineage and financial status that is either through inheritance or purchase. In the case of inheritance, it favors

mostly the male sex as it is a common culture in the study area and many parts of the country especially in English Cameroon (Fonjong et al., 2013 in Hasselberg, 2017). The land acquisition method thus becomes a major barrier to adaptation as participants complaint that they have to buy or rent land almost every farming season as soil fertility depletion has become a common phenomenon. Land tenure reforms are therefore necessary to ease access of small-scale farmers particularly women to land resources as land tenure arrangements which in most cases are defined by customary laws favors only the men (Nchu et al., 2019) thus, limited access to land remains a major constraint to agricultural productivity and adaptation.

#### **7.2.4 Post-harvest Problems**

“Postharvest” here indicates a sequence of activities and operations that proceed after the crop has been harvested (FAO, 2010 in Ngek, 2018). Post-harvest problems in the context of this study, are linked to the losses encountered after harvesting which may be on the farm or off the farm post-harvest losses. These postharvest losses are to a greater extent due to the prevailing climatic conditions, political atmosphere, market potential, transport, and socioeconomic development (World Bank, 2010 in Ngek 2018). According to some participants during interviews, the post-harvest losses were due to the bad state of farm-to-market roads, poor transportation systems, no storage facilities, excessive rainfall, and sunshine that makes preservation quite difficult. Among these, the problem of poor road infrastructure and lack of a potato functional storage facility was recurrent. The findings show that post-harvest losses were perceived by participants to be related to the uncoordinated actions of small-scale potato farmers in the production chain particularly the post-harvest chain. This is justified to be a consequent of the lack of effective farmer's cooperative societies and the unwillingness of the farmers to join the existing one which could go a long way to address some of these problems especially those related to postharvest losses which is a major challenge to farmers. Given that most of what is produced is often lost in the postharvest chain, it however reduces the incomes of farmers and resources for adaptation thus, negatively affecting farmers livelihood ad adaptation choices.

### **7.2.5 Lack of education and sensitization on adaptation**

The lack of education on good agricultural practices, limited information, and sensitization on climate change adaptation particularly in the potato sub-sector was mentioned severally by participants during in-depth interviews as a major barrier to adaptation. Participants shared the view that climate change was real through their experiences but there is a lack of a functional structure to educate and sensitise farmers on the strategies of climate change adaptation in their community. However, there exists an agricultural post in the study area, but most participants held the view that they don't even know there exist an agricultural post with an officer in the village and those who had a clue of its existence said they don't know the functions of such an agricultural post if it is unable to accompany them in coping with the current agricultural exigencies especially that of climate change. In addition, it was also reported by respondents that the few agricultural meetings organized by local NGOs and government authorities are occasional mostly once a year and those of the government representatives are political and more pronounced only during election campaigns. According to IPCC (2022), "the lack of climate literacy at all levels and limited availability of information and data pose further constraints to adaptation planning and implementation". Thus, the lack of training on good agricultural practices, limited knowledge, and access to information on improved seeds, modern technology, and looming environmental challenges constraint adaptation efforts.

### **7.2.6 Old age and stress**

Age was also mentioned as one of the limitations to the adaptation of small-scale potato farmers to climate change. The findings indicate that about 18.5% of participants in the study area were between the ages of 60 and above meaning therefore that age becomes a major determinant of certain types of agricultural practices and adaptation strategies since potato farming is labour intensive and demands a lot of attention from private individuals. For instance, potato adaptation strategies such as irrigation and manual spraying of the crop is labour intensive and require the constant and active involvement of the farmers. In this regard, the farmer must constantly go to the farm to change the position of the water sprinkler every morning and evening.

In the case of the fight against pests and diseases, notably early and late blight depending on the season, the farmers have to constantly carry the knapsack sprayer on their backs (picture 5.3 & 6.2) to spray the crop as many times as possible before maturity and harvesting. In these

circumstances, people of a certain age can't withstand the pressure and stressful nature of such adaptation strategies. This, therefore, constitutes a major challenge to the relatively aged farmers to adapt to climate change. Marie and Pius shared the same view on this: "it is quite stressful to get up every morning and walk to far off farms to change the position of the water sprinklers. In addition, old age is a big limitation as we the aged are no longer able to carry the sprayer on our backs, we only have to solicit for help which is not easy to get someone to help you". Thus, aged people believe and depend on natural factors and god for adaptation urging traditional authorities to act by appeasing the gods of the land to stop the climate crises.

