

NORWEGIAN UNIVERSITY OF LIFE SCIENCES



**CLIMATE CHANGE ADAPTATION AND MITIGATION IN THE CONGO BASIN
FOREST OF CAMEROON: STRATEGIES FOR SYNERGY**

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DECLARATION

I, CHIA EUGENE LOH, declare that this thesis is a result of my research investigations and findings. Sources of information other than my own have been acknowledged and a reference list has been appended. This work has not been previously submitted to any other university for award of any type of academic degree.

Signature.....

Date.....

DEDICATION

This thesis is dedicated to my family and friends.

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ABSTRACT

Climate change mitigation through Reduced Emissions from Deforestation and land Degradation (REDD), is dominating climate policy processes in many tropical forests countries. However concerns have been stressed about the implications of these activities for the livelihoods of forest-dependent communities, who are already vulnerable to climatic and non-climatic stresses. Synergizing adaptation and mitigation to exploit win-win opportunities is a necessary but challenging strategy. Build on the concepts of vulnerability, adaptive, mitigative and response capacities this study investigated win-win strategies in two community forests REDD Payment for Ecosystem Services (PES) in Nomedjoh and Nkolenyeng in the Southern and Eastern regions of Cameroon respectively. Furthermore, the role of relevant actors and stakeholders in the design of synergy strategies was also examined.

The study used a combination of surveys (110 households), key-informant interviews and field observations, and secondary sources for data collection. Based on the perceptions and attitudes of forests communities in relation to the conservation projects, the study reveals firstly, that the communities are vulnerable to local climate variability and the PES project is limiting their adaptive capacity. Secondly, on the adaptation side, the adaptive capacity of the communities can benefit directly from guarantee food security and income, the improvement in livelihood diversification, strengthening the viability of local economic activities, knowledge and capacity building of local agriculture systems and alternative livelihood options; and indirectly from the use and access to resources, better tenure arrangements, equity and participation. Thirdly, on the mitigation side, the motivation, incentives and willingness of forest communities to participate in forests conservation activities are influence by factors which are linked to their adaptation needs and the REDD conservation objectives and activities have adaptation opportunities for the forest communities. The two communities show dissimilarity on both the adaptation and mitigation side, due to differences in local socio-economic and governance factors. However, the implication of this dissimilarity on project outcome can only be confirmed after both projects are evaluated. Lastly, the study finds that, designing effective synergetic strategies requires a multisector, multilevel, multiactor approach with emphasis on coordination, communication, collaboration, networking and partnerships. This study concludes that the vulnerability of communities is a point of departure to design strategies that minimised risk on both adaptation and mitigation.

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ACRONYMS

AFHAN	: Association de Femmes et Hommes ami(es) de Nkolenyeng
ANAFOR	: National Agency for Forest Development
CARPE	: Central African Regional Programme for the Environment
CBD	: Convention on Biodiversity
CBFP	: Congo Basin Forest Partnership
CDM	: Clean Development Mechanism
CED	: Centre for Environment and Development
CEFDHAC	: Conference on Ecosystem Forests and Wetlands of Central Africa
CF	: Community Forest
CF	: Corporation Francaise
CIFOR	: Center for International Forestry Research
CIRAD	: International Centre for Agriculture Research and Development
CFMC	: Community Forest Management Committee
CoFCCA	: Congo Basin Forest Climate Change Adaptation
COMIFAC	: Congo Basin Forest Commission
DFID	: Department for International Development
EU	: European Union
FESP	: Forest Environmental Sector Programme
GHGs	: Green House Gases
GIC	: Common Initiative Groups
GoC	: Government of Cameroon
GOs	: Governmental Organisations
GTZ	: Gessellschaft Fur Technische Zusammen
ICRAFT	: World Agro-forestry Centre
IITA	: International Institute of Tropical Agriculture
IPCC	: Intergovernmental Panel on Climate Change
IOs	: International Organizations
IRAD	: Institute de Recherche Agricole pour le Developpement

IUCN	: International Union for the Conservation of Nature
MEA	: Millennium Ecosystem Assessment
MINADER	: Ministry of Agriculture and Rural Development
MINEP	: Ministry of Environment and Nature Protection
MINFOF	: Ministry of Forest and Wildlife
NGOs	: Non-Governmental Organisations
NPFE	: Non Permanent Forests Estate
NTFPs	: Non Timber Forests Products
PES	: Payments of Ecosystem Services
PERAD	: Organisation for Environmental Protection, Research, and Development support in Africa
REDD	: Reduced Emissions from Deforestation and Land Degradation
UFA	: Forests Management Unit
UNFCCC	: United Nations Framework Convention on Climate Change
UNFCCD	: United Nations Convention to Combat Desertification
WWF	: World Wildlife Fund

CHAPTER ONE – INTRODUCTION

1.1 Statement of Problem

The United Nation Framework Convention on Climate Change (UNFCCC) highlights two approaches to respond to the causes and impacts of climate change: mitigation of climate change by reducing green house gas emissions (GhGs) particularly carbon dioxide and methane; and adaptation by limiting the negative impacts of climate change on social and ecological systems (Klein et al., 2005). In the forest sector implementing adaptation and mitigation policy strategies risk cancelling each other. Integrating adaptation and mitigation to exploit win-win opportunities is a policy option. However, climate policy response sets which include both options – adaptation and mitigation – are still receiving less attention in the climate response processes, especially in the developing countries. This could be due to the limited knowledge on the commonalities between adaptation and mitigation (Dang et al., 2003).

Climate change policy designs in the Congo basin forest region is being polarized between the recent REDD (Reduced Emissions from Deforestation and Degradation) opportunities and the adaptation needs of the forest and forest-dependent communities (Somorin et al., 2010). Identifying commonalities between adaptation and mitigation is vital, but very challenging; due to socio-economic and institutional dynamics from the local level to the national level in the Congo basin countries. Thus investigating how to design mitigation strategies that incorporate adaptation needs and vice-versa in the Congo basin forest, taking into consideration the interest of different stakeholders is necessary to support the present climate policy process in the region. Synergizing adaptation and mitigation is an emerging response option that needs to be well explored. Integrating green house gas mitigation and adaptation is necessary for three reasons. First, mitigation needs adaptation. For example, REDD has the possibilities of succeeding if it considers the impacts of climate change on forest and forest-dependent communities, and incorporates their adaptation needs. Secondly, adaptation needs mitigation. For example a well defined and constructed REDD policy and activities can reduce the vulnerability of social-ecological systems to climate change. Thirdly, with financial resources being directed towards mitigation than adaptation, it is essential to define mitigation policies and projects that contribute to the adaptation of forest communities.

However, knowledge is limited on how to synergize adaptation and mitigation strategies at the local and national scale. Poorly designed mitigation policies and activities can have negative consequences on local livelihoods and hence on local adaptation. New methods and approaches are essential to analyze synergies and trade-offs between adaptation and mitigation in the forest sector.

The bulk of literature discusses the links between adaptation and mitigation theoretically with limited empirical knowledge and venues for implementation (Bizikova et al., 2007). Implementation of mitigation options are related and confronted by technical, socio-economic and institutional issues, which are also linked to the indicators of well-being and the adaptive capacity (or vulnerability) of forest and forest-dependent communities (IPCC, 2007a). The vulnerability of forest-dependent communities can have implications for efforts to mitigate greenhouse gas emissions as well as the sustainable management of forest resources and the provision of ecosystem goods and services for forest-dependent communities (Ravindranath, 2007).

Adaptation and mitigation actions involve different institutions and actors and they operate at different temporal, spatial and organizational scales (Neufeldt et al., 2010, Swart and Raes, 2007, Brown, 2009). In addition, the actors have different views and they frame adaptation to and mitigation of climate change from different angles (Somorin et al 2010). This might be challenging for collective action, better co-ordination, understanding and the reinforcement of present and future policies and behavioral changes among stakeholders and actors.

The above concerns form the bases of this research, which is to explore necessary strategies which simultaneously enable forest-dependent communities to adapt to climate change and enhance emission reduction from reduced deforestation and land degradation through community PES forest protection mechanism in the Cameroon rainforest. It will also examine the transforming processes and structures involved in the design and implementation of such potential strategies.

This research was carried out in the Congo basin forest of Cameroon, within which livelihood strategies of forest communities depend directly on forest resources. However, climate change is perceived to have impacts on the livelihood strategies. In addition their livelihood activities through the exploitation of timber and NTFPs, agriculture expansion are responsible for deforestation and land degradation, hence carbon emission. This research will focus on

Cameroon, due to its progress in climate change and forest policy initiatives and it will also guarantee access to data, as it is the seat for some regional organizations involved in the management of the Congo basin forest. Despite its focus on Cameroon, the outcome of this research can be applied to other countries in the Congo basin region, taking into consideration their institutional and governance capacity. This research project will be carried out as part of the Congo basin Forest Climate Change Adaptation project (CoFCCA). This is a three year adaptation project in the Congo basin forest region carried out by the Center for International Forestry Research (CIFOR) with the general objective of contributing to the national efforts of adaptation to climate change by developing policy oriented adaptation strategies that also ensures sustainable use of natural resources in the Congo basin forest. This research is related to its cross-cutting area of interest; which is to develop potential synergies between adaptation and mitigation options in the Congo basin forest region (CoFCCA, 2009).

1.2 Justification and rationale

It is pertinent to understand the position and interest of forest-dependent communities in the context of their adaptation to climate change and their role in climate change mitigation. It is also important to understand the position of forest communities regarding incentives, motivations and their willingness to participate and collaborate in forest conservation activities which reduce deforestation and land degradation. Furthermore it is also important to understand the interplay of different actors at the different levels regarding adaptation and mitigation policy design and implementation. This study will provide lessons for future design of community- based REDD projects and contribute to national and regional climate change response processes in general.

1.3 Climate change adaptation and mitigation setting

Climate change science and policy have been dominating environment and development issues for the past decade from the local to the global level. Climate change and climate variability is already having enormous impacts on natural and human systems, and despite the uncertainty surrounding the full understanding of these impacts, scientific predictions indicate that the human and natural systems will continue to suffer from climate variability and change, if current trends in greenhouse gas emissions continue (IPCC, 2001, Kanninen et al., 2005). Climate

change is considered to be a major threat to terrestrial and aquatic ecosystems with subsequent impacts on agriculture and food security, health, infrastructure etc. Extreme weather events such as storms, floods, droughts and increasing temperatures will add more stress to the global social-ecological systems. The multiple impacts of climate variability and change vary across regions and across different sectors. Sub-Saharan Africa and other regions in developing countries will be highly vulnerable to the impacts of climate change (IPCC, 2001, IPCC, 2007a, Brooks et al., 2005).

The livelihoods and national development of these regions depend on climate-sensitive sectors. The poor and indigenous peoples depend directly on sectors such as agriculture, fisheries and forestry for food, medicines, household energy, and water supply (Sunderlin et al., 2005). As a consequence, the vital factors necessary for development and poverty alleviation such as water, food supply, health and infrastructure will seriously be endangered (Halsnæs and Verhagen, 2007). From this perspective, the livelihoods and national development need to respond to climate change and climate variability. However designing and implementing respond approaches has been a major challenge in the different climate sensitive sectors such as forest, land use and agriculture.

Adaptation and mitigation are both necessary for a complete response to climate change (Dowlatabadi, 2007, Willbanks et al., 2003). Even the most effective mitigation efforts cannot avoid the present impacts of climate change, because of historical emissions, thus adaptation is a need. On the other hand, adaptation cannot provide a comprehensive response to future impacts, thus mitigation is needed to prevent worse impact scenarios in the future (Willbanks et al., 2007). Mitigation and adaptation have the same objectives; to reduce the impacts of climate change (Swart and Raes, 2007). In addition they are intrinsically linked, because the more we mitigate, the less adaptation we will need in the future. Despite this position on the need of adaptation and mitigation, they were considered as separate issues in the climate science and policy debate (Ravindranath, 2007, Swart and Raes, 2007). Mitigation was seen as a problem of the north with the greatest responsibility for climate change, while adaptation is seen as a problem of the South, with low mitigative capacity and with high adaptation needs (Ayers and Huq, 2009).

Researchers have put forward conceptual approaches, in linking or integrating adaptation and mitigation across different sectors and at different levels, with highlights on the opportunities and

challenges (Bizikova et al., 2007, Dang et al., 2003, Ravindranath, 2007, Swart and Raes, 2007). The forest sector is one of the sectors which provide opportunities to promote synergy between adaptation and mitigation (Ravindranath, 2007). The role of global forests in the response to climate change is becoming very important in the present climate change science and policy debate, due to its significance in adaptation to climate variability and change and mitigation of climate change (Ravindranath, 2007, Guariguata et al., 2008). Locatelli et al (2008) have highlighted that forest ecosystems are very important for peoples and societies to withstand the imminent present and future impacts of climate change. In addition, the forest has been recognized as a system which enhances carbon stocks and reduces carbon sources (Haore, 2007), through its different mechanisms – REDD and Clean Development Mechanism (CDM). If properly designed and implemented mitigation options will provide co-benefits such as employment and income generation opportunities, biodiversity and watershed conservation not forgetting aesthetic and recreational facilities (Brown, 2009, IPCC, 2007a, Angelsen, 2008, Stern, 2007). Such indications raise the stakes in terms of the need to protect tropical forest. Furthermore, billions of people depend directly and indirectly from forest goods and services for their livelihoods. Thus the forest needs to continue providing these goods and services in the future. As these forest ecosystems contribute to reducing the vulnerability of the society to climate change, the conservation or management of tropical forest is imperative in adaptation policies (Locatelli et al., 2008b). The forest sector has been caught in between adaptation and mitigation policies, as it has the potential to reduce greenhouse gas emission and at the same time the forest is required by millions of people to cope with the shocks of climatic and non climatic stresses (Locatelli et al., 2008b). At the interface between adaptation and mitigation synergy and trade-offs occur (Ravindranath, 2007, Seymour, 2008, Tol, 2005). The outcome of the synergy and trade-offs between adaptation and mitigation can be on the one hand detrimental to sustainable development efforts, and on the other hand it can reinforce the potential of climate sensitive sectors like the forest to contribute to national welfare (Dang et al., 2003, Ayers and Huq, 2009).

This study seeks to contribute to this growing literature on synergy in the forest sector, in a developing country context where adaptation needs are high and mitigative capacity is low. Maybe linking adaptation and mitigation at the activity or project level can simultaneously enhance adaptive and mitigative capacities and provide adaptation needs for forest and forest-

dependent communities. This issue will be explored further through a case study in the Congo basin forest of Cameroon, in which as a social-ecological system it is sensitive and exposed to climate change and variability, but also has the potential for green house gas (GHG) mitigation (CoFCCA, 2009).

1.4 Congo Basin forest and climate change

The Congo Basin forests, has recently received much attention regarding the response (mitigation and adaptation) to climate change. Firstly, the vegetation of the Congo basin forests contains an estimated 25-30 million tons of carbon stocks due to agriculture and forest activities (timber exploitation, small-scale and plantation agriculture) large amount of carbon stocks are released from the forest, which contributes to global warming (Haore, 2007). The forests is vulnerable to degradation and deforestation activities such as logging and slash-and-burn agriculture (Haore, 2007, Nkem et al., 2008, CBFP, 2006).

According to Haore (2007), selective logging activities are responsible for about 25-30 % of the regions carbon losses. In addition, these activities open up forest areas, which enhance the carrying out of slash-and-burn, fuel wood extraction, and animal grazing which are likely to increase biodiversity and losses.

Second, the forest is needed by millions of people to adjust to climate change and climate variability (Justice et al., 2001, Haore, 2007). It is the second largest rainforest after the Amazon and its 1.5 million square miles cuts across six countries in the Central African sub region. Countries benefiting from this trans-boundary resource include; Cameroon, Gabon, Central Africa Republic, Equatorial Guinea, Republic of Congo and Democratic Republic of Congo. The millions of people inhabiting the Congo basin forest depend directly or indirectly from forest goods and services. They exploit the forest for food, household fuel wood and medicinal plants. In addition, they also generate income from the trade in non-timber forest products (NTFPs). Besides the support to local communities, the Congo basin forest also contributes significantly to the national economies of the region with a contribution of about 10-15 % of the regional GDP, and it is a major source of government revenue, employment and foreign exchange (Sonwa et al., 2009, CBFP, 2006).

Cameroon`s rainforest covers 10% of the 2 million km of the Congo basin forest. Its 16 million hectares of dense humid forest covers about 40 % of the national territory and it is home to more than 8 million people who depend directly and indirectly from forest resources (Robiglio et al., 2010).

Research has underscored the vulnerability of the Congo basin forest to the impacts of climate change. Sectors in the Congo basin forest vulnerable to climate change include food, water, and energy. (CoFCCA, 2009). Thus adaptation of the Congo basin forest to climate change is imperative for the region to continuously benefit from the forest resources as far as national development and poverty reduction is concerned. However, emissions from deforestation and degradation of the forest might reduce local capacity to adapt to climate change and might also challenge the global response to climate change (Nkem et al., 2008). The Congo basin forest has a significant role to play in climate change response, but this role can be put at risk if care is not taken to underline the position and capacity of different interest groups and stakeholders, regarding climate change adaptation and mitigation at the project/activity level and national level. This study will be focus on the Congo basin forest of Cameroon with emphasis on the Nkolenyeng and Nomedjoh community forests Payment for Ecosystem Services (PES) projects in the Southern and Eastern regions of Cameroon. Relevant issues about the projects and project sites will be presented in the case study chapter.

1.5 Objectives and Research questions

1. To explore based on the perception of forest communities, strategies and forest management options that can simultaneously cater for their adaptation needs, and enhance the conservation of carbon stocks through PES, related to reduced deforestation and forest degradation.

- What are the concerns and needs of forest-dependent communities regarding adaptation to climatic and non-climatic changes?

Assumption: The determinants of vulnerability (food security, source of income, livelihood options, knowledge and capacity, viability of primary economic activities, tenure rights, use and access, equity and participation) of forest-dependent communities are related to their adaptation needs and mitigation activities

- What are the threats and opportunities emerging from the relationship between the adaptation needs of forest communities and the implementation and outcome of conservation activities?

Assumption: The determinants of adaptive and mitigative capacities, associated to the vulnerability of forest-dependent communities are threats and opportunities for the conservation of carbon stocks.

2. To examine the processes involved in the design, and better implementation of these potential win-win strategies
 - What roles and actions are required from the different actors and stakeholders expressed in terms of coordination, collaboration, networking and partnership, knowledge and information sharing and communication in the process of designing and implementing integrated response strategies?

1.6 Thesis outline

The thesis is structured as follows. Chapter 2 presents a review of relevant literature and some key concepts in relation to climate change response and forest ecosystems. This chapter also includes a framework which links the different concepts into a simple understanding of adaptation and mitigation synergy in the forest sector. Chapter 3 presents the case study with emphasis on the national context of climate change response and forest from an institutional perspective in Cameroon, the study sites and the REDD PES project in question. The methods employed for data collection, research limitations are also included in this chapter. Chapter 4 outlines and discusses the findings, based on the assumptions drawn from the conceptual approaches highlighted in the literature review. Chapter 5 summarizes and concludes the study in addition with some recommendations and concerns for further research.

CHAPTER TWO – LITERATURE REVIEW AND CONCEPTUAL ISSUES

This section will review some of the literature regarding the relevance and connection between forests, forest-dependent communities and climate change and climate variability. It will also present and explore key concepts postulated by some researchers to analyze and understand the relationships and linkages between climate change response (mitigation and adaptation), forest resources and livelihoods/well-being of forest-dependent communities, from the sub-national to the national level. This study acknowledges the different positions, criticisms and broadness regarding some of the concepts, but these criticisms have been downplayed and the concepts narrowed down to fit into the theme of this study.

The first section of this chapter presents the interaction between climate change and forest-forest communities including the relevant concepts. This will be followed by a brief presentation of the synergy concept in the context of climate change response with some of the initial published literature. Lastly, a framework is presented, which is based on the different concepts presented in the preceding sections, which can be used to analyse integrated response options.

2.1 Forest – Forest dependent communities’ and climate change interaction

This section will present issues related to the importance of forest ecosystems and the well being of forest communities, the impacts and the vulnerability of forest ecosystems and the subsequent adaptation measures as social-ecological systems. The vulnerability and adaptive capacity concepts will also be introduced to understand their role in analyzing climate change adaptation with other related concepts such as equity and participation, resources access and rights, knowledge and capacity. Furthermore, sustainable development which is another viewpoint to analyse and understand integrated response to climate change will also be presented.

The role of forest in climate change on the emission side will be stressed, including the different activities leading to emissions and practical abatement mechanisms such as PES. Moreover, the challenges related to mitigation strategies will be presented, including the mitigative and response capacity concepts and how they are connected to the sustainable development of forest communities.

2.1.1 Importance of forest ecosystems

Local communities, developing countries and the world in general benefit significantly from ecosystem services (Vignola et al., 2009). According to the Millennium Ecosystem Assessment (MEA) report, the forests provide three major ecosystem services that contribute broadly to human well-being: provisioning services such as food, fuel wood, fibre, genetic resources; regulating services such as climate regulation, water regulation and water purification; cultural services such as spiritual, religious, recreational and ecotourism, aesthetic and education. Moreover, all these goods and services have implications for the social vulnerability and the adaptive capacity of local communities (MEA, 2003) . In addition, forests also provide support for primary production, nutrient cycling and soil formation. In general, forests contribute to alleviating poverty and provide safety nets during difficult economic downturns. In this circumstance a disturbance of the forest ecosystem will render the already vulnerable communities more vulnerable (Sunderlin et al., 2005).

