Non-Timber Forest Products and Climate Change Adaptation / Forest Dependent Communities In Bamboko Forest Reserve, South West Region Of Cameroon

Tieminie Robinson Nghogekeh (tieminier@gmail.com)
University of Dschang-Cameroon

Chia Eugene Loh
GIZ,Yaounde Cameroon

Tieguhong Julius Chupezi
African Development Bank

Nghobuoche Frankline Mayiadieh
Universite de Yaounde I

Piabuo Serge Mandiefe
World Agroforestry Centre

Mamboh Rolland Tieguhong
Universite de Yaounde II

Research

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Abstract

Background: This study to assess the role of Non-timber forest products was conducted to forest dependent communities around Bamkoko Forest Reserve in the South West Region of Cameroon as a strategy to cope with the impacts of climate change.

Methods: Data were collected through household questionnaires, participatory rural appraisal techniques, transect walk and direct field observations.

Results: A total of 16 plants species were identified to be harvested by residents around Bamkoko Forest Reserve as None Timber Forest Products. The majority of the respondents (88%) perceived that there has been a change in the climate patterns due to increased temperatures and unpredictable rainfalls. Eru was found to be the most affected livelihood activity (55%) by climate change around Bamboko Forest Reserve. Communities living around Bamboko Forest Reserve were found to use more than one strategy to cope with the adverse effects of climate change.

Conclusion: The study concluded that NTFPs still play a safety net role to assist communities in adverse situation such as crop failure under the current change in climate. The need to emphasis sustainable harvesting, improve processing and access to NTFPs markets is crucial.

1. Background

The importance of forests to the well-being of a large number of poor people especially in tropical developing countries is indisputable and well recorded (Ruiz Pérez and Arnold 1996; Arnold and Ruiz-Perez 1998; Byron and Arnold1999; Tieguhong and Ndoye 2004; Sunderlin et al.2005;Powell et al. 2011;). In addition, tropical forests are a natural resource pool indispensable to the national development plans and poverty reduction strategies around the world. The tropical forests contain a wealth of timber and non-timber products which have thus been exploited for food, fuel wood, watershed, pharmaceutical royalties, honey, snail and other marketable and non-marketable products. NTFPs contribute to livelihoods of about 2 billion of the world's poorest people in urban and rural settlements and are among the most valuable plant resources for present and future food security. There is now clear evidence that the earth's climate is warming. Global surface temperatures have risen by 1.3 degrees Fahrenheit (ºF) over the last 100 years. Worldwide, the last decade has been the warmest on record. The rate of warming across the globe over the last 50 years (0.24ºF per decade) is almost double the rate of Warming over the last 100 years (0.13ºF per decade). But the evidence of climate change extends well beyond increases in global surface temperatures. It also includes: changing precipitation patterns, melting ice in the arctic, melting glaciers around the world, increasing ocean temperatures, rising sea level, around the world, acidification of the oceans due to elevated carbon dioxide in the atmosphere, responses by plants and animals, such as shifting ranges. Forests are tremendously naturally endowed to combat climate change by protecting people and livelihoods, and creating a base for more sustainable economic and social