### **7.2.7 Institutional weakness**

The successful application of a planned or spontaneous adaptation measure requires a well functional institution and significant material and human resources. In this light, the public and private institutions are responsible for the distribution of these resources as well as the different adaptation policies and legal instruments that facilitate the implementation of adaptation (Tani and Tumi, 2016, IPCC, 2019, 2022). In the situation where there is dysfunctionality, it becomes a major limitation to adaptation. In addition to institutional weakness is the issue of corruption. As described in chapter 3, the Cameroon government has created different structures in charge of climate change accompanied by decrees of applications, but they are weak and almost dysfunctional due to corruption and poor management. The resources allocated to accompany farmers in climate change adaptation often end up in the pockets of private individuals especially administrators and personnel incharge of those resources. It was reported during interviews by participants that it is common to see government representatives come around, but hardly have they received an expert or representative from the ministries concerned with specific climate change information e.g., information on climate change adaptation particularly on crops like potatoes which is their main source of livelihood. One of the participants was quoted saying that:

"Large quantities of aid are often announced to help farmers, but we don't know when and how it is shared but to our greatest dismay we only later turn on our TVs and radios or find out on social media that the government donated a huge amount of aid to support farmers in our communities"

It was also argued that the alleged politically stayed assistance from the government was often very little and irregular:



“Even some of us who are lucky to receive support from the government sometimes, I must say it is often very insignificant to help meet up with the challenges we face in farming presently,” (Jordan)

Even though the available institutions are weak, field observations signified that most farmers in the study area are not informed of which institutions are responsible for managing climate change affairs, this makes it difficult for them to channel their worries to the rightful quarters for assistance. Real or perceived deficiencies in access to the rightful institutions and resources can and do constrain adaptation efforts in both developing and developed nations (Antwi-Agyei et al., 2013 in Tani and Tumi, 2016; Shackleton et al., 2015; IPCC, 2019).

### **7.2.8 Cultural and Traditional Practices**

Highly conservative and protected cultural and traditional practices may go a long way to limit adaptation efforts especially when societal actors and natural systems interact (Tani and Tumi, 2016). The people of the Western Highlands of Cameroon (Grass landers) and that of Mmuock Leteh in particular are highly attached to their cultures and traditions to an extent that weekly holidays are designated for the observation of certain cultural practices. For instance, weekly holidays are observed wherein farmers are obliged to suspend farming activities for a whole day and even more in case of an important event in the village or in the case of the passing away of someone in the village where in most cases farming activities are somehow temporarily halted for the burial. Farming activities may also be suspended for days or weeks when the chief and other important notables pass away for cultural rights. Furthermore, there are cultural holidays like the village cleansing period and the “MULCUDA” annual congress cultural week where farming activities are suspended. These traditional holidays negatively affect small-scale farmer’s adaptation efforts, especially during critical periods of the farming season like sowing, weeding, mulching, application of agrochemicals, harvesting, and transportation. In addition to these holidays where farming activities are suspended, other unforeseen circumstances like ill-health, bereavements, and other celebrations increase the vulnerability of farmers to climate change (Tani and Tumi, 2016).

The high attachment to culture has gone a long way to influence the thought process of the people as some of the participants during in-depth interviews believed that climate change was from

God, and it is only through prayers and the offering of sacrifices to the gods of the land to appease them for a better farming season. “I sowed my seeds pray and depend on God for a successful season, it is only through His grace that we can cope now,” said Patrick.