Tropical forests provide environmental services which are important to both the local people and national governments. Timber is a very important economic commodity for many tropical countries. Timber exploitation contributes about 10-15% of the GDP in the countries of the Congo basin and it is a major source of government revenue, employment and foreign exchange (Sonwa et al., 2009).

Energy demand in many developing countries is satisfied by fuel wood from forests. The livelihoods of millions of people depend on the exploitation of non-timber forest products, ranging from food (bushmeat, roots and tubers, fish) to medicines (both traditional and modern) and cosmetics. Forest ecosystems services provide incomes, guarantee food security, provide water and other basic materials necessary for the day to day life of forest communities. The health of forest communities is also sustained by services from forest ecosystems. (Byron and Arnold, 1999, Shvidenko et al., 2005).

Tropical forests regulate the global climate as they store large amounts of carbon in the vegetation and in the soils. Other regulation services include detoxification and decomposition of waste, control of agricultural pest, moderation of temperatures and the force and direction of wind blow (Daily, 1997).

However, with increasing impacts of climate change on forest ecosystems and the importance of forest in climate change response, there is fear that forests ecosystems will lose their potentials to provide ecosystem goods and services.

2.1.2 Vulnerability and adaptive capacity and their determinants

The concept of vulnerability is important in analyzing and understanding complexities related to the impacts of climate change and the response to climate change across different sectors. Despite being disputed by different schools, it still provides a platform to understand the uncertainty, and it also provide an opportunity for decision makers to make decisions related to the uncertain predictions, timing, location and magnitude of climate change impacts (Adger, 2006). The challenge is how to make this concept in the context of climate change adaptation and mitigation relevant to policy and decision makers.

There are several definitions of vulnerability in the climate change literature; however in the context of this paper, the definition will be limited to that of the IPCC. The IPCC defines vulnerability as a function of exposure and sensitivity to climatic stressors and the adaptive capacity of a system (IPCC, 2001). Exposure is the nature and degree to which a system experiences environmental or socio-political stress. Sensitivity is the degree to which a system is modified or affected by perturbations. Adaptive capacity is the ability of a system to evolve in order to accommodate environmental hazards or policy change and to expand the range of variables in which it can cope (Adger, 2006). On the other hand, the resilience of the forest ecosystem as a social-ecological system is very important and it is related to: how much shock the coupled natural and human system can absorb and still remain within a desirable state, the degree to which a system is capable of self-organization, and the degree for which a system can build capacity for learning and adaptation. This implies that management options can both destroy or build resilience (Folke et al., 2007).

Assuming that forests and other natural systems are exposed and sensitive to climate, their response to climatic changes can be a direct function of natural, physical, institutional and economic factors, which in turn determines the adaptive capacity. Forest ecosystems are exposed to increase in temperatures, changes in precipitation, changes in seasonal patterns and other drivers such as land use change, land fragmentation, overexploitation of resources and pollution (IPCC 2007a; Locatelli et al.2008).

For the case of human-environmental relationships like forests and forest-dependent communities, the higher the vulnerability of the different components, and the lower the adaptive capacity of forests and forest dependent communities. The livelihoods of local communities depend directly from environmental goods and services, which are subject to deteriorating environmental conditions. In this context, vulnerability can be defined in terms of the capacity of individuals or communities to cope or recover from external stress placed on their livelihood and well-being. It is important to place the socio-economic well-being at the centre, when analyzing the vulnerability of social groups, taking into consideration the institutional constraints which may limit their response (Kelly and Adger, 2000).

Responding to climate change and climate variability through adaptation and mitigation requires a good understanding of the different factors that determine vulnerability, local realities, and how communities conduct and influence these factors to sustain their well-being amidst climatic change. An important question here is; why are communities vulnerable and how is their vulnerability linked to climate change adaptation and mitigation strategies?

Responses to climate change are linked to the well-being of natural resource dependent communities. Reducing the vulnerability of forest communities by enhancing the provision of ecosystem goods and services and better livelihoods through successful natural resource management options will enable these communities to withstand the impacts of climate related shocks (Hammill et al., 2005).

Venema and Rehman (2007) adds that poverty leads to increase in vulnerability of natural-resource dependent communities, because the underlying drivers of poverty are linked to the social, economic and environmental components of adaptive capacity.

Many of the barriers hindering forest management such as equity, ownership, governance, rights, access and use of resources may have implications or constraint for the vulnerability of local communities (CoFCCA, 2009). Kelly and Adger (2000) argues that addressing the underlying causes of social vulnerability, including the inequitable distribution of resources, will provide an atmosphere for a sustainable response to climate change (Kelly and Adger, 2000). These same factors may have implications for local communities to adapt to and to participate effectively in mitigation activities.

Adaptive capacity refers to `the ability of a system to adjust to climate change and to moderate potential damages, to take advantage of opportunities, or to cope with the consequences (IPCC,

2001). Adaptive capacity is a major component of the determinants of vulnerability to both climatic and non-climatic stresses. The capacity to adapt to climate change depends on factors such as technology, wealth, access to resources, property rights, information, education, infrastructure and institutions, equity and participation, knowledge and capacity etc (Brooks and Adger, 2005, Klein and Smith, 2003). With respect to these factors, communities deficient in any of the factors, have lesser capacity to adapt, and are more vulnerable to climate change (Romero, 2005, Yohe, 2001).

There is a relationship between access to natural resources and the adaptive capacity of forest communities. Communities with limited or no access to natural resources, have a low capacity to adapt to the changing climatic situations, and are therefore vulnerable, since they depend on natural resources. In such situations therefore communities need to increase their adaptive capacity in order to reduce vulnerability to climate variability (Murdiyarso et al., 2005). These factors can be used to highlight issues on how communities or nations might be expected to adapt to climate change, as well as how their capacity to respond to climate change in general might be improved (Yohe, 2001).

Yohe (2001) further adds that improving and applying knowledge on the constraints and opportunities to boost adaptive capacity is needed for reducing vulnerability. An interesting issue here is whether these determinants have implications for local communities to adapt and to participate effectively in mitigation strategies, as we shall explore in the study areas. It is important to draw attention to some local governance related concepts such as equity, participation, resource access, knowledge and capacity which are important in analysing opportunities and constraints of different climate change response options.

2.1.3.1 Equity

Equity has been recognized as a key element, when designing PES, especially if the poor and most disadvantaged are told to be involved in these initiatives (Rosa et al., 2003). There are three elements of equity; equity in access, equity in decision making and equity in outcome. Equity in access describes the way in which individual's households and rural communities and organizations are able to participate in emerging markets. This depends on access to information, knowledge networks, as well as access to land and resources. Equity in decision-making involves procedural fairness within the project framework, and relates to issues of recognition and

conclusion in strategies management decision (Paavola, 2003). Lastly, equity as outcome refers to the fairness and distribution of project outcome. This will be determined by access to project activities and decision-making (Brown and Corbera, 2003).

Equitable distribution of resources and forest benefits is important and can reduce the vulnerability of forest communities and it is a condition to make REDD succeed (Dkamela et al., 2009). Equity can take the form of redistribution of forest possessions to increase the level of ownership. It may also require an equitable sharing of benefits derived from forest exploitation such as logging revenues, payments for environmental services and benefits originating from the partnerships between communities and logging companies. Mitigation options such as REDD should be design in such a way to avoid elite capture of forest benefits and minimize the marginalization of forest people's rights and stewardship over forests (Seymour, 2008, Sikor et al., 2010). Inequality in REDD projects may caused communities to disrupt REDD activities through the use of fire and illegal extraction.

2.1.3.2 Participation

The principle of participation is very important in natural resource management and it requires the direct involvement of resource users. In this context participation is defined as empowering local peoples to mobilize capacities, be social actors rather than passive subjects, manage the resources, make decisions and to control the activities that affect their lives (IIED, 1994). Participation of communities bring benefits as; local support for and reduce opposition to policy proposals, projects and other decisions by building on stakeholder concerns and take account of the their interest and helping to build local knowledge and capacity to plan and implement and manage conservation and development projects (Hoben et al., 1998, Corbera et al., 2006).

Local participation is seen as a means and a right. As a means to increase efficiency, if you involve people, they are more likely, to agree with and support the development of actions. As a right, it involves the mobilization of local collective action, empowerment and local institutional building (Vedeld, 2002, Pretty, 1995). Participation in decision making can be enhanced by involving local communities in the management of forests. In the case of REDD, forest peoples must be involved in the design, development and implementation of conservation activities (Sikor et al., 2010). Otherwise efforts to reduce deforestation could have consequences on peoples livelihoods as well as forest conservation (Brown, 2009). No effort to reduce

deforestation can work without the participation and confidence of local people. Consultations with local communities ensure that proposals are rooted in the local context; this makes strategies of such nature socially and technically viable and practically feasible. A bottom-up approach to REDD design and implementation is more likely to address the needs and demands of the communities (Blom et al., 2010). When ecosystem providers participate in or involve in the commercialization of services, they act like significant incentives for participation in projects. Participation of local people in forest management and decision making have shown to increase benefits and rights to local actors, have reduced costs of protection and has provided opportunities for biodiversity conservation. (Agrawal, 2009). On the adaptation side the positive outcome of conservation actions is important in reducing the vulnerability and enhancing the adaptive capacities of local communities (figure 2.1).

2.1.3.3 Land and resource rights

Unclear and inequitable land tenure systems and lack of recognition of the rights of local communities to their forests resources and land are key drivers of deforestation. Mechanisms aimed at halting deforestation and land degradation will succeed with a number of benefits if the rights of local communities to forests resources are well defined and strengthened. Firstly, securing the resource rights of communities has been shown to reduce deforestation. Secondly, security of tenure is likely to make any reduction in deforestation and the conservation of carbon stocks more permanent. Thirdly, determining forest ownership is essential for benefit-sharing and the disbursement of payments to stakeholders and right holders. And lastly, societies with unclear and inequitable land tenure systems are likely to breed conflicts over resources. In Cameroon for example, conflicts exists between the Bantu agriculturalist and Baka pygmies hunter-gatherers and between this two groups and the state (Dkamela et al., 2009). Identifying the underlying drivers of deforestation as a starting point of action is essential for policies aimed at halting deforestation to be effective (Agrawal, 2009).

2.1.3.4 Use and access to forest resources

Many forest-dependent communities are doubtful of REDD in terms of restricting access and extraction rights to their land, because many of these communities rely heavily on forest access for their livelihoods. Restrictions placed on community access to forest, for the sake of carbon

conservation have highly significant livelihood and cultural implications (Blom et al., 2010). However, REDD also has the potential of providing additional environmental service incomes through direct sale of carbon stocks (Angelsen, 2008).

2.1.3.5 Information, Knowledge and capacity

Enhancing equity and participation will enhance knowledge, awareness and capacity of communities to respond to climate change. Improving the definition and distribution of property rights could increase the interest of communities in environmental decision making process. Strategies that enhance well-being and the equitable distribution of resources could raise concerns about climate change response in the social agenda across the population and communities (Yohe, 2001).

Access to information at the local level has been identified as a very important issue in climate change response, and this information has to be made available by Governmental Organizations (GOs) and Non-Governmental Organizations (NGOs), which can still be shared between communities to disseminate new adaptation and mitigation approaches (Challinor et al., 2007, Howden et al., 2007).

2.1.4 Adaptation of forest and forest peoples to climate change

According to the IPCC (2007a) adaptation refers to any adjustment in natural and human systems in response to present or future climate stimuli, which moderates harm and exploit beneficial opportunities. To reduce society's vulnerability to climate change adaptation demands adjustments in individual, groups, and institutional behaviour (Pielke, 1998).

Climate change adaptation in the forestry sector has two purposes. First, to enable forests to withstand the impacts of climate change known as 'adaptation for forest'; and second, to manage forest resources in a way that enable forest-dependent communities to cope with climate change and climate variability known as 'forests for adaptation'. Adaptation is needed because forests are vulnerable to climate change and adaptation may reduce the vulnerability of human systems to climate change. Adaptation measures should be defined and included in forest management strategies, while on the other hand, forest management should be included in adaptation policies aimed at reducing the vulnerability of forest-dependent peoples (Locatelli et al., 2008a).

Climate change adaptation is described as a dynamic and continuous process, which demands continuous improvement with time. Adaptation process for forest-dependent communities should involve vulnerability assessment and capacity building. Potential adaptation measures should be centered on improved governance, capacity building and improvement in land tenure arrangements. Implementing such measures in the forest sector can also enhance carbon sinks and reduce carbon sources (Murdiyarso et al., 2005). Adaptation requires reducing vulnerability and increasing adaptive capacity. How will the adaptation and adaptive capacity of forest communities look like in reality, amidst mitigation actions?

2.1.5 Adaptation measures for forest

Despite the fact that this research is based on `forest for adaptation` approach, it is still important to highlight some of the measures that can enable forest ecosystems to withstand the storm of climate change and still provide the goods and services to the society in general and decrease the vulnerability of livelihoods to other climate related risk.

Some measures for reducing the vulnerability of forests to climate change include fire prevention and management, preventing the entry and removal of invasive species, controlling insects and pests, enhancing landscape connectivity, conserving biodiversity hot spots, conserving and managing genetic diversity in natural forests through specific silvicultural alternatives (Guariguata et al., 2008, Locatelli et al., 2008b).

In addition to the above technical measures to decrease the vulnerability of forests to climate change, some institutional measures have been put forward, such as building of partnerships, increasing awareness, creating and improving knowledge and reducing socioeconomic pressures on forests and promoting good practices for fire management (Locatelli et al., 2008b, Guariguata et al., 2008, Wilbanks et al., 2007). The work of Guariguata et al (2008) indicates that enhancing the adaptive capacity of tropical forests is also important for tropical forests to play a better role in climate change mitigation.

2.1.6 Mitigation of climate change in the forest sector

The IPCC defines climate change mitigation as a human intervention to enhance the sinks and to reduce the sources of greenhouse gases (IPCC, 2007b). With regard to the forest sector,

enhancing sinks could be achieved by enhancing carbon sequestration and reducing sources can be achieved by conserving stocks under the threat of degradation. Forest conservation activities are aimed at preventing forest with high carbon stocks from being converted to forest with low carbon stocks. Sequestration activities are aimed at increasing or converting low carbon forest to high carbon forest (Murdiyarso et al., 2005).

Deforestation and land degradation have been identified as the major drivers of green house gas emissions in the forest sector. Poverty, unsustainable agriculture and poor environmental conditions (exacerbated by climate change) and a lack of alternative livelihood opportunities are the general drivers of deforestation and land degradation. Forest destruction take many forms including agriculture expansion, charcoal production, fuel wood extraction, exploitation of timber and non-timber products (Geist and Lambin, 2001, Venema and Rehman, 2007). Efforts to conserve forests, aimed at reducing emissions and enhancing sinks, will not succeed if deforestation and land degradation is not checked (Angelsen, 2008). This requires measures to intensify agriculture productivity, diversify livelihoods and enhance rural development (Venema and Rehman, 2007). In addition to halting deforestation, carbon conservation can also be achieved by creating recreational reserves and protected areas, sustainable forest management and enhancing fire protection techniques. Carbon sequestration can be achieved through afforestation, reforestation and agro-forestry etc. (Ravindranath, 2007).

2.1.6.1 PES: practical issues

One of the practical measures which have been recognized to reduce deforestation and support the livelihoods of forest communities is the PES. However it also has its flaws. PES are mechanisms which are designed to enhance environmental and natural resource management – by rewarding people for their efforts in protection of ecosystem services (Zilberman, 2007). Individuals and communities receive payments in return for providing services aimed at sustainable forest management. The payment can be directly financial or other benefits or incentives such as food, goods, jobs, training and improved tenure (Petheram and Campbell, 2010). The services are provided by more sustainable use or avoidance of natural resource depletion and may entail protection of forests, soil, watershed and biodiversity and carbon conservation (May et al., 2004, Ferraro and Kiss, 2002, Aylward et al., 1998). PES are powerful tools for poverty alleviation and rural development and provides a more equitable distribution of

economic and social benefits (Pagiola and Platais, 2002). It is also argued that PES can improve livelihoods and well-being, promote local sustainable forest management and strengthen local based institutions (Smith and Scherr, 2002), enhance ecosystem health (Matthews et al., 2002), and new sources of funding for biodiversity conservation (Gutman, 2001). However, it has been argued that such initiatives can be ineffective as a result of institutional and tenure issues (Rojas and Aylward, 2003).

Venema and Rehman (2007), highlights that any comprehensive greenhouse gas mitigation strategy is inextricably linked to land use and sustainable development, which I also think are linked to the well-being of individuals and communities. However it is important to acknowledge empirically that the factors linked to the well-being of communities, might have implications for mitigation options, as we shall find out in this study.

2.1.7 Challenges to mitigation strategies in the forest sector

Climate change mitigation opportunities in land-use and forest sectors are associated with challenges related to ecological and socio-economic concerns. Some of the features that have implications for mitigation options include (Ravindranath, 2007, Ravindranath et al., 2000):

- Participation of local communities: The participation of communities living and depending on forest resources is crucial and required for the implementation of mitigation strategies,
- State control of forests: In many developing countries particularly in the tropics, forests are being controlled and managed by the state forest departments and conflicts always are common between forest communities and the state forest institutions in relation to access, tenure rights and ownership. This aspect might have implications for conserving carbon stocks,
- Dependence of local economy: Millions of indigenous people depend on forests for their livelihoods, and forest mitigation strategies may impact the livelihoods and local economies positively or negatively,
- Natural disorder: Permanence of carbon stocks is affected by natural interferences such as diseases and pests, drought, fire etc. Forest activities such as regeneration and hardwood plantations take long time to provide significant mitigation benefits. This leads to uncertainties regarding carbon abatement and permanence of carbon stocks.

Mitigation activities may affect adaptation options. This can occur at two levels. Firstly, the risk at the farm level associated with reduced primary productivity such as food and secondly the risk at the carbon market level associated with non-permanence (Murdiyarto et al., 2005). It appears that the above challenges are linked or related to the determinants of adaptive and mitigative capacities. It has been acknowledged that mitigation policies and measures (such as REDD) will not succeed in halting deforestation and land degradation, if their underlying causes (small-scale agricultural conversion, fuel wood collection) are not addressed. And all the underlying causes are linked to the needs of the forest-dependent communities (Dkamela et al., 2009).

2.1.8 Mitigative and Response capacities and their determinants

The IPCC (2001) introduced the term mitigative capacity as a mirror image of adaptive capacity. Winkler et al. (2007) define mitigative capacity as `the ability to reduce greenhouse or enhance sinks`. And the ability to envision how communities, nations, corporations, NGOs, etc may respond to the challenges of climate change (Yohe, 2001). Yohe highlights that the determinants of mitigative capacity are the same as the determinants of adaptive capacity.

According to Yohe (2001) communities and socio-economic groups most vulnerable to climate change may have the smallest adaptive capacity and the same factors that increase adaptive capacity could work to increase mitigative capacity.

Some authors have suggested combining the determinants of adaptive and mitigative capacity into one concept of `response capacity`, and enhancing these determinants would increase both adaptive and mitigative capacities (Tompkins and Adger, 2005, Winkler et al., 2007). What is important here is to identify from a local perspective the different factors which are linked to the determinants of adaptive and mitigative capacities, which can be important in designing and implementing win-win policies between adaptation and mitigation in the Congo basin forest of Cameroon.

Combining mitigative and adaptive capacity may show slight differences and results across sectors, but in particular sectors with research and policy on the list of determinants can easily identify synergies and conflicts between adaptation and mitigation. These determinants makes it clear that policy measures in one area can complement action in the other (Ayers and Huq, 2009).

The determinants of response capacity are linked to the welfare of communities, countries and regions. Thus, including human welfare (equity, freedom, justice, food security, health etc) issues in the process of a combined respond to climate change may enhance win-win policy options, rather than treating one as a more central or dominant issue (Dowlatabadi, 2007).

The recent literature in the field of climate change response argues that adaptation to, and mitigation of climate change take place within the framework of adaptive and mitigative capacity respectively and both are human-centered and are connected to the human ability to respond to climate change (Yohe, 2001, Burch and Robinson, 2008). These issues will be compared with the findings of this study.

2.1.9 Climate change response and sustainable development

Many communities and nations vulnerable to climate change face other challenges such as poverty, water and food insecurity, health and resource depletion (Halsnæs and Verhagen, 2007). Policies aimed at reducing pressure on resources and increasing the welfare of poor communities can simultaneously advance sustainable development, enhance adaptive capacity, and reduce the vulnerability to climatic and non climatic stresses (Romero, 2005). According to the IPCC (2007), it is possible to harmonize adaptation with mitigation, and doing it in an optimal way, can advance sustainable development objectives (Ayers and Huq, 2009). Adaptation strategies are largely similar to development, thus strategies that link mitigation and adaptation in the developing countries can increase adaptive capacity and reduce vulnerability, while encouraging socioeconomic development paths that also mitigate emissions, all of which are tied to sustainable development (Ayers and Huq, 2009).

The indicators of well-being can be also be used to assess policies that can integrate climate change policy objectives and sustainable development. It appears that the well-being indicators are similar or related to the indicators of vulnerability and the determinants of adaptive and mitigative capacities (Halsnæs and Verhagen, 2007). Willbanks et al (2007) acknowledge that adaptation and mitigation actions are related to other aspects of sustainable development pathways (Wilbanks et al., 2007).