development. But this natural mechanism is often hampered by anthropogenic activities. It is therefore imperative to take measures which are environmentally sustainable not only for mitigation, but also for its adaptation. It is argued that climate change presents additional challenges to a country such as Cameroon, owing to its agro-ecological diversity (Brown et al. 2010). Indeed, studies have identified different aspects of climate change vulnerability specific to individual agro-ecosystems in Cameroon (Brown et al. 2010, Yengoh et al. 2010a). While changes that warrant adaptation may occur in all agro-ecosystems in the country, these changes are not likely to be of the same intensity in the entire country (IPCC 2007). Many developing countries (Smith and Scherr 2003; World Bank 2004);(Nkem et al.2010).Over1.6 billion people living in extreme poverty . Forest preservation and conservation provides an essential mitigation measure towards addressing climate variability and change (Kremen et al. 2000; Thompson et al.2009). There is limited understanding on the magnitude of the changes in local climatic scenarios in the landscape. Observations were related to uncertainty, irregularity and periodic changes. In a study in southern Cameroon, villagers describe this situation as“climate accident”(Chia et al.,2013).However, the inherent variations of climate from season to season and from year to year make variability a fundamental part of climate change (Hulme et al., 1999; Berz, 1999). Research has underscored the vulnerability to climate variability and change of sectors, such as food, energy and water (Sonwa et al.,2012),and the livelihood strategies of forest-dependent communities (Bele et al.,2013a,2013b;Nkem et al.,2012;Chia et al.,2013) in other forest areas in the region. The use of Non-Timber Forest Products (NTFPs) is proffered as an option in this paper. Non-Timber Forest Products (NTFPs) are defined as biological materials other than timber which are extracted from the forest for human use. There are suggestions, however, of three major pathways of climate change impacts on indigenous people and their livelihoods through increase in environmental risks, reduction in livelihood opportunities and consequent stressing of existing social and policy institutions (Agrawal 2007). Forest livelihood strategies are influenced by forest type, which determines the availability and distribution of various livelihood assets described in the Department for International Development (1999) sustainable livelihood framework. This may be related to the differential sensitivity of forest types to climate impacts, as well as to the nature of use of the asset by the community. These climate risks have been selected from the well documented scientific analysis of climate change on tropical forests, particularly Congo Basin forests (CBFP 2005; IPCC 2007; Locatelli et al. 2008; Somorin 2010).NTFPs encompasses as all tangible animals and plants forest products other than industrial wood, coming from natural forests, managed secondary forests and enriched forests.. NTFPs contribute to livelihoods of about 2 billion of the world’s poorest people in urban and rural settlements and are among the most valuable plant resources for present and future food security. There is limited understanding on the magnitude of the changes in local climatic scenarios in the landscape. Observations were related to uncertainty, irregularity and periodic changes. NTFPs if properly managed can provide good sources of animal protein and income to the immediate communities as well as promote tourism. Adaptation through reducing vulnerability is therefore one of the approaches considered likely to reduce the impacts of long-term climate changes. Importantly, it has been argued by Nkem et al. (2010) that sustainable utilization of NTFPs could be among the effective climate change adaptation strategies in Africa. Several climate change related policies and programs have focused on NTFPs. According to UN (2009), NTFPs are one of

the co-benefits of REDD+ (Reduced Emissions from Deforestation and Forest Degradation plus). Through its implementation, communities will gain more benefits of ecosystem services, especially through creation of sustainable NTFPs based enterprises (URT, 2010b). The Fifth Assessment Report of the IPCC Smith et al., (2014a) describes how older people are usually at greater risk from storms, floods, heat waves, and other extreme events partly because they tend to be less mobile than younger adults, more likely live alone in some cultures and thus find more difficult to avoid hazardous situations. During such times of stresses, the most important coping strategy for households involves gathering of NTFPs such as wild mushrooms, firewood, wild fruits, thatch grasses, medicinal plants, bush meat, building poles to mention a few. This reliance on forest resources is often greater considering that forests also support local industries that produce wood products (Nkem et al., 2010).

Study Objectives

The objectives of this study were to:

1. Identify different types of NTFPs in the study area and amount sold per household per year in BFR.
2. To examine local perception of climate change vulnerability and impacts on NTFPs availability and livelihoods of forest dependent communities around BFR, perceptions on changes in rainfall patterns and temperatures around BFR.
3. To examine the coping/adaptation strategies at community level in the changing climate.

2. Material And Methods

2.1 Study area description

The Bamkoko Forest Reserve is located between latitude 4° 19’ 53” and 4°50’ 35” North and longitude 9° 10’ 45” and 9° 25’ 35” East of the prime meridian. This study covers part of the Mbonge Sub Division in Meme Division and part of the Muyuka Sub Division in Fako Division both in the South West Region of Cameroon. Most part of the reserve is found in Mbonge Sub division where most of the activities are carried out. The study covered the following sampled villages; Munyenge, Lilale, Lykoko, Bova, and Kotto.A number of criteria were used in choosing the sampled villages which among others included: villages located not more than three kilometres from the forest reserve, Villages whose inhabitants are actively involved in the collection and harvesting of non-timber forest products,Villages having a good number of active hunters, At least one village from all the four corners of the reserve.The choice took into consideration the four corners of the reserve. Site “A” was made up of Munyenge, Lilale, Lykoko, site “B” the principal village sampled was Bova, site “C” was concern with Efolofo village while site “D” had as sampled village Kotto.The layout of the Bamboko Forest Reserve is illustrated in the figure 1 below: Sample size of 20% of the population was selected following Mugenda and Mugenda (2003), who states

that a sample of 10.0% to 20% of the total population for a large or small population is adequate and large enough to provide sufficient information concerning the population understudy (Table 1). In each of the selected strata, all households head or their representative were interviewed. Figure 1 : Lay out map of the Study area, Source : World Resource Institute, 2018