### **7.2.9 Input price hike**

The high increase in the prices of important inputs like fertilizers, improved potato seeds, and other agrochemicals was recurrent during interviews as one of the main barriers to the adaptation of small-scale potato farmers to climate change in the study area. The steady increase in the prices of inputs especially fertilizers, fowl drop, fungicides and pesticides without a corresponding increase in the prices of output in the market was reported by participants as a major barrier to adaptation as the prices of potatoes are consistently low in the market. According to participants, this amongst other socio-economic inequalities has helped in thwarting farmer's adaptation efforts and rendered most of them vulnerable to the impacts of climate change (see Molua, 2009, Azong et al., 2018). The situation of inputs price hikes notably that of fertilizers has become worse at the eve of the Russian-Ukraine war with the prices of different types of fertilizers witnessing an exponential increase with no signs that seeing light at the end of the tunnel is near for the farmers as the war in Ukraine persist. The already rising prices of the different types of fertilizers due to the effects of the corona pandemic and the current inflation rate in the country has continue with a sharp rise in prices (e.g., Urea fertilizer price rose by an average of 80 percent, NPK (20:10:10) by 70 percent, and NPK (13:23:13) by 80 percent). Noteworthy, Russia is the highest supplier with about 43 percent of Cameroon’s annual fertilizer imports (Resource trade earth, 2020; OCHA, 2022). Thus, the Russian-Ukraine war has a strong influence on fertilizer supplier and prices in Cameroon.

All participants during interviews complained of input price hikes and stated that their adaptation choices and quantity of production were determined by the prices of these inputs. In the face of the input price increase crises, when the research participants were asked how they plan to remedy the situation, most farmers told the researcher that they have no choice than to reduce the size of the farm cultivated or they will simply reduce the quantity of fertilizers used per season until when the situation normalizes. One of the participants added “we have no choice than to reduce the farm sizes and rely on what is available since there isn’t a well-trained Agric technician in the community who could train farmers on the production of local fertilizers”.

Even though fertilizer prices are increasing by day field observation showed that the supply is not even readily available, and some farmers have to travel to the neighboring cities like Dschang, Bafoussam, and Mbouda in the west region of Cameroon to purchase fertilizers which in turn increases the cost. Given that

climate variability has made potato farming to become more capital intensive, an increase in the prices of important inputs which most of the adaptation measures depend on becomes a major setback to adaptation and there is already an envisaged shortage of food and a negative impact on the livelihoods of those who depend on potato cultivation for survival. In sum, an increase fertilizers prices which is considered a primary means to improving productivity, as suggested, and accommodated by UNSDG 2.3 to “double agricultural productivity and incomes of small-scale food producers...through secure and equal access to land, other productive resources, and inputs (e.g., fertilizer) ...” (World Bank group, 2022) remains a major barrier to the adaptation of small-scale farmers. Thus, agricultural productivity is threatened by fertilizer price hikes likewise the incomes of small-scale farmers and their adaptation choices. The increase in the prices of an important farming input like fertilizers and other agrochemicals continue to increase the vulnerability of small-scale farmers to climate change impacts.

## Chapter 8. Summary and Conclusion

The impacts of climate change on agriculture in the world particularly in Africa are alarming and continue to make headline debate in the sustainable development circles. The literature on this subject has demonstrated beyond reasonable doubt that most parts of less developed world especially most of Africa south of the Sahara are likely to face chronic hunger if the current trends of climate change persist. The different reports of IPCC notably since the AR5 have warned that the impacts of climate change from observed vulnerabilities of people and systems have heightened especially from the intensity and widespread pervasive impacts observed from climate and weather extremes in Africa which are likely to constitute a bigger threat to the already limping livelihood situation in Africa (IPCC, 2022). The study examines the perceptions of climate change impacts and adaptation of small-scale potato farmers to climate change in the western highlands of Cameroon particularly in Mmuock Leteh and environs where fieldwork was conducted. The research addressed three main questions i.e. the perceptions of climate change and impacts, adaptation strategies and challenges/barriers of adaptation.