According to IPCC (2001) factors that enhance adaptive capacity share aspects that promote sustainable development such as resource access, increased equity and capability to participate in local politics and actions and improve well-being. Identifying and addressing the linkages

between sustainable development climate change response can reduce the demarcation between adaptation and mitigation and create new pathways that can simultaneously enhance the adaptation to and mitigation of climate change (Venema and Rehman, 2007).

Furthermore, linking mitigation and adaptation in the context of sustainable development can provide incentives for vulnerable communities or countries with low mitigative capacity to engage in actions which recognize the South's adaptation needs and also the mitigation concerns of the North (Venema and Rehman, 2007).

2.2 Adaptation and mitigation synergy

Synergy between adaptation and mitigation options can offer better opportunities for effective response to climate change. Synergies arise when we combine adaptation and mitigation strategies, to take advantage of the low potentials each of the response options will offer if handled separately (Swart and Raes, 2007). In addition, formulating strategies that exploit synergy can make climate response policies more efficient, alert and complete (Dang et al., 2003).

Adaptation actions are aimed at reducing vulnerability to climate change, and are described at times as egoistic or can be viewed as a private good, while mitigation actions are considered as a global public good with high possibilities of free-riding (Dang et al., 2003). Incentives and motivations are needed to enhance people's participation especially at the project level. The issue here is whether reducing the vulnerability of individuals and communities can provide such incentives and willingness to participate in mitigation options.

Synergy between adaptation and mitigation can also be observed from their similarities. Arguments have been raised that both depend on the capability of a society to develop and diffuse new ideas and to change behaviour, and suggest integrating society's adaptive capacity and mitigative capacity in a single concept of response capacity (Tompkins and Adger, 2005).

The determinants of adaptive and mitigative capacities (technological options, access to resources, social capital, human capital, knowledge and skills, equity, participation, tenure rights, institutions) always overlap and are linked to the vulnerability of individuals, communities and countries. Several factors related to these determinants are also indicators of vulnerability and sustainable development. Since the determinants of adaptive and mitigative capacities overlap

(response capacity), they can be used to respond to climate change impacts and or to reduce greenhouse gas emissions (Winkler et al., 2007, Goklany, 2007).

However, synergetic options that reduce greenhouse gas emission and reduce vulnerability can be possible only in certain climate change related areas; land-use and forestry, urban infrastructure planning and water resource management (Swart and Raes, 2007, Murdiyarso et al., 2005). Forestry mitigation projects such as forest conservation, agro-forestry can also reduce the vulnerability of forest and forest dependent communities to climate change (Dang et al., 2003, IPCC, 2007b).

Synergy between adaptation and mitigation through reduced deforestation and agricultural conservation can help to diversify livelihoods, which is a pertinent option during extreme climatic events. In addition, other conservation methods which protect forests, may provide a form of insurance, as forests are crucial safety nets, with communities turning to the forests for sustenance and income in the face of severe climatic and non climatic events (Campbell, 2009, Nkem et al., 2010).

Exploring options that promote synergy between adaptation and mitigation, can be beneficial to the REDD mechanism which is presently advocated as an important measure for climate change mitigation. REDD activities could affect the vulnerability of the society at regional and local scale but poorly designed REDD activities could also deprive local communities of their main sources of livelihood (Dkamela et al., 2009). It is therefore necessary to promote synergies in forestry management and in other sectors which depend from forest ecosystem goods and services (Murdiyarso et al., 2005, Ravindranath, 2007).

2.2.1 Synergy at the sub-national level

At the project level, adaptation opportunities exists in mitigation activities, while on the other hand, adaptation activities can promote forest conservation, biodiversity and enhance the conservation of carbon sinks. Some forest management options are able to incorporate adaptation options (IPCC 2007; Ravindranath2007). First, forest conservation through REDD is a potential adaptation activity. Biodiversity rich forests, are less vulnerable and more resilient to climatic and non-climatic stresses, hence they have the ability to sustainably provide ecosystem goods and services to the environment and for the society, such as watershed protection, and better livelihoods. Second, the expansion and management of protected areas could halt deforestation

and re-growth of trees resulting in carbon sink conservation and sequestration. However, this management option can also limit local people's use of resources. Linking different protected areas offer migration opportunities for plants and animal species; this could facilitate adaptation to climate change and variability. Third, mitigation activities such as urban forestry, sustainable forest management, agro-forestry, all have potentials of conserving carbon sinks and sequestration, while at the same time reducing the vulnerability of forest and forest communities to climatic and non-climatic stresses (Ravindranath, 2007).

On the other hand, adaptation options could also offer opportunities for carbon sequestration and carbon sink conservation. Projects aimed at conserving water and soil, developing resistant crop species, improving soil organic matter content, forest and biodiversity conservation and urban park and tree planting, can play double roles in the response to climate change in the forest sector (Ravindranath, 2007).

Some factors and principles have been identified to verify and guide the extent to which synergy and trade-offs exist between adaptation and mitigation activities.

Firstly, identifying the individuals or communities participating in the response options is crucial. It is important to determine the extent to which the communities targeted for adaptation and mitigation activities overlap. The communities to be involved in adaptation activities are identified by vulnerability assessments. And the vulnerability of such communities to climate change may be determined by food security, skills and capacity, level of development and primary economic activities. Subsistence agricultural communities with high food insecurity and with little livelihood diversification have less opportunities to respond to climate change. The willingness and capacity of the population to participate in mitigation strategies can also be determined by the socio-economic situation of the communities (Murdiyarso et al., 2005). However, these are relationships that require empirical investigation. Murdayarso et al (2005) further highlight that the vulnerable groups in most communities are the poor and food insecure people who depend on agriculture and other natural resources for their subsistence. On the other hand these same vulnerable communities can also contribute in enhancing sinks or reducing sources of greenhouse gases through land use changes. However, their efforts and incentives to participate in response activities may be influenced by access and use of resources, land tenure arrangements etc. It is therefore important to ask whether addressing the constraints arising from the vulnerability of vulnerable communities can provide a base to design policies which can

promote synergy between adaptation and mitigation activities. These are issues which still need to be tested and verified empirically.

Secondly, the location of the project is very critical in determining the need for adaptation and the effectiveness of mitigation. Climate change impacts and vulnerability of communities are spatially distributed. Communities with vulnerable agro-ecological areas require more efforts in terms of adaptation. Mitigation potentials are also spatially distributed. Characteristics of soils, topography, land-cover use and climate patterns drive the potential productivity of sequestration as well as alternative land uses, which ultimately will determine the incentives and feasibility to participate in sequestration programs (Murdiyarso et al., 2005).

Lastly, it is also important to know whether a particular activity on the adaptation or mitigation side increases or reduces vulnerability. Market instability can be a major source of risk to vulnerable populations, and interventions aimed at organizing markets, can provide an effective way to reduce vulnerability of forest communities to climate change and may increase willingness or incentives to participate in climate change response options (Nkem et al., 2010). Mitigation strategies can reduce the vulnerability of vulnerable populations through income diversification. Income can be generated from mitigation services like carbon markets and through the diversification of agricultural activities like agro-forestry and exploitation of non-timber products and energy products (Murdiyarso et al., 2005).

Murdiyarso et al (2005) suggest four principles that are essential for linking adaptation strategies and mitigation measures;

- Prioritize mitigation strategies that reduce pressure on forest resources;
- Include vulnerability to climate change as one of the risk to be analysed in mitigation activities;
- Prioritize mitigation activities that enhance adaptive capacity; and
- Increase the sustainability of the livelihoods of poor communities.

2.2.2 Synergy processes at the national level

The response to climate change involves different stakeholders and cuts across different sectors at different levels. Designing and implementing integrated actions requires a multi-level and cross or inter-sectoral approach. Actors and stakeholders include both state and non state actors, communities and scientists operating at all levels within a state (Figure 3.1). (Yengoh et al.,

2010). Coordinating adaptation and mitigation at the national level is important to achieve win-win options between mitigation and adaptation, which can go further to avoid major risks associated with the designing and implementation of adaptation and mitigation projects. In this circumstance, communication and collaboration (Howden et al., 2007), networking and partnership, knowledge sharing between actors and stakeholders at the national and sub-national level is required (Challinor et al., 2007). A holistic approach and understanding of forest management is also imperative in the design and implementation process of integrated climate response (Challinor et al., 2007, Murdiyarso et al., 2005).

Proper co-ordination of mitigation and adaptation strategies at local and national levels is necessary for the designing and implementation of win-win options and to avoid risk associated with the actions of the different stakeholders (Yengoh et al., 2010). Different institutions are involved in climate change adaptation and mitigation policy design and implementation. At the national level in many countries, the Ministry of Environment is responsible for the national communication program, which entails the analysis of climate change impacts and vulnerabilities and possible adaptation options across different sectors. The Ministry of Forestry is responsible for the management of forest ecosystems. In addition, the Ministry of Energy is concerned with decisions regarding energy generation and distribution. Coupled with the presence of NGOs and other stakeholders involved in the climate change response in the forest sector and if the activities and programs of these ministries are not well co-ordinate, adaptation and mitigation strategies will fail (Murdiyarso et al., 2005). Communication and information sharing across sectors and between levels of governance is vital to inform and enhance coordination between the different levels of decision-making about the priorities and possibilities necessary in meeting climate change response challenges (Yengoh et al., 2010). The pertinent question is how can this co-ordination be carried out and facilitated for better design and implementation of win-win policies?

The forest sector is an area where some international conventions share common concern on environmental and sustainable development issues in the context of climate change and climate variability. Efforts are already being made at the international level between the UNCCD (United Nations Convention to Combat Desertification) are, CBD (Convention on Biodiversity) and UNFCCC, to promote synergy in the implementation of mitigation and adaptation strategies and policies. This raises questions of how these activities should be synergized at the national and

local level and what mechanisms or approaches should be employed to effectively promote these synergies (Murdiyarso et al., 2005). Synergizing the activities of the UNCCD, UNFCCC and CBD requires linking their provisions on sustainable forestry, adaptation measures, monitoring and environmental impact assessment. Joint effort is required to analyze the impacts of climate change on biological diversity and to integrate biodiversity concerns in the designing and implementation of land-use and forestry activities under the different climate change mitigation measures or under adaptation measures as well as to combat desertification and land degradation (Murdiyarso et al., 2005). Enhancing biodiversity conservation is relevant from the local livelihood perspective which is said to be important to enhance the adaptive capacity local communities (Reid and Huq, 2005).

Networking among institutions would facilitate learning on how to integrate climate change response with other priority areas like forest and biodiversity, poverty reduction and sustainable development (Brown, 2009).

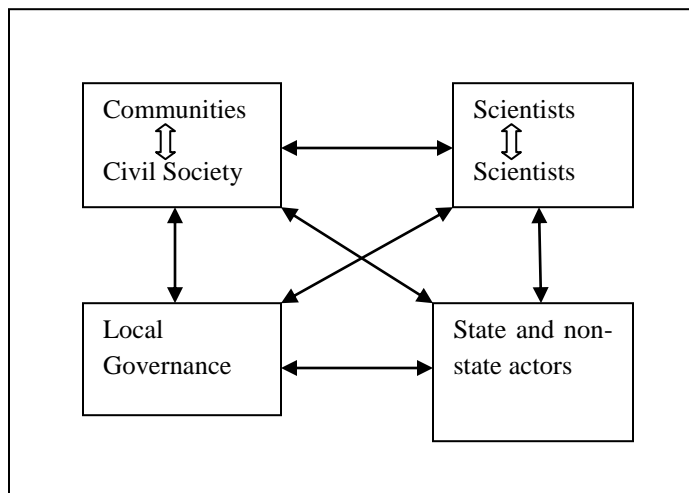


Figure 2.1: A multi-level collaboration and information sharing framework for addressing cross and inter-sectoral problems related to climate change and variability (adapted from Yengoh et al. 2010).

2.3 Analytical framework

The above concepts can be used in a framework to analyze win-win strategies between climate change adaptation and mitigation at the sub-national level in the forest sector. This framework assumes that livelihood activities are vulnerable to climate change and climate variability, institutions and markets, which influences the outcome of livelihoods activities. The outcome of livelihood activities is associated with the adaptive and mitigative capacities of local communities. Equity, participation, knowledge and capacity can influence the vulnerability of local communities to climate change, and are on the other hand related to the outcome of mitigation activities. The outcome of mitigation activities can also influence the adaptive capacity or vulnerability of forest communities. External factors such as markets for carbon and NTFPs can influence vulnerability or adaptive and mitigative capacities and hence the outcome of mitigation activities. The outcome of livelihood strategies can also be influenced transforming processes and structures which can be seen as the institutions, policies and legislations that influence livelihoods (DFID 199). The actions of NGOs, private logging companies and the carbon projects might constraint or enhance the livelihood activities of local communities.

According to this framework, the incentives and motivation of forest communities is crucial in determining their participation and the outcome of forest protection activities.

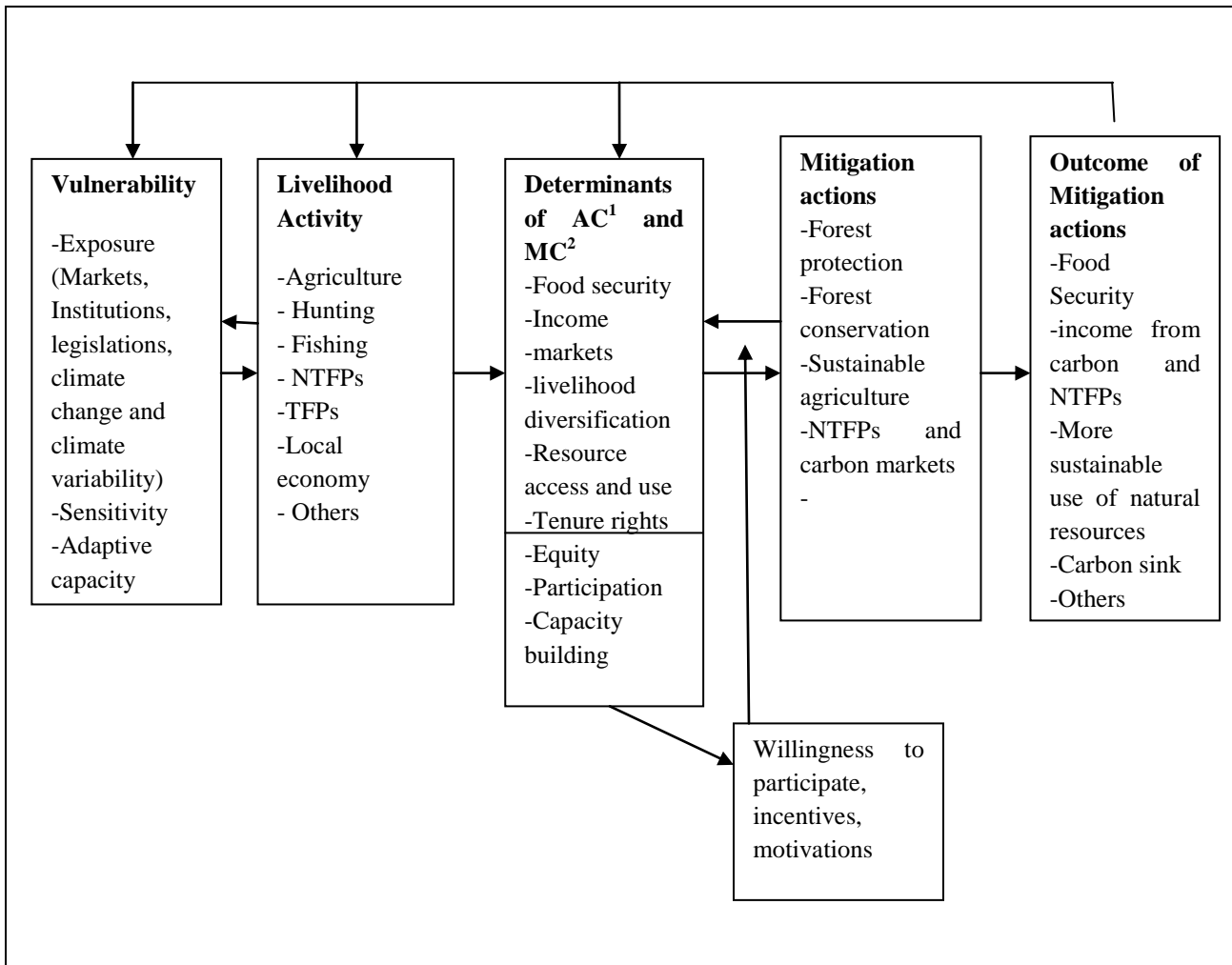


Figure 2.2: Integrated approach to analyze climate change adaptation and mitigation in the forest sector (1-Adaptive capacity, 2- mitigative capacity)

CHAPTER THREE – CASE STUDY CONTEXT AND RESEARCH METHODS

This chapter will present and describe the national level context of this study, with emphasis on institutional issues and the community forest regime in Cameroon. This will be followed by a description of the study areas. Lastly, the research procedures and data collection methods will be described.

3.1 National level context

3.1.1 Institutional capacity of climate change and forest policy framework in Cameroon

The Ministry of Environment and Nature Protection (MINEP) in Cameroon, is the main body which defines and implements climate response policies and actions at the national and international scenes. The Ministry of Forest and Wildlife (MINFOF) is the main institution responsible for the management of forest, through the implementation and enforcement of the forest legislation. How the two ministries operate to guarantee better climate response, relating to mitigation and adaptation in the forest sector, remains a big challenge. The National Agency for Forest Development (ANAFOR) is an arm of MINFOF, with the task of ensuring forest regeneration. The actions and policies of MINFOF are based on the Forest Environmental Sector Plan (FESP), and this plan also serves as a guide for local, national and international organizations as well as bilateral activities in the forest sector. However it has been highlighted that the establishment of the FESP had little or no involvement of civil society, research institutions, private sector, and the media. The FESP has five management components, four attributed to the MINFOF and one to MINEP. Regional institutions are also involved in the forest management process in Cameroon. Cameroon hosts the secretariat of the Congo Basin Forest Commission (COMIFAC), and plays a major role in the Congo Basin Forest Partnership (CBFP) and it is a member of the Conference on Ecosystem Forests and Wetlands of Central Africa (CEFDHAC).

The forest sector also gets institutional support from professional schools and universities that train Cameroonians on different aspects related to forest management. In addition, international organizations like CIFOR (Centre for International Forestry Research), ICRAFT (World Agroforestry Centre) CIRAD (International Centre for Agriculture Research and Development),

IUCN (International Union for the Conservation of Nature WWF (World Wildlife Fund), IITA (International Institute of Tropical Agriculture) etc are also involved in forest management issues in Cameroon (CBFP, 2008). Furthermore bilateral institutions such as European Union (EU), German Technical Corporation (GTZ), Corporation Francaise (CF), are also involved in forest management and governance issues in Cameroon. Some civil society organizations are consulted, though rarely in policy processes.

There is insufficient capacity in the forest management sector due to the lack of human and financial resources, and the MINEP also has insufficient institutional capacity to provide technical support, coordination, collaboration, partnership, knowledge and information sharing within the climate change response machinery (Dkamela, 2010).

3.1.2 Community forest tenure in Cameroon

The 1994 forestry law and its subsequent supporting decrees, established the base for decentralized forest management in Cameroon. This approach had two major objectives (Oyono, 2007);

- To promote community participation in forest management
- To contribute to sustainable forest management.

This restructuring established community forests as one of the mechanisms of decentralized forest management in Cameroon. The 1994 forest law gave opportunities for village communities to create community forests. According to this law, a community forest refers to part of the Non Permanent Forest Estate (NPFE), with a management plan agreed upon between the community and the forest administration, and management is entrusted to the village concerned with technical support from the forest administration (GoC, 1994, GoC, 1995). To establish a community forest, the village community needs to organize itself into a legal entity such as an association, common initiative group or a co-operative and it can be set up over the place where the village community has customary rights (Oyono et al., 2007). Once established the communities can start exploitation through frequently used mechanisms such as; industrial logging, artisanal logging under the control of the community itself and artisanal logging in partnership with a logging company (Oyono et al., 2007). A community forest management plan is signed for a period of 5 years over a surface area of not more than 5 000 hectares and is renewable over a period of 25 years, and it is liable to suspension if the forest is poorly managed

(GoC, 1995). Research has indicated that the processes of creating community forests in Cameroon is slow and challenging, due to lack of information to and among local communities and complex and expensive financial, bureaucratic and administrative procedures (Djeumo, 2001).

The process of power transfer is conditional, according to Oyono et al (2007), and it has the effect of making local leaders accountable to MINFOF instead of their population, thus reducing local freedom in decision making. This is based on the fact that the community forest is liable to suspension and withdrawal by the MINFOF if poorly managed. In this case power is only delegated, and insecurity looms over rights of ownership and exploitation by village communities. The positive impacts of devolution of power on local democracy, equity, living standards, poverty alleviation, social and environmental sustainability is yet to be experienced (Oyono et al., 2007, Oyono, 2005).