Table 1
Sample Frame

Strata	Population (HH)	Proportion (%)	Sample Size
Munyenge	760	20%	152
Lilale	800	20%	160
Lykoko	750	20%	150
Bova,	943	20%	188
Kotto	500	20%	100
Total	3753	100%	750

2.2 Methodology

2.2.1 Data collection

The study involved both collections of primary and secondary data. Primary data were collected from November 2017 to March 2018 through household interviews, Participatory Rural Appraisal (PRA) techniques and direct field observation. A reconnaissance survey was carried out prior to actual data collection to provide a general picture of the research area, including identifying and meeting various stakeholders around the BFR. Reconnaissance survey enabled the researcher to obtain basic information on population size, ethnicity and socio-economic activities of the study area. Ecoguards and village officers were the main sources of baseline information related to the study area.

2.2.2 Participatory Rural Appraisal (PRA) techniques

PRA is an exploratory method that aims at having a dialogue with stakeholders and getting information from them through participatory communication and analytical method (Duangsa, 1996). The participatory tools and techniques for assessing climate change impacts and exploring adaptation options by Regmi et al., (2010) were modified and adopted for use during the exercise. The tools used in the study were resource mapping to map local climatic hazards; free listing of NTFPs; matrix scoring; climatic hazard trend analysis to gain insight into past hazards; climatic hazard ranking to compare and

contrast the impact of major climatic hazards on the social group; vulnerability assessment; coping and adaptation strategies to assess the effectiveness of the current coping strategies.

2.2.3 Transect walk

Transect walks was conducted to verify the identification of NTFPs in the BFR. In each village, two transects of 3km each from the edge of the forest towards the center were carried out. Distance from one transect to the next was 2 km. The first plot was established randomly followed by systematic sampling where the distance from one plot to another was 500m. The square sample plots of 25 m^2 x 25 m^2 were adopted because they are easy to layout. The square plot design is also recommended in the guideline for the baseline study of Community Forests in Cameroon (ICRAF, 2017), Sustainable Financing of Community Forest Enterprises in Cameroon (DRYAD) project. A total of 4 sample plots were established and existing NTFPs assessed and recorded (Figure 1). People with long experience in utilization of particular NTFPs were asked to identify plant species and provide information on the use and quantity which can be harvested from each plant. Identification of plant species were in vernacular names and later were translated into botanical names. Secondary data involved collection of information from different sources like reviewing relevant documents like publications, journals, reports and books.

2.2.4 Data analysis

Data were analyzed descriptively using excel spread sheed. Statistical were carried out where necessary to test for the level of significance among variables.

3. Results And Discussions

Table 2
Major NTFPs in and around BFR

NTFPs Scientific name	Local name
Garcinia cola	Bitter kola
Irvingiagabonensis	Bush mango
Piper quinensis	Bush pepper
Garcinia mannii	Chewing stick
Gnetum africana	Eru
Cola nitidia	Kola nuts
Cola lepidota	Monkey kola
Ricinodendronheudelotii	Njansang
Prunus africanus	Pygeum
Lacospermaspp	Rattan cane
Helix aspersa	Snail
Acacia seyal delile	Fuelwood
Aframomum spp.	Alligator Pepper
Dacroydesedulis	Bush Plum
Marantaceae	Ngongo
Afrostiraxkamerunensis	Bush Onion
	Cashew nuts

Forest resources in the form of NTFPs serve as safety nets, sustaining the livelihoods of some forest communities in BFR. They play a vital role in income generation and household food security (Nkem et al., 2010). The results of this study indicate that the collection and sale of NTFPs is a major livelihood activity and a source of income for households especially in Munyenge, Lilale, Lykoko, Bova, and Kotto and the access to NTFPs is open to the people in both forest reserve settings. They collect NTFPs known as shown on the table above. Local people extracted NTFPs primarily for meeting household needs, as well as for earning additional income to support or supplement their livelihoods. NTFPs harvested from the BFR have been classified according to the benefits identified by the respondents including direct and indirect benefits. Direct benefits included human food, animal feed, medicinal plants, and poles, wood

fuel and ropes. Indirect benefits include environmental conservation and watershed protection (ecosystem services).

3.1 Amount of NTFPs used and sold per household per year in the BFR

Table 3 shows the amount of NTFPs used and sold per household per year in the BFR. Bitter kola,eru,bush mango,njansang,kola nuts,snails were the most traded NTFPs in the area. It was learnt that the demand for these resources was higher compared to the supply. It was estimated that a household can generate up to 1990000 FCFA per year from selling of NTFPs. The amount of revenue was low because the forest is protected by the village, government and the entry to the forest and the harvest of NTFPs were through the permit and they also have their limit were they can collect NTFPs. There is a need to sensitize communities around the BFR on the importance of the law enforcement. About 53%, 24% and 23% of the respondents agreed that eru, bush mango njansang,bitter kola and snails, respectively could be used to assist households cope with climate change.