The findings portrayed that the participants demonstrated a good knowledge and understanding of climate change expressed through their experiences of changes and impacts observed in the environment and in their day-to-day activities. The changes observed by small scale farmers were attributed to climate change impacts. The participants further related climate change to prolonged periods of dry season, increase temperatures, sunshine, and high variation in rainfall patterns and associated it causes to deforestation, poor farming practices, industrial pollution, bush fires, ozone depletion and destruction of natural and cultural sites. Some of these findings observed by small scale potato farmers have been confirmed in many studies and reports (Collier et al., 2008; Molua, 2009; Filho et al., 2015; Yaro and Hasselberg, 2016; IPCC, 2014, 2019, 2022). The participants further associated the impacts of climate change based on their experiences to a fall in productivity, yield and income, water scarcity, increased incidents of pests and other potato diseases, erosion, rural urban migration, wilting of crops, increased cost of farming etc., these impacts were perceived by participants to be as a result of early start and prolonged dry season, high temperature, variation in rainfall, shortened growing season and increase in the prices of inputs especially fertilizers, hybrid seeds and agrochemicals.

Since climate is an important factor in the growth of potato, the findings showed that the fall in productivity and yields was due to the late start of the rainy season observed via the high variation in rainfall patterns across the country. The late start of the rainy season was also noted to have delayed the germination of seeds planted at the beginning of the planting season. Those that managed to germinate were noted to have been

forced to wilt as a result of high sunshine coupled with high temperatures. This affected the quality and quantity of production thus a fall in productivity and yields likewise incomes of farmers. A fall in farmers income was also perceived to have been caused by the high prices of inputs notably climate resilient seeds and agrochemicals used to fight blight and viral diseases. The study also concludes that water scarcity in the study area was associated with climate change. Increased temperatures, drought experience via the prolong dry season that caused most of the streams to dry, high rainfall variability (decline in rainfall) and high exploitation of water catchments were perceived to be the causes of water scarcity. Erosion that depletes soil fertility and destroys seasonal earth roads was also found to be related to climate change notably the heavy erratic rains that surprise farmers and wash away the earth roads making maintenance difficult. Some of these findings from the experiences and perceptions of small-scale potato farmers are similar to those discussed in the climate change literature (Collier et al., 2008; IFPRI, 2009; Molua, 2011; Mngumi, 2016; Ngo et al., 2019). Based on participants demonstrated knowledge and experiences of climate change and its impacts, this study concludes that they are aware of what is climate change and its impacts on their day-to-day activities. However, access to information and education on climate change remains a major challenge since some participants were quick to attribute the causes of climate change to cultural factors notably religion. In this light, the study suggests wide sensitization of farmers and improvement on climate change education to facilitate comprehension and adaptation.

Drawing from the findings, farmers through their experiences of climate change impacts, have been making efforts to cope through a number of strategies. These coping (adaptation) strategies are either modified local farming practices or planned adaptation strategies detailed in the NAPACC known in its French acronym as PNACC. However, most of the strategies adopted emerged locally and spontaneously since most farmers don't have ready access to this policy document. One important conclusion of the study is that the adaptation strategies adopted by small scale potato farmers to resist climate change do not sufficiently satisfy their adaptation aspirations due to the lack of the necessary resources and government support to follow up consequently most of the strategies are limited in attaining the desired objectives. This has gone a long way to increase the vulnerability of small-scale farmers particularly potato farmers to climate change and its related impacts.

The study also observed that irrigation is one of the most adopted strategies. This has been suggested and confirmed in many studies (FAO, 2009; Mngumi, 2016; Yaro and Hasselberg, 2017; GIZ, 2019; Adesina and Thomas, 2020) as an adaptation strategy to climate change. Despite this, irrigation use is constraint by a number of factors notably the lack of financial resources to purchase irrigation materials and the recurrent water shortages as a result of this, a greater majority of potato farmers greatly rely on rainfall which has been

challenged by high variability. The study therefore concludes that irrigation is crucial to the adaptation of small-scale potato farmers to climate change although not sufficiently exploited due to water scarcity. This study recommends the putting in place of a water management scheme in the study area to ensure proper water management and protection of water catchments, construct reservoirs to collect and store rainwater/runoffs for irrigation use in the dry season. Other studies have also suggested investment in the construction and development of reservoirs and small-scale irrigation schemes for farmers as they are cheap and easy to develop and manage given their little capital and space requirement (Mngumi, 2016; Adesina and Thomas, 2020)).