3.2 The PES REDD projects

The PES REDD projects are part of the Congo Basin Forest Fund (CBFF) initiative established by the government of United Kingdom and Norway with the goal of assisting forest communities in the Congo basin to protect tropical forest by finding ways to integrate PES and community forest management. The projects are supposed to run for a five year period, and a trust fund has been set up and administered by the DFID (Department for International Development) has commitments to provide payments to the communities for halting or slowing down deforestation. The projects were initiated and implemented by the Center for Environment and Development (CED), with collaboration and acceptance from the communities concerned. The CED has worked and supported the communities in Nkolenyeng and Nomedjoh for more than a decade. It has supported the communities in obtaining their community forest permits from the state. In addition, it has worked with the communities to understand their land management skills and livelihood activities and identify ways in which they can manage their resources more sustainably. Other partners in the project include the Bioclimate Research and Development, Econometrica and the Rainforest Foundation UK. Project partners agreed that the carbon stocks in woody biomass will be a useful and relatively straightforward means of measurement. The funds will flow from the trust fund, to the CED, and then to the Community Forest Management

Committees (CFMC), which will be used to finance the different components of the projects (figure 3.1).

The objectives of the project are; to maintain carbon stocks and biodiversity through maintaining forest cover, increase community knowledge and capacity on forest management, provide income generating activities to alleviate poverty, help develop technical capacity and support reforms and formulation of national community forestry legislation and institutions, and lastly derive practical lessons for future REDD policy processes. The project activities comprise; forest protection and regeneration, sustainable forest use and management, sustainable agriculture and NTFPs generating activities.

Payments were supposed to start flowing by December 2010, but by the time of data collection none of the communities have received money or compensation attributed to carbon sales. The financial flow from the project will be used to invest in the activities mentioned above, in other to sustain livelihoods over a long-term (Figure 3). Some of the activities have been initiated by the project partners, with some members of the local communities acting like resource persons and these activities are financed by project donors. In addition to activities, the projects have a social component which comprises of an array of rural development issues (housing and road infrastructure, health and education amenities etc.) communities have to choose among. The project also takes into consideration the interest of the different ethnic groups, age groups in proposing and designing social benefits (Figure 3.1).

Decisions on the different projects to be financed and the utilization of the revenue from carbon sales are made by the various communities

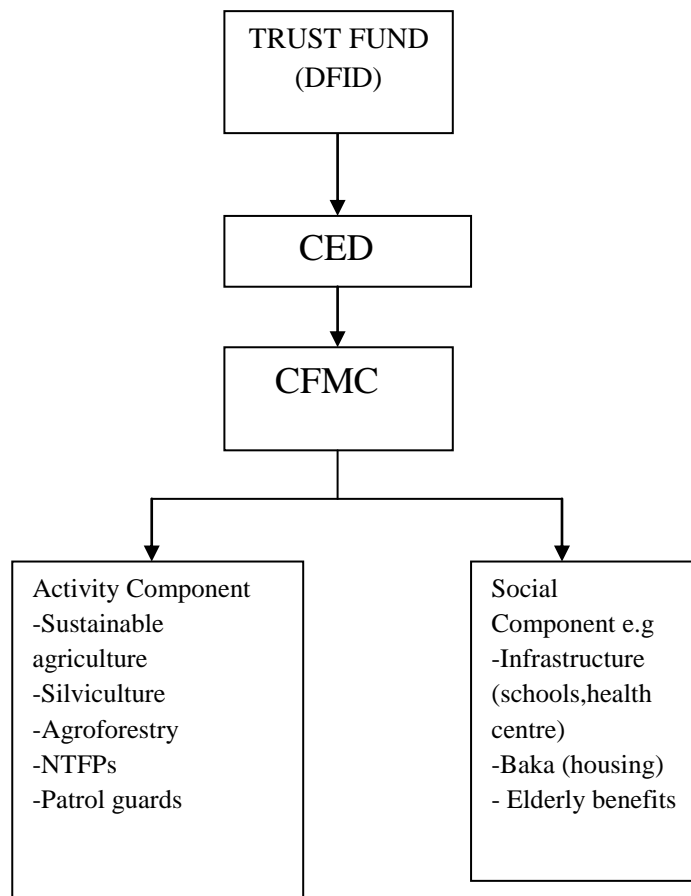


Figure 3.1 Schematic representation of PES project and possible financial and benefit flow, Community Forests Management Committees (CFMC)

3.3 Local context

This study was carried out in two different community forests where pilot REDD-type projects are being implemented. They are the Nkolenyeng and the Nomedjoh community forests. At the time of case study selection, these were the only REDD projects in the Congo basin forest of Cameroon, and they suited the research objectives of this study. In addition, the CED selected these two communities for the REDD pilot projects due to their long involvement and experience in forest management processes in the two communities.

3.3.1 Study site – Nkolenyeng community forest

The Nkolenyeng community forest is located in Djoum sub-division in the Dja and Lobo division in the Southern region of Cameroon (Figure 3.1). It was created in 2005, and it covers a surface area of about 1,042 hectares.

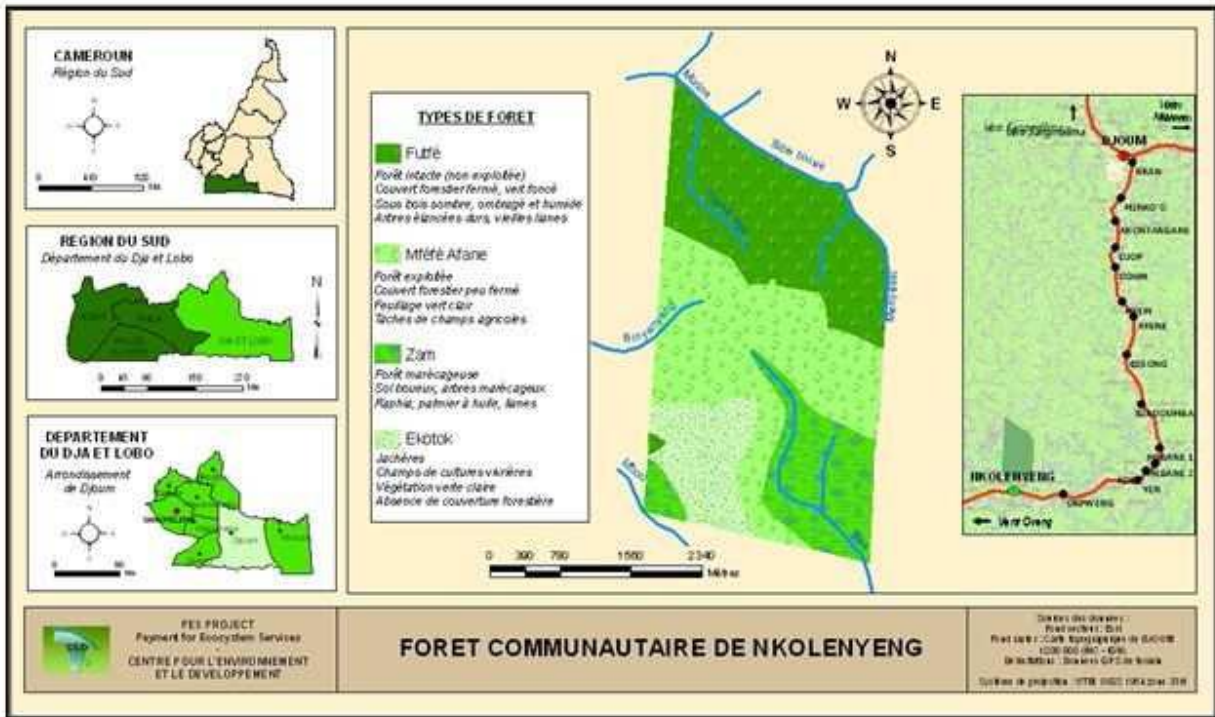


Figure 3.2: Map showing the national, regional, divisional location and forest cover types of the Nkolenyeng community forest (BRD, 2010).

3.3.1.1 Physical description- climate, land use and forest cover

The area is characterized by an equatorial climate, made up of two dry seasons (November – February and July – mid-September), and two rainy seasons (March to June and mid-September to late October). Annual rainfall is between 1,600 mm and 1,700 mm and average temperature range from 19°C to 29 °C (Santoir, 2004).

The forest is mixed evergreen and deciduous humid forest. Some parts of the forest are permanently flooded while some parts well drained. The Forest is dense, except in areas where it has been cleared for fields and where village tracks are located. The land use is characterized by slash and burn agriculture and this follows short and long fallow periods ranging from two to

seven years. The forest cover in Nkolenyeng has been stratified as follows (Neale et al., 2010) (figure 3.2) ;

- Futfe – relatively undisturbed forest.
- Mfefe-Afane – degraded forest which has been logged for commercial purposes
- Ekotok – regenerating forest with fallows and crop areas
- Zam – permanently flooded forest
- Banana plantations and newly open cocoa fields - planted with banana and areas that have been recently cleared and inter-planted with cocoa trees
- Agriculture fields – areas currently under cultivation with food crops
- Cocoa plantations – established under the cover of large trees

3.3.1.2 Forest degradation processes, trends and main drivers

The main driver of deforestation and forest degradation is the clearance of forest to establish mixed agriculture fields for subsistence and for commercial purpose. The establishment of new cocoa fields as well as banana fields for subsistence and commercial purposes is responsible for the thinning or more substantive removal of forest cover.

3.3.1.3 Socio-economic and cultural context

Nkolenyeng has a population of 555 inhabitants, 56 % of whom are women and young people below the age of 20 make up 60% of the population. This population comprises two ethnic groups: the Fang (92% of the population) and the Baka (8% of the population). However during the cocoa harvest season, the community experiences a population increase as a result of seasonal workers, mainly between the months of March and December.

The village has a primary school with an enrollment rate of 23 %. The village also has a small health centre, a bore hole for safe drinking water, three Christian churches for worship and some small shops that sell basic commodities.

Cocoa is the main source of income for the Fang community members in Nkolenyeng. Other sources include the sale of bushmeat, livestock (goats and pigs) local brewed wine, plantain, peanuts, cassava and maize. The Baka population in Nkolenyeng makes little or no income from the agriculture fields. Their land sizes permit them to produce basically for subsistence. They supply hired labour to the Fang agriculturalists in exchange for food, clothes and money. They

also raise income from the sale of NTFPs such as bushmeat, local brewed wine, rattan for basket production and honey.

3.3.1.4 Relevant governance organization

The community forest is managed by the AFHAN Development Association (Association de Femmes et Hommes ami(es) de Nkolenyeng, in accordance with the community forest management plan. AFHAN is an association of the sons and daughters of the Nkolenyeng community and its decision influences socio-economic affairs of the community. With support from the community, the AFHAN is responsible for initiating, implementing and monitoring socio-economic development in the community. However, with the PES project which appears to be a major source of revenue and development, the credibility of the AFHAN is put to question. Common Initiative Groups (GICs), provide support to increase production and the marketing of agriculture products and NTFPs. During cocoa harvest seasons, the members of the GICs pull their produce together and look for a common market. Through this arrangements members say that they get better market prices than if they did the marketing individually.

3.3.2 Study site – Nomedjoh community forest

Nomedjoh is located in Lomie sub-division in the Upper Nyong division in the Eastern region of Cameroon (figure 3.2). The village is situated along a 2 km distance on the Abong-bang - Lomie road. The area of the community forest is 1942 hectares. The community forest is surrounded by two other community forest (the Assobadjoka and the Codevir), a forest management unit (UFA) and a co-management zone (Djaposten).The community forest to the north belongs to the Bapile, Djaondjila, Kassarafam villages, while the one to the south belongs to the Djebe, Nemeyong, Djenou, Abakom villages respectively.

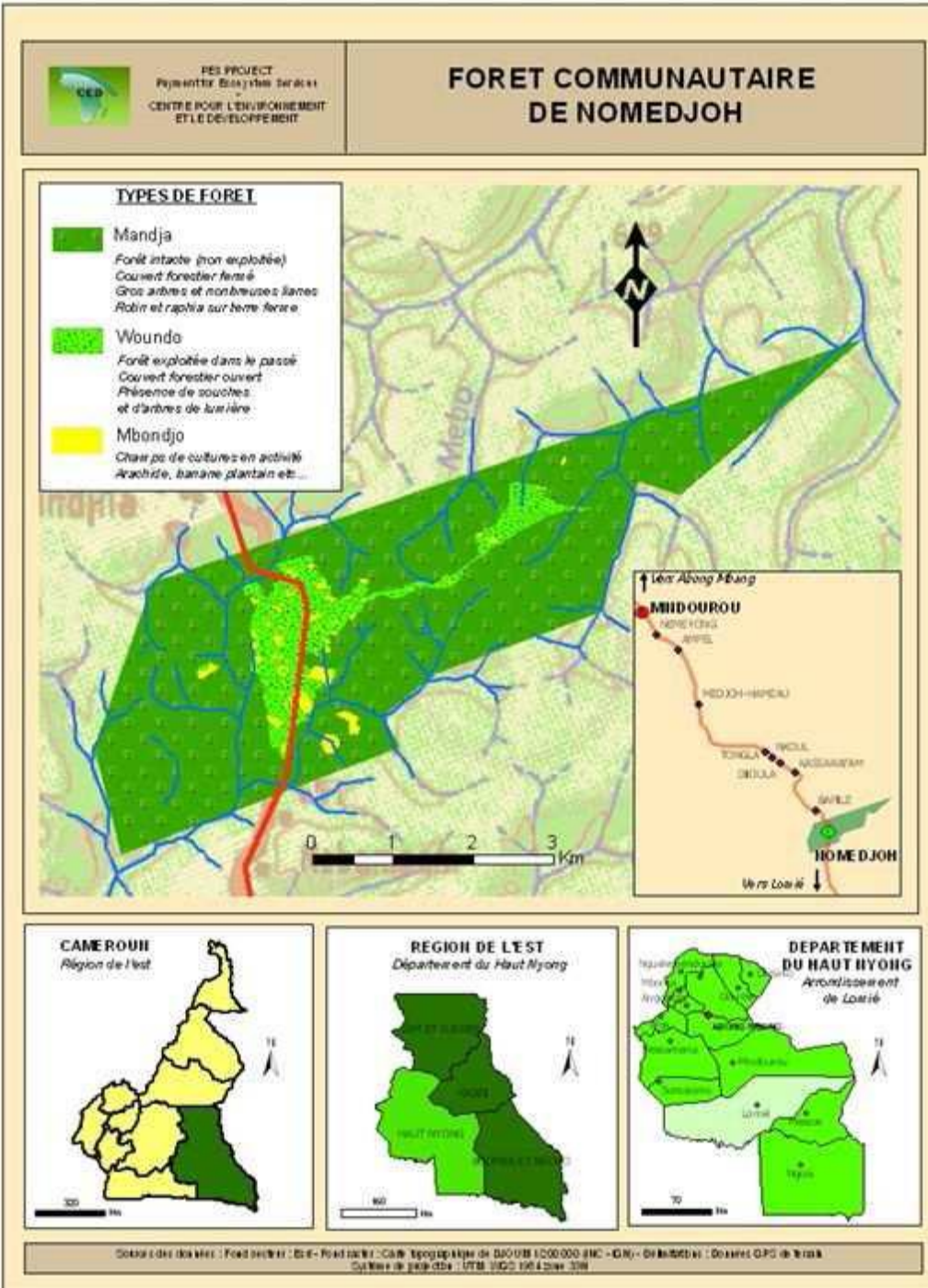


Figure 3.3: Map showing the national, regional and divisional location and the forest cover types of Nomedjoh community forest (BRD, 2010).

3.3.2.1 Physical description of land, land use and forest cover in Nomedjoh

The forest type is mixed evergreen and deciduous humid forest. The forest is stratified according to the language of the Baka ethnic group as follows (figure 3.3):

- Mandja – relatively undisturbed forest area
- Wondouo – regenerating forest where fallows are located
- Mbondjo – deforested, where agriculture fields are located

3.3.2.2 Forest degradation processes, trends and main drivers

The principal driver of deforestation in this area is the clearance of forest by non-villagers settlers to establish mixed agricultural fields. In addition community members also clear down forest to established mixed agricultural fields mainly for subsistence.

3.3.2.3 Socio-economic and cultural context

The village was created in 1974 and the community is predominantly Baka (pygmies) with some few Bantu households living in the village. It is made up of 15 clans with an estimated 157 households, and a fluctuating population size between 600 to 896 people. The social structure is based on the clans composed of large families, usually headed by the eldest person in the family. The village has a government primary school, a missionary dormitory for Baka girls, which is managed by the programme called the “Foyer des jeunes filles Baka” (Dormitory for Baka girls). This programme was created and run by the catholic missionaries. This dormitory now houses about 12 Baka girls. The community has a borehole and a community hall under construction. There is no health centre, and the community members receive health care from Lomie or Djaposten.

3.3.2.4 Source of income

The Baka community in Nomedjoh raise income primarily from the collection and sale of NTFPs (Mbalaka, Nguimba, Maobi, Bush-mango, wild honey, raffia tree grubs) and hunting. Other sources of income include wages from agriculture labour from neighboring Bantu villages, the making and selling of baskets from rattan and at times from the sale of crops harvested from subsistence farm lands.

3.3.2.5 Relevant local institutions in Nomedjoh

The affairs of the Nomedjoh village is managed and directed by the `Chefferie` which is a state-recognized entity, made up of a chief and a committee. In addition to the chief, the committee has a secretary general and 11 notables representing the major families (Kobos) in the community. Decisions taken by this committee influences the whole community.

The Nomedjoh community forest is managed by the Boumo Bo Kpode , a legal entity that serves as the forest management committee in accordance with the forest management plan. This committee is made up of men and women and decisions taken here influence the whole community. Comite de Gestion de RFA (forest royalties management committee), is responsible for the management of the annual forest royalties which started flowing in 2005 from the Lomie rural council. This committee acts like an organ of interface between the Lomie rural council and the community. Other important community structures include; the Comite de developpement (village development committee); the Parent's Teachers Association (PTA), common initiative groups (GICs,), created to enhance agriculture activities and the collection and marketing of NTFPs. The various committees are comprised of representatives from the 11 major families, and each family selects a representative within their family. However, the village general assembly also has a major role to play concerning the management of village affairs.

The Nomedjoh community has also experienced the presence of some external institutions, which have been instrumental in the economic, social and cultural empowerment of the Nomedjoh community. They include; Plan Cameroon, CED, Comite d'action pour le developpement de la femme (CADEFÉ), Organization for Environmental Protection, Research and Development Support in Africa (PERAD).

3.4 Research Methods

3.4.1 Data collection procedure and sampling technique

In accordance with the research objectives, data collection was directed towards the two first REDD-type projects in the Congo basin forest of Cameroon. Prior to going to the field, informal meetings were held with CED staff involved in the REDD projects to get background information, administrative and logistic issues in relation to field work in Nkolenyeng and

Nomedjoh. With the initial population information, a total of 86 and 56 questionnaires were to be administered in Nomedjoh and Nkolenyeng respectively.

Simple stratified random sampling was used to identify households in Nkolenyeng, in which the village was divided into quarters (Eko-ze, Mone nlam, Mintom and Oding which is a Baka neighborhood), and households selected from these quarters randomly. In Nomedjoh, one after every two household was sampled from the start of the village to the end, as the village is located along a 1km road.

Prior to data collection, an information meeting was held in each of the villages at the village meeting ground, with villagers who were able to attend following, the announcement made by the chiefs. The objective was to highlight my presence in the village, the objectives of the study and issues related to households identification and individual household appointments.

3.4.2 Household questionnaire survey

Questionnaires were used to collect data from households, using both closed and open ended questions. The questionnaires addressed to households covered issues related to (appendix 1):

- Socio-economic characteristics of households
- Agriculture land ownership and expansion
- Tenure, access and use of resources
- Local economic activity
- Equity and participation
- mitigation Awareness, knowledge and perception of climate change and adaptation actions
- Awareness, knowledge and perception of actions.

A total of 65 and 45 questionnaires were administered for Nomedjoh and Nkolenyeng respectively. Questionnaires were administered with the aid of a hired interpreter in each of the villages. French was the main language during the survey. Questionnaires were address to household heads, and women responded as household heads at certain circumstances such as absence of husband, divorced, single, widow etc.

3.4.3 Key informant interviews

Relevant qualitative data was collected from key informants. Informal interviews and discussions were held with the village chiefs, elders and villagers who are involve in various village committees related to the socio-economic issues and the management of community forest. Resource persons of the PES projects at the community level were also involved in informal interviews and discussions. They provided information on the development and implementation of the PES project including some practical challenges. Furthermore, informal discussions were carried out with some individuals involved in the climate change respond processes in Cameroon.

3.4.4 Field Observation

Information was gathered through field observation during the stay in the study areas. Observations where centered on farm sizes, distance of farms from households, farming methods, type of crops, project activities (experimental farms, nurseries, bee-keeping activities) of the carbon forest PES project, and other social and cultural issues pertinent to the study.

3.4.5 Secondary sources

Secondary data were collected from reports and studies that have been carried out in the study areas, Cameroon and the Congo Basin forest in general related to forests, livelihoods and climate change adaptation and mitigation processes (BRD, 2010, Dkamela, 2010, Dkamela et al., 2009, Brown, 2009, CoFCCA, 2009, Haore, 2007, CBFP, 2008). CIFORs data base provided relevant information on forests and climate change issues in Cameroon. CED reports provided reports on studies that have been carried out in the study areas. Peer reviewed articles and reports from other NGOs, GOs also provided other important information. In addition, policy documents and legislation on forests exploitation in Cameroon and the current trends of climate change adaptation in Cameroon where also analysed.