Table 3
NTFPs used and sold per household per year

Products	Amount used per household per year	Average amount sold per year	Average amount earned per year (FCFA)
Bitter kola (bucket)	2	15	300000
Bush mango (buckets)	4	30	450000
Bush pepper (buckets)	2	10	20000
Chewing stick (bundles)	1	20	10000
Eru (kg)	50	50	300000
Kola nuts (buckets)	5	22	250000
Monkey kola (buckets)	1	5	20000
Njansang (buckets)	7	16	400000
Rattan cane (Bundles)	5	15	90000
Snail (buckets)	10	30	150000
Fuelwood (bundles)	17	50	-
Bush Plum (buckets)	2	5	-
Total			1990000

3.2 Local perceptions of respondents on the impact of climate change on NTFPs and livelihoods

Forest resources in the form of NTFPs serve as safety nets, sustaining the livelihoods of some forest communities in BFR. They play a vital role in income generation and household food security Nkem et al., (2010). The results of this study indicate that the collection and sale of NTFPs is a major livelihood activity and a source of income for households especially in Munyenge and the access to NTFPs is open to the peoples in both forest reserve settings. They collect NTFPs known as Mbalaka, Maobi (*Baillonellatoxisperma*), Nguimba, Bush mango (*Irvingagabonensis*), Njansang (*RicinodendronHeudelotti subsp. Africanum*).In this study 31% of the households agreed that heavy rainfall prevented the collections of NTFPs especially fuel wood which is used by the entire households in BFR. Most of the households eat unready prepare food because the fuel wood collected is wet and produce mostly smoke

instead of flames when it is burnt. Households involve in the collection of NTFPs as a main livelihood activity especially the Kotto households communicated that the harvesting of fruits from the different tree species is at times poor as a result of poor flowering and fruiting of the tree species, Also heavy rainfall is affecting the collection of NTFPs especially the harvesting of certain fruits in some trees species according some households in Bova is very poor due pests and diseases that affect the flowering of this fruits based on their local knowledge While some household (55%) communicated that there have been decrease in eru which they attributed it to climate change and variability. In addition,(22%) of the households agreed that drought as one of the climate impact on climate sensitive resources in this communities. Drought have caused serious problem in collections of some NTFPs species especially Njansang which have become very difficult for back to decompose and cracking to remove the nuts and decrease in quantity of snails (40%) of households pointed out that it was due climate change and variability

Table 4
The figure in th bracket represent the frequences of responses and outside bracket pressent the parentages of respondents

Responses	% Responses
Drying of water sources	35 (40)
Drought	20 (25)
Heavy Rainfall	31 (22)
Decrease in Eru	55 (65)
Decrease in Snails	40 (35)
	181 (187)
Total	

3.3 Changes in temperature around the BFR

Majority of the respondents agreed that there have been changes in the temperature in the area. About 71% of them reported that there has been an increase in temperature for the more than 20 years ago

around the BFR (Figure 2). However about 12% of the respondents noticed the contrary, a decrease in temperature. While only 5% believed that there has been no change in the temperature for the last 20 years. Trend analysis of the annual temperature around BFR shows an increase in the temperature for the past 30 years (Figure 2). The climatic data records were in line with the people's perceptions, Figure 2: local perceptions on changes in temperature around the BFR, Figure 3: Average annual temperature around BFR from 1971 to 2015

3.4 Rainfall changes around BFR

The majority of the respondents (88%) agreed that there have been changes in the rainfall patterns over 25 years. They noticed a change not only in the total amount of rainfall but also in the timing of the rains; with rains coming either earlier or later than expected. But only 10% of the respondents believed that there were no changes in rainfall patterns from the last 30 years. Figure 3 indicates that 54% respondents noticed an increase in the amount of rainfall or a shorter heavy rainy season (unpredicted rainfall). It was further revealed that 21% of the respondents felt that there has been a decrease in the amount of rainfall including dry season starting early and was also longer than usual in the area. However, only 9% believed that there has been no change in annual rainfall for the last 20 years. The trend analysis of the annual rainfall from 1960 to 2015 shows fluctuations with increased annual rainfall (Figure 3). The people's perceptions were in line with the climatic data records, Figure 4: local perceptions on changes in rainfall patterns around the BFR, Figure 5: Average annual rainfall around BFR from 1960 to 2015

3.5 The Availability of NTFPs

Eru was identified as key and rare NTFPs in the study area. Majority of the respondents (55%) admitted to harvest and consume eru during the wet season. A total of 25 bags harvested from the forest were listed during PRA (Table 4). This implies the BFR is rich in wild eru and people were knowledgeable on edible eru found in the forest. It was reported by respondents that fuel wood is available during the dry season as the rainy season has been too rainier in the past years while the collection of snails is during rainy season especially during August to September which is considered as peak season for snails collection as identified by respondents.