Another important conclusion of the study is that the government and NGOs have made effort through the NAPACC, public and private financing of agricultural and adaptation operations but there are insufficient to accompany the farmers in ensuring the implementation of planned and spontaneous adaptation. The absence of a significant financial support from public and private sector has limited farmers adaptation capacity since they lack the needful capital to pursue the different adaptation options to reduce and limit the risks of climate change impacts. Based on this, we can ascertain that the adaptation gap rather continues to be widen than being bridged. The study recommends an improvement in public and private financial and material assistance to small scale farmers to strengthen their adaptation efforts, reduce vulnerability and impacts of climate change.

The study also observed that Fertilizers and other agrochemicals are important adaptation inputs given their resilience to climate induce adversities and crop diseases however, high application may negatively affect the soils, the environment, crops and human health and may likely lead to maladaptation. The study concludes that the high use of chemical fertilizers, pesticides and fungicides was already affecting the soil fertility, the crops quality, and farmers health. For instance, farmers complaint that the continuous use of chemical fertilizers on the same piece of land has rendered the soils infertile such that its non-application is futile thus, farmers have to use as much as they can to have a guaranteed harvest. The application of certain fungicides and pesticides were also noted to have affected the crops quality, human health, and the disposal of plastic waste after use in the environment and streams although there was a waste disposal site constructed for that purpose only few participants agreed that they were able to dispose of their waste there.

The adaptation strategies adopted have however faced some major barriers which have rendered most of the strategies “unsustainable” even though the findings portrayed that the farmers continue to apply it, according to some participants, it is thanks to the mercy of God that they are surviving. Most of the barriers reported were interpreted and somehow related to poor governance, lack of financial resources and the full implementation of adaptation plan on climate change adaptation. However, ToC presented in chapter 2 as suggested by (Bours et al., 2014 in Pringle and Thomas, 2019), could enable stake holders and policy makers to set adaptation goals, implement, monitor, and evaluate their advancements in the reduction of climate change

impacts and risks particularly to small-scale farmers.

## **Recommendations**

The literature reviewed on climate change adaptation and participants experiences shared during interviews reported on the severity of climate change impacts on small scale farmers and the urgent need to address adaptation barriers and foster adaptation amongst small scale farmers, this study concluded with the following proposed recommendations:

Improve on public private financing of adaptation of small-scale farmers. This could be through the subsidization of modern and adaptable inputs like high yield drought resistant seeds, fertilizers, and agrochemicals (fungicides, pesticides etc.). Grants meant for the promotion of agriculture and adaptation should be brought to the doorsteps of farmers through their representatives and not through politicians and administrative officers as it is the case in Cameroon today. This will go a long way to limit corruption.

The government and NGOs should embark on wide sensitization campaigns and education on climate change adaptation of local farmers. Through this, farmers could be trained and empowered on good agricultural practices and how to appropriately apply the different adaptation options to avoid maladaptation. In the same vein, the government could also encourage farmers to create and join common initiatives groups and cooperative societies where farmers problems could easily be addressed.

The government and development partners e.g., NGOs in collaboration with the local councils should set up small-scale water management schemes to manage irrigation of crops wherein reservoirs could be constructed to collect and store rainwater where possible. Bole holds could also be constructed to collect water from the aquifers, store it in reservoirs to be used in areas and periods where it is not possible to collect and store rainwater.

The protection and reforestation of water catchments should be encouraged. The state and NGOs should protect and promote the planting of water loving trees around the water catchments. Prohibit farmers from tapping water directly from the water catchment through the putting in place of a certain distance around the water catchment where farmers are not allowed to exploit for whatsoever reason. This could also help address the issue of water scarcity.

Encourage and promote the use of more organic fertilizers such as cow dung, fowl drop, compost manure etc., instead of chemical fertilizers as high use of it could contribute to climate change via a chain of reactions that releases greenhouse gases as well as maladaptation. Participants experiences also revealed that

high and continuous application of certain types of agrochemicals could lead to maladaptation. Even though most of these recommendations are well spelled out in the NAPACC discussed in chapter 3, farmers are yet to see them take effect.