3.4.6 Limitation of data collection

Data was collected amidst research fatigue in the study areas. The study areas are host to two pilot REDD-type projects, with so much attention which have attracted so many researchers

within a very short period of time. At the time of data collection communities were waiting impatiently for initial financial and social benefits of the REDD-type project.

3.4.7 Data Analysis

The response from households were analysed using the SPSS statistical package. Frequency tables were used and the proportions were analysed in percentages to identify dominant responses between households. Chi-square was also employed where variables were cross tabulated to investigate the relationships between variables and the differences between communities in relation to particular variables.

CHAPTER FOUR – FINDINGS AND DISCUSSION

This part will present some of the findings, views and discussion in relation to the objectives and research questions of the study. Arguments will accentuate on the;

- concerns and needs of forest-dependent communities regarding adaptation to climatic and non-climatic changes
- threats and opportunities emerging from the relationship between the adaptation needs of forest communities and the implementation and positive outcome conservation of activities
- required actions and roles of stakeholders and actors in the design and implementation of synergetic strategies

The results and discussions presented are based on the data collected within the sample in the study areas. It may slightly diverge from the results of other studies in and around the study areas (Samndong, 2009, BRD, 2010, Neale et al., 2010). This part will begin with the vulnerability concerns of the communities in question and this will be followed by their adaptation needs. The next section will present the threats and constraints for conservation activities, and the opportunities the PES objectives and activities offer to the adaptation needs of forest communities. This section will further highlight areas of synergy, or common ground between the adaptation needs and the forest protection objectives. Lastly, the role of relevant stakeholders based on the activities and needs of a synergetic response will be presented.

4.1 Vulnerability concerns of the forest communities

The major concerns of the two communities are; their exposure to local climate variability and the constraints on their ability to adjust to changes caused by the presence of the PES project, which differs according to figure 4.3. In addition, particular features and some facts about the socio-cultural setting and different livelihood options of the forest people will be highlighted and the disparity between the two forest communities dominated by the Baka and Bantu-Fang ethnic groups in Nomedjoh and Nkolenyeng respectively will also be presented. Traditionally, the Baka ethnic group is a typical nomadic hunter-gatherer group. However they are settling down

gradually and they are in a transition towards an agrarian way of life; with a greater proportion of the sample having attempted at least to start primary education. On the other hand, Nkolenyeng is made up of a long established and settled agrarian Bantu-fang ethnic group, with a small Baka population (Table 4.1).

Table 4.1: Socio-economic features of study areas captured in the sample.

Features	Nomedjoh(N=65) %	Nkolenyeng(N=45) %
Ethnic group		
Bantu-fang	0	90
Baka (pygmies)	100	10
Gender		
Male	71	69
Female	29	31
Household size		
0-5	73	47
6-10	26	52
Level of education		
None	15	20
Primary	75	48
Secondary	9	31

To understand the concern of forest communities in relation to climatic and non-climatic changes, it is important to first identify the livelihood activities and other relevant socio-economic issues of the local people in the two communities.

4.1.1 Livelihood activities and sources of income in Nomedjoh and Nkolenyeng

Households in the two communities carry out different types of activities to achieve livelihood outcomes (Table 4.2). Agriculture, hunting, collection of NTFPs, fishing constitute the major activities and sources of income. This appears as indicated in the analytical framework in figure 2.2. However, the level of involvement and intensity varies between the two community forests and most of the households are involved in more than one of the activity (Table 4.2). This finding is similar to another study (Samndong, 2009) carried out in and around this study area.

Table 4.2: Main livelihood activities and source of income in study areas

Livelihood activities	Nomedjoh(N=65)%	Nkolenyeng(45)%
Agriculture	15	91
Hunting	22	2
Fishing	3	0
Collection of NTFP	66	0
Others	0	7

4.1.1.1 Agriculture methods in the study areas

Agriculture production is very important for income and livelihoods for communities in developing countries. The agriculture system comprise of agriculture activities, types of crops grown, and the process of acquiring agriculture land. Households are involved in a variety of agriculture activities (Table 4.4). This study shows that about 15 % and 91 % of the households in Nomedjoh and Nkolenyeng respectively have agriculture as their main livelihood activity and source of income. The community in Nkolenyeng is more concerned with agriculture than the Nomedjoh community because it is traditionally an agrarian society where agriculture is a prime means of support and sustenance. Meanwhile, the Baka community in Nomedjoh as the table is more involved in NTFPs collection and hunting than the community in Nkolenyeng, because it is a hunter-gatherer society, and they are still in the process of becoming agrarian and sedentarised. Agriculture is an activity, but not the most important; it is carried out for subsistence purposes. However, nearly all households (95 % for Nomedjoh and 96% for Nkolenyeng) surveyed stressed their involvement in agriculture for household subsistence and food security.

The major crops grown in the study areas include; cocoa, cassava (*Manihot esculenta*), plantain (*Musa paradisiacal*), groundnuts (*Arachis hypogea*), maize (*Zea mays*), coco-yams (*Xanthosoma sagittigolium*) and sweet potatoes (*Ipomea batatas*) (Table 4.3). Many of the households surveyed are involved in cash cocoa production, mainly in Nkoleyeng, made up of the Fang

ethnic group. More than 90% of the households involved in the study in the Nkolenyeng community forest are involved in cocoa production, against none of the households in the Nomedjoh community forest is involved in cocoa production. Cocoa production is a traditional cash crop for the Bantu-fang ethnic group in the South region of Cameroon, with nearly all families involved in cocoa farming. Cocoa farming is not favored by a nomadic way of life as, practiced by the Baka in Nomedjoh however the small Baka population in Nkolenyeng is gradually getting involved in cocoa farming. This is because they have been forced to settle permanently by the Bantu community in Nkolenyeng. Maize and groundnuts is part of the traditional meal for the Bantu in Nkolenyeng and that is why they are more involved than the Baka community where maize and groundnuts is little known. These crops are gradually being introduced in the Baka community in Nomedjoh. Despite the fact that coco-yam and sweet-potatoes production in Nkolenyeng is not captured in the sample, it is produced by some households. They are not the primary crops as compared to the others. The local agriculture systems in the two communities depend on natural rainfall, temperature and sunshine.

The importance of agriculture in the communities indicates the importance and processes involved in agriculture land acquisition, ownership and sizes. Acquisition of agriculture land in the study areas follows three different processes; inheritance, cleared forests, and hired, and ownership of land is through permanent use of land. None of the households possessed a land title (Table 4.5). Acquiring land through forest clearing necessitates acceptance between immediate neighbours and family members. The sizes of agriculture land varies between the communities, households in Nkolenyeng possessed bigger land sizes as compared to households in Nomedjoh. There is significant difference ($p=0.00$, $df=2$) of land sizes between the communities (Table 4.6). This is due to the fact that agriculture constitutes the main livelihood activity and source of income in Nkolenyeng as compared to Nomedjoh where agriculture is mainly for subsistence. Agriculture for cash purposes requires more land.

Table 4.3: Major crops produce in the study areas

Main crops grown	Nomedjoh (N=65)%	Nkolenyeng(N=45)%
Cocoa	0	90
Cassava	97	89
Plantain	85	98
Groundnuts	9	51
Maize	3	44
Coco-yam	88	0
Sweet-potatoes	60	0

Table 4.4 Agriculture activities carried out in study areas

Type of agriculture activity	Nomedjoh(N=65)%	Nkolenyeng(N=45)%
Subsistence	95	96
Small-scale	8	13.3
Plantation(cocoa)	0	76

Table 4.5 Land acquisition and ownership processes in study areas

Land ownership processes	Nomedjoh(N=65)%	Nkolenyeng(N=45)%
Inherited	27	100
Cleared forest	78	16
Hired	2	0
Land title possession	0	0

Table 4.6 Size of landholdings in study areas

Size of landholdings	Nomedjoh(N65)%	Nkolenyeng(N45)%
0-2 ha	94	27
2-4ha	6	31
>4ha	0	42

4.1.1.2 Collection and sale of NTFPs

Forest resources in the form of NTFPs serve as safety nets, sustaining the livelihoods of some forest communities like in Nomedjoh. They play a vital role in income generation and household food security (Nkem et al., 2010). The results of this study indicates that the collection and sale of NTFPs is a major livelihood activity and a source of income for households especially in Nomedjoh and the access to NTFPs is open to the peoples in both community forest settings. They collect NTFPs known as Mbalaka, Maobi (*Baillonella toxisperma*), Nguimba, Bush mango (*Irvingia gabonensis*), Njansang (*Ricinodendron Heudelotti subsp. Africanum*). In addition they are also involved in the harvesting of wild honey, collection of fuel wood and sticks for construction. NTFPs collection is very strategic in the Nomedjoh community forest; it constitutes about 66% of main livelihood activity and source of income. However nearly all community members in Nomedjoh are involve to a certain extend in the collection of NTFPs for subsistence

purposes. According to the quantitative data collected none of the households in Nkolonyeng is involved in NTFPs collection as a major activity. Despite not captured by the data, some households collect NTFPs once in awhile. All households in the study areas depend on fuelwood for household fuel and energy. Households also mentioned the collection of mushrooms, caterpillars, canes for basket making as in (Samndong, 2009). *B. taxosperma* seeds are used in the production of cooking oil, and it is described by the villagers as oil with a better quality and flavour. However very limited processing of *B. taxosperma* takes place in the community.

Initially, most of the NTFPs were collected for subsistence by women in Nomedjoh, the emerging market in NTFPs increased its financial value, and both men and women are now involved in this activity. As of now men have an advantage in the collection processes since they have the energy to carry more of the fruits over long distances as compared to women. Collection is done in and out of the community forest and the Baka were exploited at first as far as the prices were concern by outside buyers. However, despite not satisfied with the present price, the Baka community is getting to understand the market situation and is gradually getting fair market deals with buyers. Mbalaka is the main NTFPs attracting many buyers from Nigeria, Yaounde and Bamenda, and during its harvesting season (November to March) it takes priority over most of the activities in Nomedjoh community forest area. The wild harvesting of honey also constitute a resource especially for the households in Nomedjoh. It usually involves the feeling of trees, thus it is mostly done by men. Honey is an important traditional asset, which demonstrates the strength and responsibility of a man when getting married, if presented to the in-laws.

4.1.1.3 Hunting

Hunting is a major livelihood activity and a source of income for some households in the study areas. However, many of the households are involved in hunting mainly for household consumption. Hunting of bush meat varies between the Baka in Nomedjoh and the Fang ethnic group in Nkolonyeng The Baka ethnic group are more involved (22% and 2% of households in Nomedjoh and Nkolonyeng respectively) in hunting as a main source of income than the Fang ethnic group, this is similar to other findings (Samndong, 2009). This is due to the fact that hunting is a traditional way of life for the Baka ethnic group. Hunting takes place within and outside the community forest areas, into forest management unit under logging concessions.

Most of the animals hunted appear to be illegal according to the 1994 forest and wildlife law, as most have been classified as endangered species. Thus, most hunting activities are illegal. Animals hunted include monkeys, chimpanzees, porcupines, snakes, birds, and rats. Hunting is mostly carried out by men using hunting-dogs and snares and some use hunting-guns borrowed from Bantus. Hunting provides income and food throughout the year, but the rainy season is a good hunting period with about three visits of snares per week. The Baka, find about three animals per visit, the first animal is for home consumption, and the other two for sale. Although returns are low during the dry season, hunting still continues and some sales are still made.

4.1.1.4 Fishing

Fishing is another activity and a source of income to some households in the study areas. About 3 % of the households in Nomedjoh carry out fishing as a major activity, while none of the households in Nkolenyeng is involved in fishing as a major activity. Despite not captured by the data as a major activity in some households, fishing still contributes to food security, and this activity is mostly carried out by women. Women frequently camp out in and around fishing sites for days during fishing seasons. They use a combination of different methods such as baskets, lines and hooks for fishing and at times build dams. They also carry out poison fishing using poisons from pounded leaves and the bark of particular trees in the forest. Fish species caught by local people include crabs, shrimps, silure and carpe. This finding is similar to the study carried out by Samndong (2009) around these study areas.

4.1.1.5 Livelihood diversification and food security

Findings from this study indicates that beside their main livelihood activity and source of income, the households are involve in at least two of the different activities; agriculture, hunting, NTFPs and fishing. Nearly all households are involved in subsistence agriculture (95% and 96% for Nomedjoh and Nkolenyeng respectively) despite the fact that they have other major activities. Households involved in different activities are more diverse. Many activities are carried out by households due to the seasonal nature of these activities and they also minimised risk as a result of negative unforeseen circumstances.

The households in the study areas are also involved in diverse crop production. Households are engage in the production of at least three of the seven main crops. As mentioned above there is a

diversity and difference in crop types between the two communities due to traditional and cultural motives. With better market prices, households can get income from the marketing of excess crops after household consumption. The more activities households are involve in, the more diverse their livelihoods, the more ability they will have to withstand risk and uncertainty (Ellis, 2000, Samndong, 2009). Livelihood diversification is also a guarantee for food security for the local population in the study areas. Household food comes directly from farm harvest (Murdiyarso et al., 2005) (100%) followed by NTFPs (99%) , hunting and fishing in both communities. This show that a threat to agriculture production is a threat to food security and apart from direct consumption, income from crop production is used to purchase other nutritional compliments for the household consumption. The threat to food security might be more in Nkolenyeng as compared to Nomedjoh, since the community in Nomedjoh have NTFPs and hunting as alternative income and food sources. Thus in situations of food insecurity forest communities are vulnerable to climate change and climate variation (Murdiyarso et al., 2005).

4.1.2 Perceptions of climate variability impacts and linkages to livelihood strategies in Nomedjoh and Nkolenyeng community forests

The vulnerability of human-environmental systems is determined by exposure, sensitivity and the adaptive capacity of environmental and socio-economic factors as indicated in the analytical framework (Figure 2.2). Exposure relates to the potential impacts as a result of changes and variation in temperature, changes in rainfall, changes in seasonal patterns and changes in climate sensitive and related resources and activities (Locatelli et al., 2008c, Ionescu et al., 2009b) . The households in both communities expressed variation in temperature and sunshine, variation in rainfall, variation in water sources, variation in sowing period, variation in harvesting period and diseases and the observation of the households is over a minimum period of 15 years, as most of the households (96%) have spend a minimum of 15 years in the study areas. On average, households have observe variations in the order of temperature and sunshine (96%), rainfall (99%), diseases and pest (5%), variation in sowing period (12%) , variation in water resources (8%) and variation in harvesting period (2%) . The magnitude of the changes was difficult to observe, observations centred on uncertainty, irregularity, and periodic changes. Rain comes unexpectedly during periods observe as dry season and delay to come during the period when rain is expected following the local seasonal calendar. This is same with temperature and

sunshine. Households expressed a distortion in the seasonal calendar which is linked to major climate sensitive schedules such as sowing and harvesting periods. Local people describe the present situation as “accident climatique”, which is interpreted as “climatic accident”. The inherent variation of climate from year to year and from seasons to seasons, makes variability an integral part of climate change (Hulme et al., 1999, Berz, 1999).

The study reveals that a significant proportion of households in the both communities (84%) are aware of the causes of the climatic accident, and they (90 %) relate it to their activities which cause deforestation and land degradation. However, they raised concerns that the causes of deforestation goes beyond their activities. This knowledge and awareness is due to effective NGO activities in the study area, as more than 92 % of households in the two communities combined, uttered getting their knowledge from NGOs especially the CED, PERAD (Organisation for Environmental Protection, Research, and Development support in Africa). There is difference between the communities regarding knowledge and awareness on the causes of climate change, however the difference is not very significant ($p=0.003$ and $df=1$). The NGOs have been involved in these areas for over a decade working with the communities and their actions cut across conservation and sustainable management of forest through participatory approaches with sustainable livelihoods, equity and justice at the heart of their actions. The CED was instrumental in the various processes in which the communities acquired legal community forest entities from the government.

Climatic conditions such as rainfall, temperature vary significantly over short periods of time i.e from seasons to seasons and from year to year, and at relatively smaller spatial scales and may bring surprises to an otherwise unsuspecting population (Yengoh et al., 2010). Exposure to isolate surprises either man made or natural leads to the degradation of the adaptive capacity of agriculture dependent communities. In addition it reduces the potentials of these communities to attain objective of food sufficiency and better nutrition. Locally specific climate stressors with low predictability are mostly likely to negatively affect small-holder and subsistence farmers (Morton, 2007). Results from this study show that, a considerable percentage of households have experienced and also predicted the impacts of unexpected variation of local climatic conditions on their activities (82% and 85% for Nkolenyeng and Nomedjoh respectively). There is no significant difference between the communities regarding perception of possible impacts of climate variability ($p=0.447$, $df=1$). Farmers complained of a distortion in the different stages of

crop production such as farm preparation, planting or sowing, farm maintenance and harvesting. Abortive germination of crops was a major complain from farmers, as a result of over and unexpected sunshine and temperature during periods initially observed for rainfall. Cocoa farmers also complain of poor harvest and they attribute it to the prolongation of rainy season. However, this relationship needs to be verified. In addition, certain crops are left in the farms, for preservation against post-harvest losses, but prolonged rainy season makes this method difficult nowadays. This situation is worse with limited preservation resources and lack of preparedness. This has immense impacts on income generation from crop production (Kurukulasuriya and Rosenthal, 2003). Households involve in the collection of NTFPs, communicated that harvesting of fruits from the different tree species is at times poor, as a result of poor flowering of the tree species. The collection of NTFPs is facing a decline according to some households. They attribute the poor flowering to the confusion in the climatic system, as they describe it. This assumption is based on local knowledge.

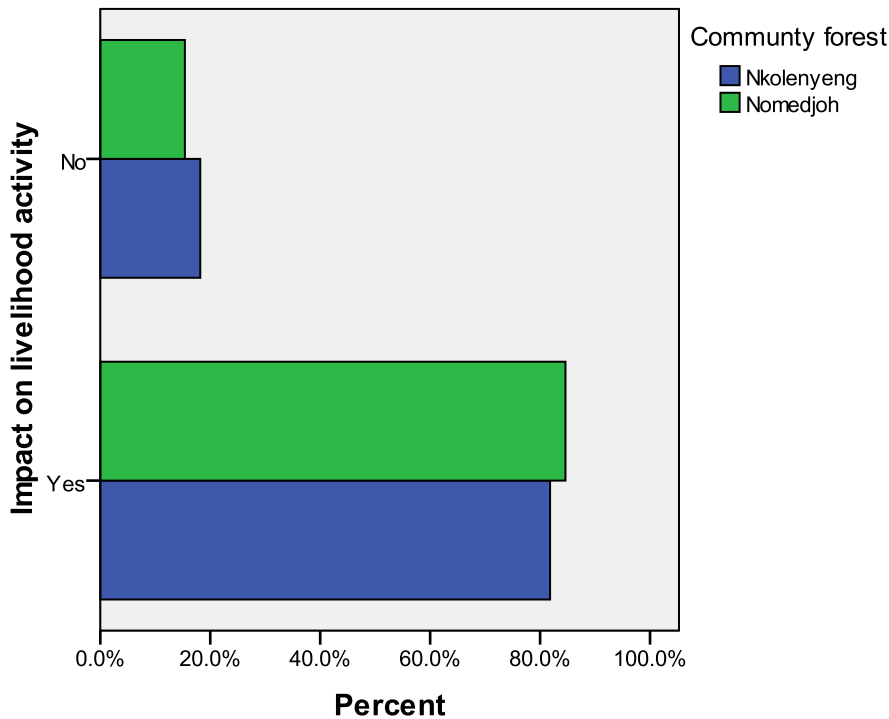


Figure 4.1 Perception of possible impact of climate variation on livelihood activities in Nomedjoh and Nkolenyeng

4.1.3 Constraints and opportunities for adaptive capacity offered by socio-economic changes including the PES project

The vulnerability of human environmental systems is also defined as a function of adaptive capacity (Figure 2.2). Adaptive capacity of local communities is also defined as a function of access to resources, economic wealth, property rights, knowledge, information and capacity, equity and participation, institutions both internal and external (Brooks and Adger, 2005, Klein and Smith, 2003, Ionescu et al., 2009a) (Figure 2.2). Communities deficient in any of the factors mentioned above have lesser capacity to adapt, thus are more vulnerable to climate change and variability (Romero, 2005, Yohe, 2001). Due to the presence of the PES carbon project, some households are predicting a possible decline in their economic and financial resources for the upcoming harvest seasons.

The conservation conditions put in place by the project is seen to affect the main livelihood activity and the source of income of some 48 % of households in the two communities put together. The envisaged impact of PES project on the livelihood activity and source of income varies with a significant difference ($p=0.00$ and $df=1$) between the two communities and there is a relationship between the two community forests and the livelihood impacts of the carbon project. This is due to the fact that many households (91%) are engaged in agriculture as their main source of income in Nkolenyeng, as compared to Nomedjoh (15%) and the conditions put in place by the PES project has direct repercussion for traditional agriculture practices.

The conservation conditions with direct consequence on agriculture activities are;

- Slash-and-burn agriculture – the PES project has forbidden slash-and burn method of farming in the community forest areas. This according to the local people implies the need for more labour to open and prepare agriculture fields. In this situation farm sizes will not be increased due to much work involve preparing fields for planting. A decline in farm sizes indicates a decline in crop production and thus a subsequent decline in income from agriculture.
- Opening of new fields in Virgin forest – Yearly opening of new agriculture fields in the virgin forest is a routine and a necessity for farmers in the forest communities both for subsistence and commercial purposes. About 96% of households in both study areas open new fields on a yearly basis. There is no difference ($p=0.549$, $df=1$) between the

increase of farm sizes between the two forest communities. 96 % and 97 % of households in Nkonlonyeng and Nomedjoh respectively hope to open new fields (Figure 4.2). This indicates the importance of new fields in crop production in the forest areas. Newly open fields in virgin forest are more fertile, with high agriculture productivity. In Nkolenyeng the undisturbed forest area is known locally as the `Futfe`, while in Nomedjoh, it is known locally as the Mandja. Despite the fact that it is not a main activity in Nomedjoh, it is still important as a subsistence activity, and the Baka ethnic group in Nomedjoh is gradually becoming an agrarian society. However the carbon project has forbidden the expansion of new fields into virgin forest. Agriculture has been limited only to certain areas in the community forest such as the already existing fallow areas.

In this regard a decline in future agriculture productivity with subsequent impact on food security, income, has been predicted by farmers especially in the Nkolenyeng community forest area. There are claims that the conditions of the PES project were not imposed on the communities; there was a mutual understanding between the communities and the donors, since the communities were interested in benefitting from their forest through this mechanism as compared to timber exploitation. Communities acceptance of the conditions were influenced by the fact that financial flows will be immediate and fast, but this is not the case as with many PES projects. This atmosphere has initiated the negative perception and attitudes of households towards the PES project. Making a choice between timber exploitation and carbon sales is purely academic and technical especially with the low level of education; this implies that the communities may have been influenced by the CED.

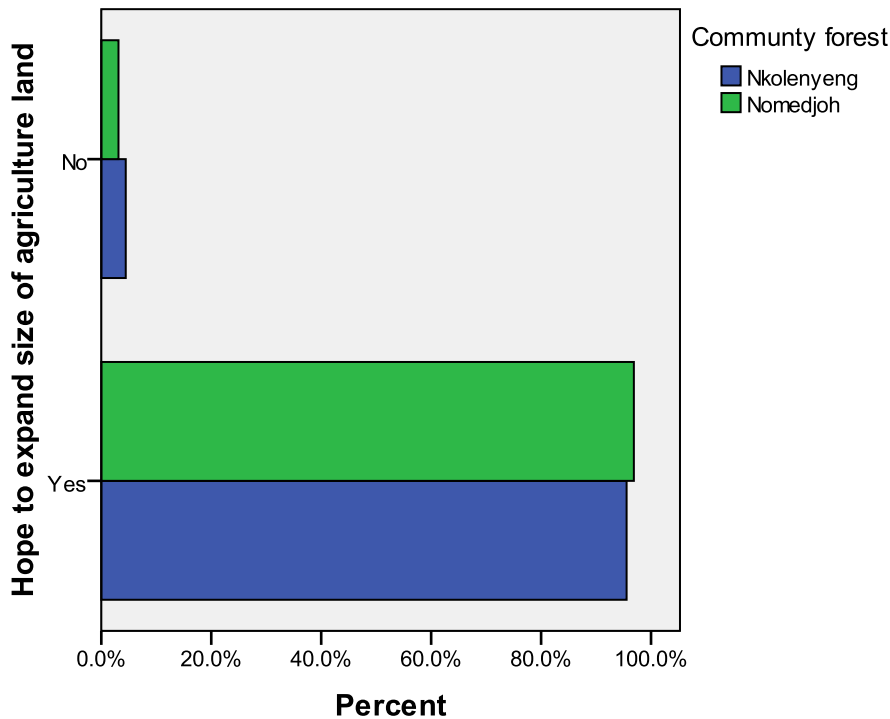


Figure 4.2: Respond to the opening of new agriculture fields in Nomedjoh and Nkolenyeng

The livelihood activity of 87% of households in Nkolenyeng might be affected by the project as compared to the households in Nomedjoh (22 %) (Figure 4.3). This is because of the difference in main livelihood activities. The collection of NTFPs and hunting constitute the main livelihood options for the Baka ethnic group in Nomedjoh, and the PES project has no major limitations on hunting and gathering activities. Thus any constraint on their subsistence agriculture activities which is mostly an alternative livelihood option will be supported by NTFPs collection and hunting activities. Although wild harvesting of honey has been forbidden in the project areas, it has little implication for the livelihood strategies of the community in Nomedjoh. This issue indicates the importance of initiating and supporting realistic alternative livelihood options.

Patrol teams comprising of community members have been created in the two communities, to monitor and enforce the conditions put in place by the PES project. Punishment of defaulters is handled by the different forest management committees following traditional rules and regulation.

Food security, source of income in Nkolenyeng will be constraint by the carbon project. According to the analytical framework (figure 2.2), food security and income, are classified as determinants of adaptive capacity. This implies that the PES carbon project reduces the adaptive capacity of the households in Nkolenyeng as regard main source of income. While on the other hand, the adaptive capacity of the households in Nomedjoh experiences little or no constraint. This is because they have alternative sources of income and household food, other than from agriculture. However, the above is a scenario, where households have little or no external intervention or support. The interventions from the PES project to boost adaptive capacity will only be realised after the first harvest season following the implementation. And the outcome also has repercussion for the mitigative capacity of households, especially in Nkolenyeng.

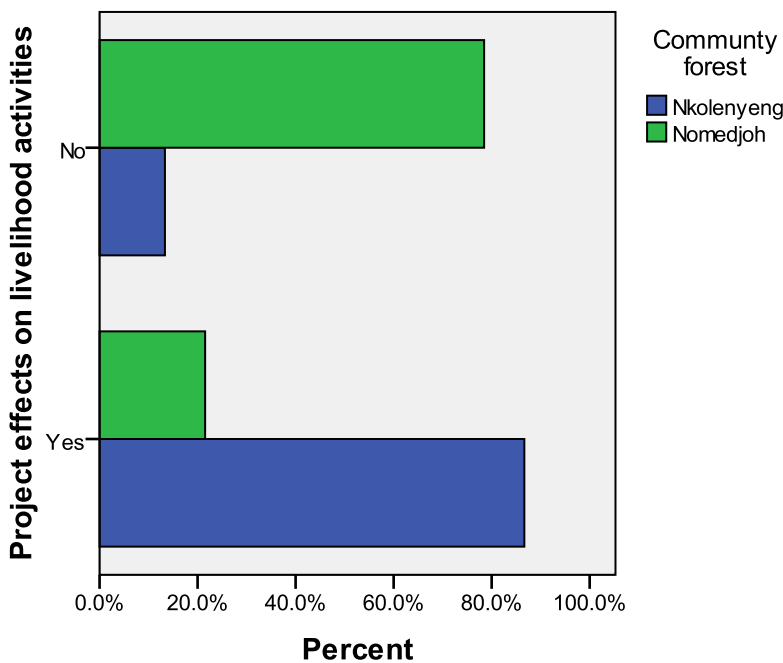


Figure 4.3 Perception on the possible impact of PES carbon project on livelihood activities in the two forests communities

The analytical framework in figure 2.2 presents some local governance related issues such as equity, participation, tenure rights, knowledge and capacity as determinants of adaptive capacity,

and these concepts have roles to play as far as the constraints on the adaptive capacity of forest communities are concerned.

4.1.3.1 Equity, participation and tenure rights - Equitable distribution of resources and forest benefits is important and can reduce the vulnerability of forest communities (Dkamela et al., 2009). Access to forest resources is open, especially for the collection of NTFPs and fishing, within each of the community forests. Hunting is free but limited to certain species by the Cameroon wildlife legislation. Nearly all (98%) community members in both communities have equal rights to access resources; however access to land is also free, but with special understanding among family members and neighbours. A significant proportion (96 %) of community members express that they participate in decision making processes, and they think that they have equal rights to decision making concerning community forest management. The issue of equal rights to participation and decision making is more complex as to what community members think. Their participation in decision making is passive; they participate in meetings, make proposals but rarely influence decisions. However, the fact that households think they have equal rights have been transform into positive attitude and participation of community members in the management of community forest resources. There is no significant difference ($p=0.542$, $df=1$) between the two communities concerning the perception of equal rights to decision making. However, some members of the community expressed dissatisfaction with benefit sharing of revenues from forest exploitation, and annual forest royalties from the rural councils. About 7% of the households in Nomedjoh are dissatisfied with benefit sharing from the community forest revenues, while 87 % of the households in Nkolenyeng are not satisfied with benefit sharing despite their high expression of equity and participation in decision making concerning the management of their community forest. For the case of Nomedjoh, some households attest that the sharing of the annual forest revenue have been marred by an atmosphere of mismanagement, lack of transparency, lack of accountability and corruption. This is also the same situation with the sharing of the revenue in the Nkolenyeng community forest generated from timber sales with a French timber company. The difference in dissatisfaction with benefit sharing between the two communities is due to the fact that the Baka community is not yet acquainted with monetary value, so most of the community members appreciate whatever they receive as financial benefits. While on the other hand, the Nkolenyeng community is a long

time cash crop community with much knowledge about the value of money. Despite this situation, households are still maintaining an atmosphere of trust, but benefit sharing from the initial carbon sales will determine the level of trust for the local governance processes, and this will have repercussion on the mitigative capacity, with subsequent impact on the adaptive capacity of households (figure 2.2).

Equitable and free access to resources in the communities is highly connected to the tenure rights the communities benefit from. They are aware that the management and benefits accruing from forest exploitation belong to the communities. And 65% of the households in both communities are aware that the governments can take over management of forest if poorly managed. In addition, 96 % households claim that the benefits they get from the forest would not be the same if the forest was under state management and control. For example access to agriculture land is not a problem for community members, but would have been more complicated in the case of state control. This aspect to a certain extend can enable communities adjust to accommodate certain socio-economic changes.

4.1.3.2 Knowledge and capacity of forest communities - As earlier mentioned, local people in the study areas have been sensitised and are aware about the causes of the “climate accident” as they term it. They relate climate change to carbon emissions from deforestation; however they think the activities of logging companies contributes more to deforestation as compared to their activities within the forest zone. More than 84 % of households in both communities are aware of the causes of climate variation as a result of the PES project. They are also aware about the possible effects of climatic variation on their livelihood activities. A significant proportion (98 %) of households in both communities, lack coping strategies, and many (99 %) of them need coping strategies to prepare and withstand difficulties related to climatic and non climatic changes. This is worse with the PES project. At this juncture communities are not able to understand and master the present climatic variation and uncertainty, and are not able to reveal confidently, how their local agriculture system can adjust and contain this challenge. This situation is detrimental to the adaptive capacity of households with consequences for mitigation efforts. In addition, households think enhancing the other livelihood activities, in other to make them more viable is important. However this cannot be done amidst lack of financial, material needs and technical knowhow, linked to the various coping strategies and livelihood activities.

4.2 Proposed local adaptation needs in Nomedjoh and Nkolenyeng community forests

Berz (1999) and Hulme et al (1999), assert that the inherent variability in climatic conditions from year to year is an integral part of climate change. This suggests that adaptation to climate variability is basically adaptation to climate change. Local communities need local adaptation strategies to reduce their vulnerability to climate variability as a result of exposure and sensitivity. In addition local people require particular needs to enhance their adaptive capacity. And according to the framework in figure 2.2 the needs of local people are linked to income and food security, alternative income sources and livelihood diversification and information, knowledge and capacity building. Based on this, some of the local adaption needs of the forest communities are presented below.

4.2.1 Improve local agriculture systems

In a situation of unpredictability and unevenness of rainfall and temperature, and the presence of the carbon project, farmers stressed the need of new ideas and methods to carry out agriculture in order to sustain incomes and food security. The local agriculture system depends on natural temperature, sunshine and rainfall. This implies adjusting and improving (technically, financially and materially) agriculture activities which will reduce the vulnerability and increase the adaptive capacity of households. However, the various strategies must fit into the local agriculture landscape in the study areas, taking into consideration local climate variability and uncertainty. And farmers can employ them to minimise climate risk. They might in addition provide benefits to cope with surprises as a result of prolonged or short rainy and dry season.

In relation to crop production farmers can engage into more mixed cropping, multi-level cropping and in the planting of improved existing and new crop varieties. However, households highlighted that the new crop varieties must be able to adapt to local climatic conditions, if not they will not be appealing like a coping strategy.

Garden farming appears to be of major interest to households in Nomedjoh, in which with limited rainfall, crops can be supplied with water using watering cans. In addition soil fertility of gardens can be improved by using organic manure. This aspect can enable year round production

of certain crops. But with only one bore hole and most of the villagers depending on natural springs, this aspect might still have challenges.

Cocoa production, a major agriculture activity in Nkolenyeng can also be improved through pruning of diseased and dead branches, burying of diseased cocoa pods, planting new rootstock, grafting new higher yielding or more resistant varieties, more effective crop spraying and improved drying and management techniques. Households in Nomedjoh, also think that introducing a cash crop like cocoa, will reduce their dependency on NTFPs as the major source of income.

Improved agro-forestry through fruit trees; households saw the planting of fruit trees as a means to have products for home consumption and the market, such as fruits, nuts, edible oils. However this will depend on the species that will be planted in the farms, as some species might take long to start producing fruits.

The above farm management strategies fall within the objectives and activities of the forest carbon PES project in the study areas aim at reducing pressure on forests resources. This study reveals that some of the activities have already been initiated in the study areas, such as plantain propagation, the introduction of new crops and the setting up of experimentation farms for crops such as ginger and cassava. Community nurseries have been put in place containing avocado, cocoa, fruit trees, Maobi (*Baillonella toxisperma*), Bush mango (*Irvingia gabonensis*) etc. All these activities were accompanied by training for both women and men in the study areas. But the local climate still appears to be a threat to these initiatives.

4.2.2 Improve alternative income sources

Initiating other income generating activities within the confines of local resources is of great importance, and the benefits can enable forest communities adjust to climate variability and uncertainty. Activities such as beekeeping, improved collection and marketing of the different forest fruits, fish farming, and mushroom growing will enable peoples in the study areas to earn income from activities other than agriculture. This study show that beekeeping activities have been initiated by the PES carbon project, with capacity building, followed by the construction and distribution of bee hives to households in the study areas. The marketing and benefits from NTFPs have been improved with the help of NGOs like PERAD and CED. These NGOs have been working relentlessly over a decade with the communities to improve their livelihoods based

on their local resources. This means that the benefits communities got from the marketing of NTFPs were low in the past, in relation to the value of their products. Nonetheless, more still need to be done according to some households. The mushroom farming has not yet been initiated, however the species to be introduced must be able to cope with local climate variability and this requires an understanding of the local climate variability.

4.2.3 Ameliorate livelihood diversification

Sustaining diversity has been seen as an appropriate adaptation option for protecting food security and livelihoods in the face of climate extremes and uncertainty (IDRC, 2009).

Crop diversification among farmers, offer many benefits and enable them to become less vulnerable to climatic variations. Farmers integrating livestock production and food production could offer benefits in health, income, food production and security for small-scale farmers in developing countries (Yengoh et al., 2010). Households in the study areas have expressed interest to engage in other activities than from agriculture. Livestock was mentioned as a major activity, including beekeeping, mushroom farming, and fish farming. There is a possibility to create fish ponds, as observed during the field work. There is a fish pond project which has been initiated by a Reverend Pastor, a Bantu, in Nomedjoh. This project survives amidst financial, technical and material problems; and lessons can be drawn from this initiative. The PES project has a series of activities, which if well implemented, may provide alternative income sources and household food and nutrition. This study also show that diversification as an adaptation option at the local levels, cuts across different sectors (environment, forest and wild life, livestock and fisheries, agriculture and rural development, scientific research, finance and commerce), thus it requires the development of inter-sectoral coordination. This finding is supported by that of Yengoh et al (2010), which draw attention to the fact that coordination and collaboration is required between sectors that build the capacity of rural livelihoods.

4.2.4 Enhance information, knowledge and capacity building of local forest peoples

Access to relevant information and knowledge is identified to be the key to adaptation for local communities in sub-Saharan Africa (Challinor et al., 2007). Most of the adaptation requirements mentioned above appear more or less new to forest peoples in the study areas. There is need for new information and knowledge sharing and dissemination between the different stakeholders

involved in the different adaptation strategies. Training is required to build the capacity of households regarding new farming techniques and adaptation strategies. Training has been initiated by the PES project in beekeeping, plantain propagation, nursery management, mixed cropping, and the planting and management of new crop varieties.

The needs of forest communities to enhance their adaptive capacity involve a variety of research domains, which requires a multi-disciplinary approach to minimise challenges arising from the implementation. Other researchers have acknowledged the multidisciplinary nature of climate change response both at the local and national level (Howden et al., 2007). Integrating knowledge from other policy domains such as sustainable development can be a necessary path towards achieving better adaptation to climate related risk. Gaining access to information, knowledge and resources that can promote local adaptation requires additional intervention from local and national NGOs and GOs in the study areas. This idea is similar to that some authors (Howden et al., 2007, Challinor et al., 2007). In such a situation, communication and collaboration is recommended for strategies that involve an integrated approach to risk as a result of climate variability (Yengoh et al., 2010). The PES project coordinator (CED) is working relentlessly towards this objective and more than 92% of households confirmed that their awareness on climate change and livelihood relationships is as a result of CED activities in their community.

4.2.5 Increase viability of local economic activities

The commercialisation of agriculture commodities and NTFPs constitute the main economic activity in the study areas. Marketing is done within the community or with traders who come from outside called ‘buyam and sellam’ or through common initiative groups for the case of cocoa. In both communities households market their commodities through “buyam and sellam” (78%), local market (23%), and cooperative (22%). The household survey reveals that some households (31%) are not satisfied with the market prices, and others accept on the basis that they have no other option. This aspect varies between the two communities (Figure 4). They attribute low prices to poor road infrastructure linking their communities with major towns. There is a difference ($p=0.000$, $df=1$) between households in the Nomedjoh and Nkolenyeng, regarding satisfaction with prices they get from the market. The difference in satisfaction with market prices between the two communities is the fact that the Baka community in Nomedjoh is

not yet acquainted with monetary value and the worth of products and market price fluctuation so most of the community members appreciate whatever they are paid. On the other hand, the Nkolenyeng community is a long time cash crop community with much knowledge about the value of money, market value of goods and price fluctuation. In addition to the market experience the difference in commodities marketed between the two communities may also influence perception on market prices.

Better market prices and road networks, will increase household benefits and improve household income. This will improve the adaptive capacity of households against climatic uncertainty and exposure. This finding confirms that of Nkem et al (2010) which underscore that better returns and benefits from commodities may improve the role of forest goods and services as safety nets for adaptation to climate change in tropical forest countries. Improving markets for NTFPs is a major activity for the PES project and organising markets for NTFPs has been initiated by CED in Nomedjoh even before the carbon PES project, with substantial increase in benefits for households. However, better markets and road networks can also increase pressure on forest resources.

With the presence of the PES project, households expressed that if they are able to sustain their livelihoods with the above interventions, and then there will be no reason for them not to maintain forest cover. However, it is difficult in reality to achieve some of the above within one to two agriculture seasons even throughout the stipulated project period which is five years.

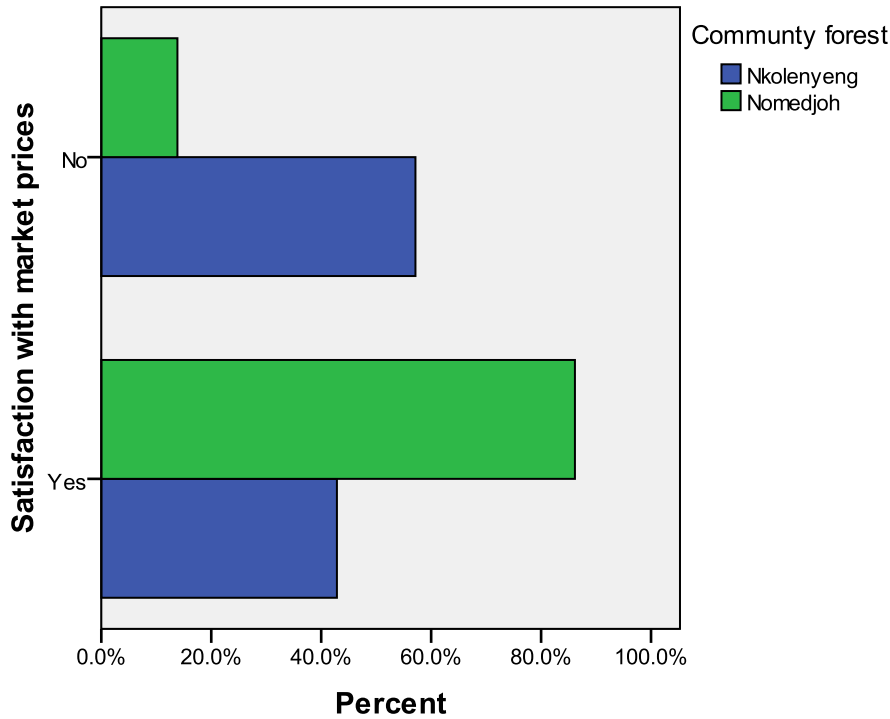


Figure 4.4: Satisfaction with market prices for commodities between the two communities

4.3 Constraints and opportunities for the conservation measures in Nkolenyeng and Nomedjoh community forest areas

Deforestation and land degradation is the major threat to forest protection and conservation in the study areas. Households are incentivised and motivated to cut down the forest in order to sustain incomes, guarantee food security and diversify livelihood options. In addition to the direct threats, the participation of the communities living and depending on the forest resources in the study areas is important in implementing the forest conservation strategies. Enhancing equality and access to resources in the study areas are important to increase participation of households which is an opportunity for the forest protection measures to achieve its goals.