## **Areas for Future Research**

The findings of the study through the exploitation of secondary sources and participants experiences shared from beginning to the end has revealed distressing impacts of climate change on small scale potato farmers and limitations to the efforts made to adapt to the impacts reported. This study therefore suggests a future in-depth study to find out the limitations of the adaptation of small-scale potato farmers to climate change and the potential risks of failure to adapt. Further studies could also be conducted to find out how the water catchments could be protected and saved without necessarily stopping irrigation. Another study could also be conducted to examine the financing of climate change adaptation of small-scale farmers in Cameroon and lastly the role of farm size in climate change adaptation.



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# Appendices

## Appendix 1: Semi-structured interview

### Interview Guide – Personal/in-depth interviews

#### Basic Demographic Information

Place of interview .....  
date.....start.....end.....  
Name .....  
Age..... Sex.....Occupation.....

#### **RQ1. What are the impacts of climate change on potatoes farmers?**

##### **A. Knowledge on farming practices**

1. Can you explain briefly how the farming of potatoes was practiced twenty, forty or fifty years back? i.e., Preparation, planting, harvesting, and marketing processes?
2. Have you observed some unusual changes in the farming processes? Can you briefly describe what you observed?
3. How is the cultivation of potatoes practiced today?
  - i. How do you get access and use of fertilizers, manure, and potatoes seeds (do you produce and save your own seeds and farmyard manure?)
  - ii. How do you store and transport your crops to the market?
  - iii. what strategies do you use to get the best market prices (Is it by market actors, price control, phone calls, etc.,)?

#### **RQ2. How do farmers perceive and respond to the effects of climate change?**

##### **B. Knowledge on climate change and adaptation**

4. Have you observed some changes in the weather patterns and seasons of the year? Say many rainy days, month, or changes in length of dry or rainy seasons.
5. Have you heard about climate change? What do you think is climate change?
6. What are the causes of climate change?
7. Do you think climate change or changes in weather patterns has an impact in your farming activities? Why?
8. Apart from climate change, what are other challenges you faced in the farming of potatoes?
9. What do you do to adapt your potatoes farming to climate change? Why and how?

#### **RQ3. What are the factors affecting farmers adaptation strategies to climate change?**

10. Has it been a problem adapting your potatoes farming to climate change? What are some of the challenges you face?

11. Have you received assistance from the government or any organization or private individual in any form to adapt your potato farming to some of these challenges? What type of assistance and how often?
12. How do you appreciate the assistance you get from the government or private organisations to adapt your potato farming to climate change? Why?

**RQ4. How sustainable are farmers adaptation strategies? What does the government and NGOs do to ensure sustainability?**

**A. Farmers**

- i. How long have you been applying these measures?
- ii. Do you have an idea if there are sustainable? why?  
Sustainability here is how Helpful (in socio-economic terms) long lasting, and void of environmental degradation.
- iii. What do you think about the measures?
- iv. Do you have any solution to propose to the government or NGOs?

**Thanks for participating!!!!**

**B. Government and or NGOs:**

**Questions to government/NGOs officials.**

Opening statement. The interview is about climate change adaptation and small-scale potato farmers, and I believe we are all familiar with climate change and its effects on agriculture likewise potato's farming.

- i. What are some of the treaties on climate change to which the government of Cameroon is signatory? Why and how is this important to Cameroon?
- ii. What are some of the policies and laws put in place by the government to address climate change in Cameroon?
- iii. What is the government doing to assist small-scale farmers to adapt to climate change?
- iv. Does government policies and adaptation strategies on climate change consider local and cultural specificities? e.g., land tenure, gender etc?
- v. What are some of the difficulties faced in implementing adaptation plans? e.g., in assisting farmers to adapt to climate change?
- vi. Apart from climate change intervention measures, what are the main challenges faced in the potato value chain?
- vii. According to you are the national policies on agriculture and climate change adaptation sustainable? Why? 'sustainable' i.e., how helpful (in socio-economic terms), long lasting and void of environmental degradation
- viii. Do you have anything to add or any remark to make about the interview?