4.3.1 Drivers of deforestation in Nomedjoh and Nkolenyeng community forest areas

Drivers of deforestation in the tropical rainforest like the humid forest zone of Cameroon (HFZ) has been attributed to both direct (agriculture expansion, wood extraction, infrastructure development)(Geist and Lambin, 2001, Venema and Rehman, 2007) and indirect drivers (demographic pressure, economic and technology issues) (Robiglio et al., 2010). Identifying the underlying drivers of deforestation as a starting point of action is essential for policies aimed at halting deforestation to be effective (Agrawal, 2009). Most of the changes in forest cover in the study areas are the consequences of land use changes. Agriculture expansion, fuel wood extraction, wild harvesting of honey and the exploitation of timber products were identified as the drivers of deforestation in the study areas. However, the intensity of these activities varies between the two communities.

4.3.1.1 Agricultural expansion

Small-scale agriculture for subsistence and for market (domestic consumption e.g. plantain or for export e.g. cocoa), is massively practiced in the study areas. Cocoa plantation is a major driver, in Nkolenyeng for example 88 % of households own cocoa farms. Farmers carry out shifting cultivation practices for annual crop production e.g. cassava, plantain, and for perennial crop production e.g. cocoa. Agriculture land expansion is on an almost yearly basis, with the clearing of new fields. Shifting cultivation in these areas is carried out by the traditional slash-and burn agriculture systems. About 96 % of households confirm their hopes for yearly increase in their farm sizes. The yearly increase of farm lands is an objective shared in both communities, but their sizes differ. Most farm lands in Nomedjoh are located close to the villages, and small in sizes since production are mainly for subsistence, while in Nkolenyeng, farms are located far away from the village location with the intentions to produce enough for both the market and household consumption. This is similar to the research carried out by Robiglio et al (2010), in the Southern region of Cameroon. In the shifting cultivation systems, land is cleared, burned and cropped for few years and later abandoned for longer period. Land is mostly abandoned when yields become unsatisfactory as a result of soil infertility, weed invasion or pest incidence. Presently, fallow periods are being shortened in the humid forest areas due to forest land scarcity as a result of the growing population. Slash and burn farming system demands less labour from households and it is a factor which encourages the opening of large farms. Household in study

areas are complaining that, preparing large fields without employing wild fire is labour intensive, this has caused them to limit farm sizes.

4.3.1.2 Fuel wood extraction and NTFPs in the study areas

Fuel wood extraction has been found to contribute to forest destruction in some tropical forest countries (Venema and Rehman, 2007, Geist and Lambin, 2001). Findings from this study reveal that all households depend on wood from the forest for cooking fuel. All the households use the three stone fire-sides. Local people stressed that fuel wood is getting scarce, and they walk long distances to get fuel wood, especially when it concerns energy efficient fuel wood. Charcoal production is not an activity in the study areas, as compared to other forest countries where charcoal production is a major contributor to deforestation and a threat to forest conservation (Angelsen, 2008).

NTFPs activities such as wild harvesting of honey were also identified by households as another forest destruction factor. Very tall and mature trees, inhabited by honey bees are often cut down by villagers to harvest honey, and harvesting is often carried unsustainably by the use of forest fire. This is a practice reported in the Baka community in Nomedjoh. Illegal exploitation of timber is a recorded practice in Nkolenyeng. They are not able to quantify the illegal harvested wood from the community forest, however they think it contributes to the disappearance of forest cover.

4.3.2 Direct motivations and incentives for deforestation in Nkolenyeng and Nomedjoh

The livelihoods of forest-dependent communities is expressed by income, food security, viable local economic activities, and that they sustain their livelihoods through the exploitation of forest resources (Ravindranath, 2007, Ravindranath et al., 2000). Households in the study areas are at the centre of deforestation because their main livelihood activity and processes contribute to deforestation and land degradation especially in Nkolenyeng where agriculture is the prime activity. Faced with limited resources and options, households are bound to pursue their traditional agriculture systems and gathering and hunting methods to sustain and ameliorate their level of income, and to guarantee food security. Three reasons were presented for continuous expansion of agriculture land in the study areas: low harvest (>12.8%), low market prices (>9.5%), food security and income (>85%). However, the motives are interconnected and

coupled with household demands which determine the pace of household activity in the forest. Employing alternative measures to replace or adjust the traditional methods such as sustainable agriculture, but with the same potential of sustaining income and food security, will enhance adaptive capacity and will also reduce the expansion of agriculture fields. The adaptive capacity of households may determine the rate of household's involvement in forest conservation.

4.3.3 Equity, participation and tenure rights on the mitigation side

Equity (in access, in decision making and in outcome) (Paavola, 2003, Brown and Corbera, 2003), is very important in designing and implementing PES projects (Pagiola and Platais, 2002). Equitable distribution of resources and forest benefits is a condition that incentivizes and motivates forest communities, this can facilitate the positive outcome of REDD-type projects (Dkamela et al., 2009). First, as concerns equity to access forest resources such as NTFPs and fishing grounds in the communities, access is free. Apart from land, which requires negotiation between neighbours and family members, 98 % of households have free access to the other resources. And as mentioned in section 4.1.3.1, 96 % of households in both communities think that they have equal rights to decision making in their community forest management process. Second, the Nkolenyeng community forest has once received benefits from forest exploitation, meanwhile Nomedjoh community have been, receiving annual forest revenue from the Lomie rural council since 2007, however differences was noticed between households and communities about equity in benefit sharing. The household survey reveals that 65 % of households in both communities are satisfied with the benefit sharing from the community forest. There exists a great variation and a significant difference in the feelings of households regarding benefit sharing between the two community forests. The explanation for this difference is presented in section 4.1.3.1. High perception about equality in Nomedjoh, is a strong indication that households will adhere to project conditions compared with households in Nkolenyeng. Households in Nkolenyeng attributed their frustration to mismanagement and embezzlement of revenue that accrued from earlier forest exploitation deals. As a result suspicion and doubt looms around the present carbon project and this is a big threat to the project outcome. Dkamela et al (2009), stress that inequality will cause communities to disrupt REDD activities through illegal exploitation, use of fire and field expansion. However, even with the uncertainty and doubts, there is much hope for the project to succeed, as households (100% for Nomedjoh and 75 % for

Nkolenyeng) are satisfied with the general management of community forest affairs (Figure 4.5). This finding is practically strange, though the question on satisfaction with community forest management appears to be broad for the respondents. Strong family and social cohesion may also contribute to the positive view about community forest management in the communities. In Nomedjoh, community forest is managed by a committee (Boumo Bo Kpode) and the annual forest royalty fees is managed by the Comite de Gestion de RFA (forest royalties management committee). In Nkolenyeng, the community forest is managed by AFHAN Development Association (Association de Femmes et Hommes ami(es) de Nkolenyeng), according to the forest management plan.

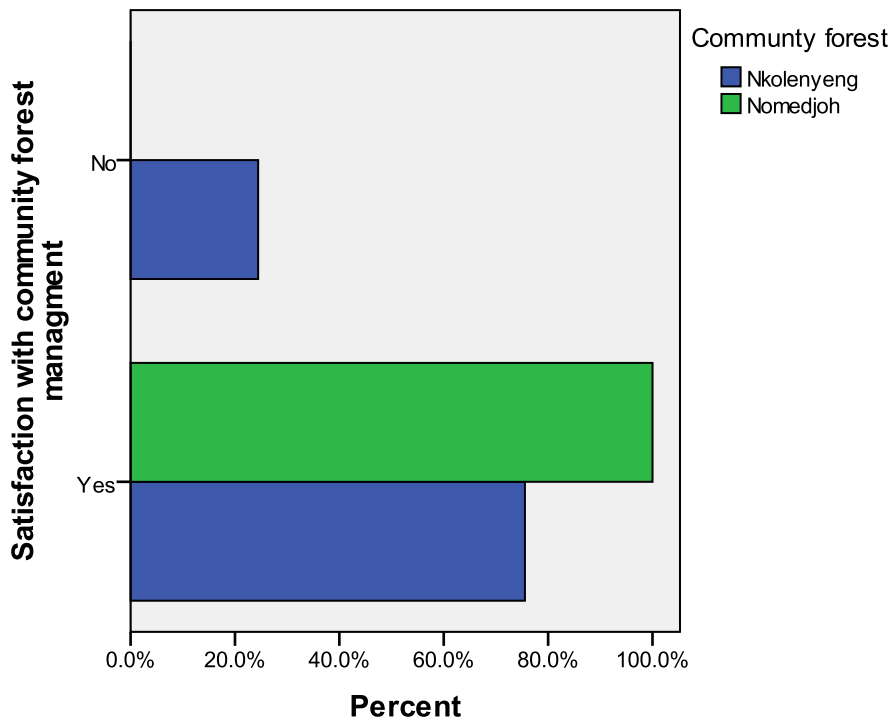


Figure 4.5: Household satisfaction with community forest management in Nomedjoh and Nkolenyeng community forest areas

Participation is very important in natural resource management. The perception of participation by communities is not in accordance with the theoretical assumptions of the concept of participation and they attribute participation to regular attendance in meetings regarding

community forest management, which is open to all community members. The communities claim that they have been involved in the design and implementation process of PES. This assumption of participation is responsible for community's involvement in the projects and all households at this stage of the project are respecting the forest management and protection conditions. This circumstance indicates a possible positive outcome of the project as this appears to be a strong incentive and motivation for household involvement. However community engagement is conditional according to households and it depends on the capacity of the project to meet-up and sustain the positive implementation of project objectives and activities. This is similar to the position of some authors, in which they bring to light that the more local people are involve, the more likely they will agree with and support local development actions and participation mobilizes local collective action and builds local institutional capacity (Vedeld, 2002, Pretty, 1995).

The findings from the study areas indicate that the PES project was welcome and support due to the tenure situation which favours communities as far as forest benefits are concern. They know and are aware that they own the forest and any benefit stream from the forest goes directly to the community. However benefit sharing will be another problem and this might influenced the mitigative capacity of households. Communities were more confident as they got involve in the carbon deals with the project partners and payments will be made to the communities with limited or no conflict with the state. Despite small (20%), households communicated that the respect they have for the present forest management conditions will not be the same if forest was under state management. They consider forest resource management under state control as unfair, and more beneficial to industrial forestry companies. The affirmative view about ownership and management of their forest is a motivating factor for the households to get involved in the PES project activities. This is similar to other findings from Dkamela et al (2009). As concerns equity and participation in community forest management, the findings of this study is weird and contrary to others (Oyono et al., 2007, Oyono, 2005).

Based on the analytical framework in figure 2.2, it is true that equity as access, in decision making, equity in benefit sharing, participation and tenure rights enhances mitigative capacity by incentivizing and motivating households in the communities to participate in the implementation of forest protection activities. However maintaining positive attitudes towards local governance

structures and processes is very important and challenging for the mitigative capacity of households throughout the project cycle.

4.4 Forest mitigation activities and opportunities for the adaptation needs of households in Nkolenyeng and Nomedjoh forest areas

The analytical framework in figure 2.2, underline forest protection, sustainable agriculture as activities that conserve carbon stocks. It goes further to present the outcome of the mitigation actions, which are beneficial to adaptive and mitigative capacities. Murdiyarso et al (2009) assert that some mitigation strategies such as income diversification, income from mitigation services, agriculture intensification and agro-forestry have the potentials of reducing the vulnerability of vulnerable populations. The PES project is carrying out a series of activities in the project areas, which can directly and indirectly protect forest cover and reduce pressure on forest resources. These objectives and activities can also provide opportunities for households to benefit as far as their adaptation needs are concerned. However, the benefits are still awaited. Some of the opportunities have been mentioned in section 4.2. Concerning activities that directly protect the forest, the PES project is involved in the following;

- Forest protection and regeneration, where it has marked boundaries and created forest reserve zones (figure 3.1 and 3.2), and the reserve is being observed by a patrol and monitoring team made up of community members. This activity might protect some trees species which will be available for the harvesting of NTFPs in the future, especially in Nomedjoh where NTFPs collection is a major activity.
- Sustainable forest use and management. First, the project is increasing tree cover, by planting new trees in new fallows, old fallows and in cocoa farms. Second, the project is reducing tree felling, by reopening abandoned fallows and avoiding new clearance, controls on logging, approval process for agriculture expansion, and the monitoring and mapping of agriculture expansion. The nurseries that have been established contain some native tree species e.g. Maobi (*Baillonella toxisperma*),
- Improve sustainable agriculture by improving agro-forestry and cocoa production. The agroforestry will improve soil fertility and provide households with fuelwood. The positive impact of agroforestry as an adaptation and a mitigation strategy depends on how

the trees species may be suitable for the local climate in the study areas. Cocoa production in the form of agro-forestry will be introduced in Nomedjoh, as an alternative income source to NTFPs. However, cash flow from this activity might motivate households to increase farm sizes in prohibited areas, thus households have to be monitored when introducing such practices.

- Significant emphasis is being made on creating and ameliorating alternative income generating activities such as the production and marketing of NTFPs (beekeeping, mushroom farming, livestock and fishing). The collection of NTFPs is an activity which is being encouraged in Nkolenyeng, despite the fact that many of the tree species found in Nomedjoh are not found in Nkolenyeng. The project is introducing some of the tree species in Nkolenyeng, but it is not a certain alternative income source for the moment. First, the local climate in Nkolenyeng may pose a challenge, and secondly some of the trees species need about a century to attain the fruit producing stage. The beekeeping activity has been introduced in the two project areas, but some of the constructed bee hives have not been inhabited by bees in the communities.
- Knowledge and capacity of households and communities in general is being strengthened. Access to information and knowledge is very important in climate change response actions (Challinor et al., 2007, Howden et al., 2007). Communities have been made aware about the relationship between their livelihood activities and climate change, the presence of CED and the objectives of the PES project has a major contribution as far as the outcome of the project is concern. About 82% of the households have participated and benefitted from at least one training activity. Some have benefitted from bee hives which was constructed and distributed to households, even though some have not been inhabited by bees. However, households are expecting more training, material and financial assistance from the project, to meet-up with the livelihood challenges as a result of the carbon project.
- Making the commodities produced by household's worth their value in the market is one major priority of the PES project, because with better incomes from commodities, households will limit pressure on forest. About 38% of households asserted to this position. But better prices can also mean more incentives to exploit and destroy forest.

Better road networks can contribute to this aspect, but the PES project may be able to handle road infrastructure depending on the size of cash flow from carbon sales.

- Direct cash flow from the carbon sales, will enable the communities to invest in the activities mentioned above and in the social development of their community as presented in figure 3.2, in section 3.2.3. Households are very interested to know about the sustainability and the fate of the cash and the project in general. This is a difficult question to answer due to the interplay of many factors for example biophysical, institutional and socio-economic, in the life cycle of the project.

According to this study comparing these objectives and activities with the reality on the ground, much work still needs to be done to be assured that the projects will be able to protect forest cover, with household and community benefits such as improved and sustained food security, income and livelihood diversification and the ability of communities to cope with institutional, economic and natural resource changes.

4.5 Searching for commonalities between adaptation needs and mitigation strategies in Nkolenyeng and Nomedjoh community forest areas

This study shows that the communities especially in Nkolenyeng in are constrained by the presence of the forest carbon PES project, which limits activities that can allow local people to enhance their adaptive capacities. On the other hand households are the main agents of deforestation through their livelihood strategies in their respective forest areas. The strategies put in place by the carbon PES project have a double objective.

On the adaptation side, the project shows the capacity to provide income, sustain food security, and livelihood diversification for the communities in the study areas. This aspect will be proven after the projects are evaluated. In addition the project has increased the knowledge and capacities of local communities regarding the relationship between climate change and their livelihood activities. These are requirements to enhance adaptive capacities according to the analytical framework.

On the mitigation side, the mitigation strategies may have the ability to protect forest, with the possibilities of guaranteeing income, sustain food security and alternative livelihoods and provide cash flow from carbon sales. These are incentives that make the changes in the adjusted

land management attractive to land managers. The positive outcome of the mitigation activities depends on the willingness and motivation of the households to engage and participate in the different mitigation activities as shown in Figure 2.2. This will depend on the capacity of the project activities to provide and sustain community adaptation needs in addition to supporting institutional issues such as equity and participation.

Synergy strategies do not germinate from anywhere; there must be a point of departure whether on the adaptation or mitigation side. Identifying the most likely impacts of and vulnerability to climate and non climatic changes in the project areas will enable the definition of potential activities and measures that could reduce vulnerability to climate change and other socio-economic changes. And forestry activities with the highest mitigation potential must consider its socio-economic changes that it brings to the project areas, not forgetting environmental issues. The vulnerability of forest-dependent communities to both socio-economic and environmental changes according to this study is a common ground to analyse strategies that enhance both the adaptive and mitigative capacities of communities (figure 4.6).

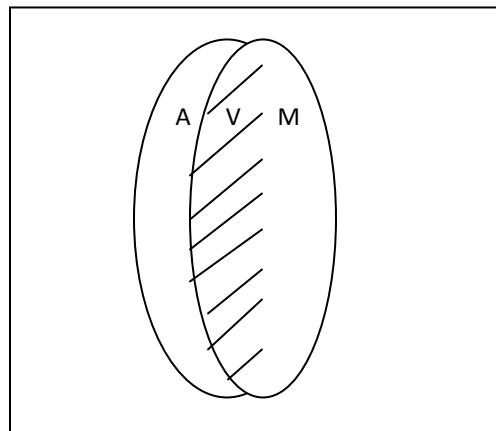


Figure 4.6: Schematic representation of synergy between adaptation (A) and Mitigation (M), with the shaded area (V) representing the vulnerability of forest-dependent communities.

4.6 Role of actors and stakeholders in the design and implementation of integrated approaches to climate change adaptation and mitigation

To present the roles of the different actors (policy makers, local communities and civil society, researchers), it is important; to identify the different activities in which their efforts are needed to design and implement projects of this nature.

First, agriculture intensification in the different project areas has been identified by this study as an adaptation need for the communities and as a condition to motivate community involvement in the mitigation activities. Some of the agriculture activities which have been initiated in the project areas are already facing technical problems. In Nkolonyeng for example the avocado nursery is not performing as planned, as the young plants are drying up. There is a disconnection between village resource persons responsible for the nursery activities and the CED staff responsible for this component. This particular project activity was carried out in collaboration with IRAD as technical experts, however the collaboration is not running as planned as there is total lack of monitoring of this activity. In addition the plantain propagation initiative is also facing similar problems with overgrowth and the villagers require technical support to transplant to their agriculture fields. These problems and more which still have to emerge as the project rolls on have created an atmosphere of doubt and uncertainty among the households in the study area concerning the positive outcome of the activities. This study perceives it as detrimental to the adaptive capacity of the communities and also de-motivates households. In addition, the climate variability being a threat, suggest that the various crop varieties to be introduced have to be able to adapt to local climatic conditions, this requires an understanding of the local climate variability.

Livestock and fisheries activities were identified during the study as activities that can boost income and food security in the study areas. However this activity is more or less new to the communities, extra technical and financial support is needed from the ministry of livestock in the design and implementation of these activities. In Cameroon the beekeeping activity is classified as an activity in the livestock sector. Presently in the study areas, beekeeping is a major activity which has been initiated as a means to protect forest and a means to diversify livelihood, but as of now only 20 % of the bee hives constructed has been inhabited by bees. The villagers are

worried about this situation and technical knowhow is needed by the villagers to attract bees to their various bee hives.

Forest regeneration and conservation constitute to be major activities of the mitigation project, and for these activities to suite the interest of forest- dependent communities' measure have to be taken to sustain the livelihood of the communities. The conservation project is envisaged to enhance the adaptive capacity of the local communities, which is very challenging in practice. This view is similar to the idea of Reid and Huq (2005), in which they draw attention to the fact that biodiversity conservation enhances the adaptive capacities of local peoples. This requires the attention of researchers, practitioners and managers at all levels, from the government e.g MINFOF, ANAFOR, regional (COMIFAC, CARPE), international organisations e.g CIFOR, WWF, IUCN, NGOs (CED), not forgetting the involvement of the focal points of UNFCCC, CBD.

Adaptation needs through new crop varieties need an understanding of the local climate by agriculture technicians and the communities. Thus climate science experts are also needed on board, regarding the design and implementation of win-win strategies. These experts can come from both GOs and NGOs. In Cameroon the Ministry of environment is the leading institution on climate change adaptation and mitigation issues at the national and international scene. They have to be present, in other to understand local interest, capacity and challenges to climate change response.

This study reveals that the different actors mentioned are necessary for adaptation to and mitigation of climate change; however in the context of synergy which is important in the forest sector, they will not achieve better results if they carry out activities independently in policy design and implementation. Thus a mechanism is required to galvanised the efforts of the different actors (local communities and civil society, policy-makers and scientist) at the different levels, and this mechanism according to some authors should be based on collaboration, communication, networking and partnership and information sharing etc (Yengoh et al., 2009, Brown, 2009, Challinor et al., 2007). After field research and data analysis and discussions, this study has the following arguments to make concerning the roles of different relevant actors in the design and implementation of integrated strategies.