**Thanks for participating in the interview!!!!!!!!!!!!!!**

## 1. Household Surveys

### Questionnaires for Household Surveys

#### A) Basic demographic information

Date.....Place.....  
Name..... Gender..... Age.....  
Marital status.....Level of education.....  
Household number.....

#### B) Information on agriculture and climate change

**You can choose more than one option in each question below**

1. How long have you been a farmer? a) one to five years b) five to ten years c) Ten to 20 years d) 20 years and above
2. Is potato farming your main farming activity? Yes/ No if no specify.....  
.....
3. What are some of the major challenges you faced in your potatoes farming? a) Inadequate or lack of inputs b) changes in weather c) limited farmland d) blight and pests. If others specify.....
4. How do you raise capital to invest in your potato farming? a) 'njangi' houses b) borrowing from financial institutions c) gifts from family members d) support from government and NGOs
5. Do you belong to any agricultural union or group that shares knowledge on farming practices and climate change? If yes state, the type of union or group  
.....
6. How do you prepare, plant, and harvest your crops? a) hoeing or tilling, planting, and harvesting using traditional tools b) Using modern techniques like tractors c) none of the above. If others specify.....

- .....
7. Have you observed any changes in the weather patterns compared to many years back? a) changes in the start of rainy and dry season b) changes in the number and length of dry and rainy days c) variation in rainfall and temperatures b) None of the above
  8. What according to you is climate change?.....  
 .....  
 .....
  9. What do you think is the cause of climate change? a) human activities like industries, poor farm practices, etc. b) natural activities c) the gods of the land are angry d) I have no idea
  10. Do you think climate change has been a problem to your potatoes farming? If yes in the following propose responses, choose as many options as possible a) fall in income b) fall in yields c) fall in quality and quantity of productivity d) increase incident of blight and pests

**C) Adaptation and sustainability**

11. How do you adapt your potatoes farming to climate change? a) changing of seed types and planting dates b) mixed cropping and crop rotation c) using irrigation in drier periods d) consulting the gods of the land
12. How do you acquire land to farm your potato? a) inheritance b) grant or gift from family members c) rent or leasing d) purchase. If others, please state  
 state.....  
 .....
13. Does the method of land acquisition affect the selection and sustainability of adaptive response measures to climate change? Yes or NO. Why?.....  
 .....  
 .....
14. Have you received any support from the government or private organization to adapt your potatoes farming to climate change? If yes, choose the options that apply from the list below a) financial assistance and/or farming inputs from government b) financial assistance and/or farming inputs from NGOs c) training and capacity building from government d) training and capacity building from NGOs.
15. How often do you receive this assistance a) once a year b) twice a year c) during election time d) no specific time.
16. How do you appreciate the assistance given to you by the government and or NGOs? a) the assistance has helped to an extent to adapt my potato farming to climate change b) the assistance was less important to me c) the assistance was neither important nor unimportant to me d) the assistance wasn't helpful.



17. According to you, how sustainable are some of these adaptation responses of climate change to your potato farming? a) highly sustainable b) slightly sustainable c) not sustainable d) I don't know
18. In your opinion, what do you think can be done to foster adaptation and ensure the sustainability of potato farming to climate change?.....

.....

.....

**Thank you for participating!!!!!!!!!!!!**

## **Appendix 2: Information letter and informed consent**

**Topic: Impacts and Adaptation of Small-scale Potato Farmers to Climate Change in the Western Highlands of Cameroon:**

**Researcher/student:**

**University of Bergen, Norway**

**Email:**

**Contact:**

I am a master student of Geographies of sustainable development at the university of Bergen Norway. I am writing my master's degree on the impacts and adaptation of farmers to climate change in Cameroon. The study will be focused primarily on assessing the impacts and adaptive capacity of local farmers to climate change and this will be based on the collection of data through interviews with farmers and field observations. The fieldwork part of the study will begin from May 2021 to mid-August 2021 and the written part will end on 15.12.2021. The main objectives of the study are:

- To find out the perception of farmers about climate change, impacts, and adaptation measures.
- To find out how the challenges of adaptation measures and how the government through the National Adaptation Plan enable farmers to cope with these challenges, and sustainability of adaptation measures to climate change.

In the interview process, some of your personal data like duty post, and audio of your voice maybe recorded and store electronically in protected research server. The data from this interview is required to understand the impacts of climate change on small scale farmers especially potato farmers and what the government of Cameroon is doing to assist farmers adapt and ensure sustainability of adaptation measures.

You have been selected to take part in this interview through a purposive and convenient sampling. The data from this study is not going to be used for any purpose apart from that indicated in this study.

Hence, if you decide to take part in this project, it means that you will be involve in a personal interview which will take approximately 50minutes. The interview involves question about climate change and agriculture and what the government is doing to combat climate change and assist farmers to adapt their farms to climate change. Your answers will be recorded electronically or by note taking.

Participation in the project is voluntary. If you chose to participate, you can withdraw your consent at any time without giving a reason. All information about you will then be made anonymous. There will be no negative consequences for you if you chose not to participate or later decide to withdraw.

### **Your personal privacy – how your personal data will be stored.**

Your personal data will only be used for the purpose(s) specified in this information letter. Thus, your personal data will be processed confidentially and in accordance with data protection legislation (the General Data Protection Regulation and Personal Data Act).

Given that this is a master thesis which is a tradition for student to write a master project in partial fulfilment of the award of a master's degree, I am responsible for the project and only my supervisor, co-supervisor and I will have access to the personal data. Special data protection rules such as de-identification of informants with fictitious names and codes will be applied to ensure that unauthorised persons do not have access to the personal data. The list of names, other contact details if any, and codes will be stored separately on an encrypted research server at UIB. It is also important to note that participants will not be recognised in the publication of this project.

### **What will happen to your personal data at the end of the research project?**

The project is scheduled to end 15. 12. 2022. All personal data including digital recordings will be anonymised and stored personal data deleted when the project is completed.

### **Your rights as a participant**

So long as you can be identified in the collected data, you have the right to:

- access the personal data that is being processed about you.
- request that your personal data is deleted.
- request that incorrect personal data about you is corrected/rectified.
- receive a copy of your personal data (data portability), and

send a complaint to the Data Protection Officer or The Norwegian Data Protection Authority regarding the processing of your personal data (See NSD)

### **What gives us the right to process your personal data?**

Your personal data will only be processed based on your consent and this is based on an agreement with the University of Bergen and NSD – The Norwegian Centre for Research Data AS has assessed that the processing of personal data in this project is in accordance with data protection legislation.

### **Where can I find out more?**

If you have questions about the project, or want to exercise your rights, contact:

- University of Bergen, Faculty of Social Sciences, Department of Geography through head of department and supervisor, Peter Andersen by email , [Peter.Andersen@uib.no](mailto:Peter.Andersen@uib.no), telephone +47 55 58 30 63, co-supervisor Connor Joseph C., email: [connor.cavanagh@uib.no](mailto:connor.cavanagh@uib.no), Tel: +4755583093, and student Bidias Ndemaze Chiankem by email [bch010@uib.no](mailto:bch010@uib.no), telephone +47 45529585
- Data Protection Officer: Contact person, Peter Andersen by email , [Peter.Andersen@uib.no](mailto:Peter.Andersen@uib.no), telephone +47 55 58 30 63

- NSD – The Norwegian Centre for Research Data AS, by email: ([personverntjenester@nsd.no](mailto:personverntjenester@nsd.no)) or by telephone: +47 55 58 21 17.

## **Informed Consent**

### **Participants declaration** (Please indicate with **Yes or No**)

I have received, read, and understood information about the project: *The Impacts and adaptation of Farmers to Climate Change in Cameroon: Case study of small-scale Potatoes Farmers in the Western Highlands of Cameroon* and have been given the opportunity to ask questions. I hereby give consent:

- To participate in a personal interview
- For my personal data such as voice to be recorded

I therefore give consent for my personal data to be processed until the end of the project in December 2021.

Thanks for participating!!!!!!!

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(Signed by participant, date)