4.6.1 Role of government actors

4.6.1.1 Mainstreaming adaptation and mitigation into national policies

The adaptation needs and mitigation actions of local communities, according to this study is a prerequisite to sustainable development, a view shared by Willbanks et al. (2007). Mainstreaming adaptation and mitigation into national development policies is crucial for the design and implementation of win-win strategies. Multi-sectoral and multi-level approaches must mainstream adaptation and mitigation into policies. According to Brown (2009) the institutional linkages between the different institutions (MINEP, MINADER, MINRESI-IRAD, MINFOF, NGOs and communities), concern with climate change response in Cameroon is non-existing or weak. The linkage between international organizations and the national government sectors is moderate, as a result of multiple efforts from the international organizations. This finding is similar to the findings of this study. Apart from NGOs and IOs, activities in local communities, there is no government action at the community level related to climate change response. Implementing policies embedded in the PSFE will be a big challenge for local communities, the media and the private sector, because they had little or no involvement in the processes of preparing this strategic policy document.

4.6.1.2 Mobilise new sources of finance

The communities in the study areas are benefitting materially and financially through the PES project to increase their adaptive capacity. Vignola et al. (2009) has earlier argued that PES can complement international funding sources for adaptation, especially in circumstances where the ecosystem users are willing to provide resources for this protection. The issue here is for policymakers to be able to create an institutional environment where the carbon sellers and carbon buyers can collaborate, create partnerships and networks for a common agreement.

4.6.1.3 Influence course of action both at the international and local levels

The outcome of International discussions on climate change adaptation and mitigation influences the design and implementation of adaptation and mitigation policies. State actors have to ensure that negotiations should stress the importance and the possibilities of integrating adaptation needs into REDD mechanisms. Nevertheless, to advance their position, the policy makers have to strengthen their knowledge and understanding of win-win strategies from design to

implementation. There must be excellent collaboration, knowledge and information sharing and partnership between the different actors piloting climate change negotiations. The MINEP, which host the focal points of UNFCCC, CBD, and UNFCCD, must encourage the platform for networking, knowledge and information sharing. COMIFAC provide technical and political support and the coordination of the conservation and management of Central African forest ecosystems. The COMIFAC convergence plan offers a great opportunity for policymakers to advance policies that can enhance conservation, and reduce the vulnerability of forest-dependent communities.

This study reveals that local communities are strong and important decision makers concerning the outcome of REDD activities. State actors such as MINEP, MINFOF, MINADER, should empower local communities to facilitate mitigation processes that favour adaptation needs of local people, as we have seen in the study areas. Knowledge sharing and capacity building is crucial in this circumstance, and with limited government presence in local communities, collaboration and networking with NGOs is a mechanism to achieve this objective. NGOs are more present in local communities, on issues concerning climate change mitigation and adaptation and local livelihood activities.

Technical expertise is needed in both adaptation and mitigation actions as this study show. Policymakers need to interact with scientists, for building and implementing win-win climate change response strategies. Institutional arrangements and financial resources are needed to facilitate research, collaboration, communication and networking.

4.6.2 Role of local communities and civil society

4.6.2.1 Define and implement adaptation and mitigation actions

Local communities must be involved in identifying and implementing adaptation and mitigation actions. This study shows that adaptation and mitigation happens locally with communities as major players. Local communities should be allowed to promote adaptation and mitigation and to increase their interest in forest ecosystem health and provision services. Communities should be massively involved in designing and implementing strategies and action plans that favour conservation whilst also sustaining their livelihoods. In addition, it is equally important for communities to increase their capacity to negotiate and establish fair networks and partnerships

with other actors at the different levels and scale of decision making. NGOs can contribute in developing and fostering such partnerships and networks, but government support is needed.

The findings from this study acknowledges the important role of NGOs in strengthening indigenous peoples rights and values in the design of adaptation and mitigation plans. The communities in the study areas have benefitted from CED's presence and activities and for the high level of awareness and the massive involvement of communities in the PES project.

4.6.2.2 Interaction with policy makers

The interest, capacity and obstacles of local peoples are often not reflected in national policies. The Readiness Plan Idea Note (R-PIN), prepared by MINEP for the Forests Carbon Partnership Facility, has some limitations because of limited consultation with the civil society and local communities. Climate change response policies and processes such as REDD+ is still in the hands of few and many of the major and relevant actors have not been involved. This processes remains "externalised and elitist" with the absence of hunter-gatherers, traditional swiddeners, community forest managers, council forest managers and agro-industries (Dkamela, 2010). A key role is to enable and empower local communities for their position and voices to be heard and accepted in national policy design.

4.6.3 Role of scientists and researchers

Research on forest ecosystem services and how they reduce vulnerability to climate change is characterised by uncertainty and complexity. Blending local knowledge and scientific knowledge to design appropriate response is crucial. Communities have to collaborate and communicate with NGOs in field research with scientist on observe changes, and local adaptation needs. With limited participation of local communities, their interest, capacity, and challenges will not be taken into consideration in policy design. This study acknowledges the great importance of communities in information generation relating to adaptation and mitigation concerns at the local landscape.

Efforts should be made by scientists to communicate research results to non-scientists, such as NGOs and the media in order to build their capacity to influence the design and implementation of adaptation and mitigation. Networking and collaboration with experts from communication sciences is a major mechanism to achieve such objectives. Scientists also have to work and

collaborate closely with local communities, to understand local adaptation needs and forest conservation practices. Results generated by scientist on local adaptation needs and roles in mitigation actions of local communities should ensure that the results are communicated in a way relevant to policy makers. Furthermore, scientists should be major stakeholders in policy design, including problem identification, strategy formulation, implementation, monitoring, and evaluation. National policymakers, who participate in international negotiations relating to climate change adaptation and mitigation in the forest ecosystem, need advice from scientist to make their arguments clear and convincing on the negotiation table. These arguments are similar to that of Vignola et al. (2009). International organisations, (IITA, CIFOR, ICRAFT, WWF, IUCN, and UNDP) and bilateral organisation (GTZ, EU, French Corporation etc.) base in Cameroon are actually playing a leading role in these aspects. However, the understanding and consensus between scientists and researchers within and across these institutions regarding win-win strategies is an important point of departure.

As earlier mentioned, climate change relationship with ecosystem services are complex and uncertain. More quantitative information is needed on the roles of ecosystem services to reducing societal vulnerability as well as the cost and benefits of conserving ecosystem services in the context of climate change at the local landscape. This knowledge is very important in the design of win-win strategies.

CHAPTER FIVE - CONCLUSION AND RECOMMENDATION

5.1 Summary and Conclusion

This study investigated and explored strategies that can simultaneously enable forest-dependent communities to adapt to climate change and climate variability and also enhance emission reductions from reduced deforestation and land degradation. The processes involved in the design and implementation of potential strategies, in the Congo basin forest of Cameroon was based on household perceptions. Questions used the concepts of vulnerability, adaptive, mitigative and response capacities and were supported by a multi-level and inter-sectoral approach in analysing stakeholder interaction and roles.

Community perceptions indicate that they are vulnerable to the variation in local climatic conditions and the seasonal calendar, with noted variations in temperature and sunshine, rainfall, and other climate sensitive schedules such as sowing periods and harvesting periods. Observations centred on uncertainty, irregularity, and periodic changes in the various climatic features. The communities depend on climate sensitive livelihood activities, which constitute their main source of income and household food security. Agriculture, collection of NTFPs, hunting, fishing constitute the major livelihood activities and sources of income, with some variation between the two communities. As a result of climate variability, communities are experiencing changes in the crop production cycle; farm preparation, planting, abortive germination, farm maintenance and harvesting. The collection of NTFPs varies as a result of irregular flowering of the different tree species. With this in mind, households are very much worried with the fate of crop production which provides and support income and food security. Communities are still struggling to master the local climate variation and the type of crops suitable for this climatic change.

The second vulnerability fear is related to the constraint of the carbon project on the adaptive capacity of some households in the study areas and to some extent the lack of knowledge and capacity relating to coping strategies. The PES project has forbidden the expansion of farm lands into the virgin forest and the traditional shifting cultivation by slash-and-burn has been prohibited. Access to fertile and sizeable land has been limited, and households perceive a decline in crop production, with a subsequent impact on income and food security especially in

Nkolonyeng. Despite not direct, equity as access, as participation and as outcome to benefit-sharing is also important for the communities to enhance their ability to adjust to changes.

The needs of the communities to adapt to the changing climate were as follows. First, improving the local agriculture system with the changing climate is imperative with the introduction of improved existing and new crop species that can adapt to the local climatic conditions. Improving cocoa production using suitable measures and the introduction and enhancement of agro-forestry are also crucial for household food security and income. Second, improving alternative livelihood and income activities is of great importance for communities. Activities such as beekeeping, fish farming, mushroom growing, livestock and the collection and marketing of NTFPs will enable households gain income and food security from activities other than agriculture. Crop diversification is also of importance to the communities within this aspect of livelihood diversification. Third, organising the local market for commodities (crops and NTFPs), communities say, will improve prices and better income from commodities. Fourth, there is need for information and knowledge sharing and capacity building for local communities. Training on the different new farming techniques which communities think are needed and the other alternative livelihood activities is imperative with material support.

Expansion of agriculture fields through shifting cultivation by slash-and-burn methods, fuel wood extraction and wild harvesting of honey are the drivers of deforestation and a threat to forest protection mitigation activities in the study areas. On the other hand limiting these activities without any intervention is also a threat to the adaptive capacity of communities, since communities are motivated by food insecurity and income, limited livelihood options, low harvest and market prices to engage in these activities. However, if mitigation activities streamed to protect forest are able to give households the opportunity to enhance their adaptive capacity on the same rhythm, this will enhance the mitigative capacity of communities, since it will incentivise, motivate and increase their willingness to participate and respect project conditions. The initial stage of the PES project is experiencing a high mitigative capacity; nevertheless, sustaining this capacity will depend on the projects ability to sustain the adaptive capacities of households in the different communities. Maintaining positive attitudes towards the local governance process is a booster for the mitigative capacity of households. There is dissimilarity between the two communities regarding perception of local governance processes; however this dissimilarity has little implications for the mitigative capacity at the early stages of the projects,

but the later stages of the project after financial flows from carbon sales will tell. The study reveals that, activities aimed at enhancing adaptive and mitigative capacities cut across different sectors (agriculture and rural development, forest and wildlife, environment, livestock). And the actors within these sectors and other stakeholders located at different governance levels have specific roles to play in the design and implementation of such strategies. These roles cannot be carried out independently; it requires a combined effort based on efficient communication, collaboration, networking, knowledge and information sharing between policymakers, local communities and civil society, scientist and researchers etc. In this policy process, policymakers need to mainstream adaptation and mitigation into national policies such as sustainable development, influence international course of action, mobilised new sources of funding and enhance interaction with forest communities, civil society, scientist and researchers. As adaptation and mitigation in the forest sector happen locally, forest communities have to participate in defining and implementing adaptation and mitigation strategies, they also have to interact and collaborate with policymakers, civil society, researchers and scientists in the design and implementation of win-win strategies. Lastly, the research and understanding of local climate variability and the vulnerability of forest communities is characterised by uncertainty and complexity, scientists and researchers need to communicate results and facilitate understanding to other scientists and non scientists such as policymakers, civil society and forest communities. As a matter of fact, the vulnerability of forest communities defined by exposure and adaptive capacity has implications for the outcome of livelihood strategies, which are the adaptation needs of forest communities. Reducing the vulnerability of communities by enhancing the adaptive capacity will also enhance their mitigative capacity. Hence, designing and implementing synergetic strategies between adaptation and mitigation in the forest sector, should employ the assessment of vulnerability of forest communities as a point of departure and the analytical framework in figure 2.2 can be useful in such response options. However, this case study argue that combining adaptation and mitigation is not a comprehensive panacea for climate policy, but synergies especially at the project level can contribute and it is worth exploring.

5.2 Recommendations

Analysing synergy between adaptation and mitigation in practice indicates that they both have the potentials of supporting and cancelling each other, due to challenges associated with socio-economic and environmental risk. For the two response options to sustain each other, this study proposes some recommendations.

First, the vulnerability of forest communities to climate and non climatic stresses (socio-economic, local governance structures and processes) has to be analysed in mitigation activities, and emphasise should be made on the mitigation activities that enhance the adaptive capacity of forest communities.

Secondly, future local climate scenarios and their potential impacts in various project areas have to be taken into account when designing, planning and implementing integrated strategies.

Most of the integrated strategies are climate sensitive, thus future risk as a result of climate change has to be recognised at the project planning phase.

Lastly, timing is very important and should be respected in project planning and implementation. Many activities within integrated projects follow particular stages in a cycle. Interruption at any one stage of the activity cycle due to technical or financial reasons can be detrimental to the whole activity and the project in general.

5.3 Issues for further research

Forest conservation through REDD mechanism and the synergy approach to climate change response in the forest sector are new approaches in practical terms. Some interesting issues related to the implementation and the outcome of the REDD type forest conservation mechanism which integrates the adaptation needs of forest-dependent communities has not been fully captured by this research, thus further investigation is required to complement and make this study relevant.

First, the various processes involve in the design and implementation of a REDD type mechanism are very sensitive to governance issues such as tenure rights and resource ownership. This study was carried out in forests areas with clear resource regimes, where management and benefits accruing from the forest such as timber and carbon sales is owned by the community. It is important to undertake another study in a state owned forest area. This can enable us to

compare the perception of forest-dependent communities of the two forest regimes regarding the implementation and outcome of REDD type mechanism. This might draw attention to issues regarding the type of resource regime that REDD can be preferred.

Secondly, this study was carried out at the early stage of the PES projects, which makes it difficult to have a conclusion on the impact of the project both on forest cover and on livelihoods. In this regard subsequent data collections and analysis are needed to evaluate whether the projects have actually contributed to maintain or increase forest cover and whether the livelihoods of the respective communities have been affected negatively or positively. This will also permit the identification of the shortcoming of the projects especially the outcome of the climate sensitive activities of the project. With this, lessons can be learned for future REDD projects in community forests.

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APPENDICES

Appendix 1: Household questionnaire

Household Survey questionnaire to be administered to household in the community forests involve in the study.

Name of village.....

Questionnaire number..... Date.....

Objectives: To investigate local people's perception of climate change, their concerns and needs related to adaptation and mitigation in a community forest context.

A. Identification

1. Name of household head.....

Gender.....Age.....Ethnic group.....Religion..... Marital status? Married
/_/ Single /_/ Widow /_/ Divorced /_/

B. Socio-economic characteristics

1. Level of Education: none /_/ Primary /_/ Secondary /_/ University /_/

2. Household size: 0-5 /_/ 6-10 /_/

3. Main livelihood activity: agriculture /_/ hunting /_/ Fishing /_/ NTFPs /_/ TFPs /_/ Farm labour
/_/ Others (specify) /_/

4. Does the above activities constitute your main source of income? Yes /_/ No /_/

5. What other sources of income do you have.....? 6.

What type of agriculture activity do you carry out: subsistence /_/ small-scale /_/ plantation /_/

7. What is the source of agriculture labour: Household /_/ Hired /_/ others (specify) /_/.....

8. List five main crops grown.....

9. What type of NTFPs do you collect from the forest.....
.....

10. What type of animals to you catch from the forest?
.....
.....

11. What type of fish species do you fish?

.....
.....

13. What is the source of Household food? Agriculture /_/ NTFPs /_/ Purchase /_/

14. What is the source of portable water? Spring /_/ Well /_/

15. What type of energy system do you use for cooking? Fuelwood with improve stove /_
Fuelwood with three stone fire side /_/

C. Agriculture land ownership

1. How did you get your land? Inherited /_/ Hired /_/ Cleared forest /_/

2. What is the size of your farm land? 0-2ha /_/ 2-4 ha /_/ >4 ha /_/

3. Are you hoping to increase your size of land? Yes /_/ No /_/

4. What drives you to increase your agriculture land? Low harvest /_/ Low market prices /_
Food insecurity /_/

5. Are you limited by any community regulation to increase your agriculture land? Yes /_/ No /_/

6. Do you respect the regulations? Yes /_/ No /_/

7. Why do you not respect the regulations
?.....
.....

D. Tenure, access and use of resources

1. Are you prevented from accessing resources (land and NTFPs) within the community forest?
Yes /_/ No /_/

2. Why is your household prevented from accessing the
forest.....?

3. Has this limitation affected your livelihood activity? Yes /_/ No /_/

4. If yes, what can be done to compensate for this affected livelihood
activity?.....
.....
.....

5. Do you have a land title for your land? Yes /_/ No /_/

6. Who owns the community forest? State /_/ Community /_/ Don't know /_/

7. Who manages the community forest? State /_/ Community /_/ Don't know /_/
8. Are you aware that the state can take over management of your community forest? Yes /_/ No /_/
9. If the state takes over management of the community forest, will you respect their rules and regulations concerning access and use of forest resources? Yes /_/ No /_/
10. Do you think the benefits you get from the forest now will be different? Yes /_/ No /_/

E. Local economic activity

1. How do you sell your agriculture output and NTFPs? Local market /_/ buyam sellam /_/ Co-operatives /_/
2. Are you satisfied with the prices you get from the market? Yes /_/ No /_/
3. If No, how do you compensate for the low market prices? Increase agriculture land /_/ increase exploitation of NTFPs and TFPs /_/
4. If you get better market prices and income, can this reduce your exploitation of forest resources? Yes? /_/ No /_/
5. What do you think can be done for you to get better market prices and income?

F. Equity and participation

1. Does your household have equal rights to access and use forest resources? Yes /_/ No /_/
2. Does your household have equal rights to decision making and benefits of the community forest? Yes /_/ No /_/
3. If No, does this affect your livelihood activity? Yes /_/ No /_/
3. If No, does this inequality affect your feelings about forest conservation? Yes /_/ No /_/
4. Have you been participating in decision making processes concerning the community forest management? Yes/_/ No /_/
5. If No, have this lack of participation affected your livelihood activity and feelings towards conservation of the community forest? Yes /_/ No /_/
6. Have your household benefitted from any proceeds from the community forest before? Yes /_/ No /_/
7. Did your household participated and benefitted equally from the benefits as the other households in the community? Yes /_/ No /_/

8. Are you satisfied with the management of the community forest? Yes /_/ No /_/
9. Does inequality and lack of participation influences your respect of rules and regulation of the community forest? Yes /_/ No /_/

G. Awareness, knowledge and perception of climate change and adaptation actions

1. How long have you been living in this community forest area? >15 years /_/ >30 /_/ >45 /_/
2. Have you experienced any changes between now and the past 15 years? Yes /_/ No /_/
3. What type of changes have you experienced? Temperature /_/ Rainfall /_/ Diseases and pest /_/ Variation in sowing period /_/ Variation in harvesting period /_/ Variation in water sources /_/
4. For any of the changes, can you evaluate the differences between the past 15 years and today?
 Temperature: increase /_/ decrease /_/ no change /_/: Rainfall: increase /_/ decrease /_/ no change /_/:
 Sowing time: increase /_/ decrease /_/ no change /_/: Harvesting time increase /_/ decrease /_/ no change /_/:
 Water sources: increase /_/ decrease /_/ no change /_/
5. Have these changes affected your livelihood activities (agriculture, hunting, fishing. collection of NTFPs)? Yes /_/ No /_/

6. How have these changes affected your activity?

Agriculture

output.....

Fishing:.....

Collection of NTFPs:.....

Hunting.....

Others.....

7. Have you developed coping strategies for the changes mentioned above? Yes /_/ No /_/
8. For each of the activity (agriculture, fishing.....etc) briefly describe how you cope with the different changes (rainfall, temperature, sowing time and harvesting time)?

.....
.....
.....
.....
.....
.....
.....
.....
.....

9. Have you been assisted by any organisation concerning coping strategies to the changes mentioned above? Yes /_/ No /_/

10. What have these organisations done to help your community cope to these changes/?.....
.....
.....
.....

11. Are you prepared and willing to be supported to develop coping strategies? Yes /_/ No /_/

12. What support do you need?
.....

13. Are you aware of the causes of the changes mentioned above? Yes /_/ No /_/

14. How did you get the information? NGOs /_/ GOs /_/ CBOs /_/ Indigenous knowledge /_/

H. Awareness, knowledge and perception of mitigation actions

1. Are you aware that your livelihood activities are contributing to deforestation? Yes /_/ No /_/

2. Are you aware that deforestation contributes to the changes you mentioned above? Yes /_/ No /_/

3. How did you get the information? NGO /_/ GOs /_/ CBO /_/

4. Are you aware of the recent CED conservation project in your community? Yes /_/ No /_/

5. Have you been participating in the project process? Yes /_/ No /_/

6. Have you benefitted from this project? Yes /_/ No /_/

7. Why have you not benefited from the project?.....

.....

8. How are you benefiting from the project?

.....

9. Do you think this project will affect your livelihood activity? Yes /_/ No /_/

10. What other livelihood activity can your household pursue?.....

.....

11. Have you received any training or support concerning the different livelihood activities? Yes

/_/ No /_/

12. Are you prepared to respect the rules and regulations put in place by the project? Yes /_/ No

/_/

13. What can motivate you to respect the rules and regulations of the project?

.....

14. What benefits are you expecting from the conservation project

?.....

.....

15. What general and additional comments do you have concerning your experience of climate

change, coping strategies and your participation in conservation projects?

.....

Appendix 2: Selected field work pictures



PES project nursery sites in Nomedjoh and Nkolenyeng Community forests



Baka housing infrastructure in Nkolenyeng and Nomedjoh communities



Household surveys in study areas



Community introduction meeting Nomedjoh community forest area