Table 5
NTFPs and their availability

NTFPs Scientific Name	Local Name	Availability
Garcinia cola	Bitter kola	Rainy season
Irvingiagabonensis	Bush mango	Rainy season
Piper quinensis	Bush pepper	Dry season
Acacia seyal delile	Fuel wood	Dry season
Gnetum africana	Eru	Rainy season
Cola nitidia	Kola nuts	Dry season
Cola lepidota	Monkey kola	Rainy season
Helix aspersa	Snail	Rainy season
Gnetum africana	Eru	Rainy season

3.6 Adaptation strategies to cope with climate change and variability

The need for a multi-disciplinary approach in climate change mitigation and adaptation research is dictated by the multi-disciplinary nature of problems related to climate change. At the centre of this communication and collaboration, Vignola et al., (2009) advocate an ecosystem-based framework in which addressing the problems of ecosystem degradation and the conservation of natural capital are the main focus. In this study, 4.2% of the households used fertilizers in their farms in order to increase yields. 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. The planting of trees to protect winds 5.9% of the household have planted trees especially around their houses to protect strong winds during torrential rainfall which is accompanied by strong winds in the study site which use to up roof their houses and most households used their traditional methods to protect winds by tying red pieces of cloth round their farms land. Additional 7.6% of the household have adopted irrigation system of farming during the prolong dry seasons and drought, they moved to swamps areas and opened new farms where water is available throughout the year the local farmers used watering cane to send water into their farms. Furthermore 32.8% of household have diversified their crops, sustaining the diversity of crops it is an appropriate adaptation option for food security and livelihood in this communities. This finding is similar to other studies carried out by (IDRC, 2009). Household in the study area has actually expressed their willingness to integrate other livelihood activities like food crops and livestock rearing (sheep) have increase their source of income especially small farmers in the study area. This is similar to the findings

of Yengoh et al. (2010). This study also shows 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.

In this result 69.7% of household have diversified their occupation in order to reduce their vulnerability to local climate and uncertainty. Engaging in non-climate dependent alternative jobs such as driving, masonry works, sale of assorted goods “provision store”, shoe repairing, painting, sewing or dress making was ranked the second highest among the coping measures described by respondents. Although the dominant occupation is farming and therefore it is expected that most people will give priority to any coping measures that will help sustain their dominant livelihood activity, household members especially the young migrating to urban centres in search for jobs resulting to rural exodus in the study site.

Also 78.2% of respondent have increase their farms sizes. According to the household, they increase their farms sizes every beginning of farming seasons as an adaptation option to local climate variability and uncertainty. The expansion of agricultural land is a coping and adaptation strategy for these forest dependent communities. This supported finding carried around the same area Bele et al.,(2013a,2013b) and Chia et al.,(2013). Increasing the agriculture land to compensate for losses has put more pressure on other natural resources on which the communities depend, resulting in a perverse cycle that could increase their vulnerability even more. Increase climate variability and uncertainty seems to be one of the main disturbances shaping current vulnerability in these communities. It was revealed that 85.2% of respondents consume and sale NTFPs from the forest as climate change variability coping strategy. They use NTFPs like bush mango, fuel wood; bush blum, snails, bitter kola, kola nut to be sold in Mbonge and Munyuka markets. Finally, 52.3% of respondents’ sale timber trees from their farm as coping strategy to climate change and variability.

Table 6
Responses on various adaptations as coping strategies to climate change

Adaptation strategies	% Response(n)
Used of fertilizers	4.2(34)
Planting of trees	5.9(37)
Irrigation	7.6(41)
Diversification of crops	32.8(57)
Diversification of occupation	69.7(60
Increase in farm sizes	78.2(85)
Used of NTFPs	85.2(92)
Timber selling from own farm	34.3(43)

4. Conclusion

The coping and adaptation strategies of the communities to the changing climate were as follows. Improving cocoa production using suitable measures and the introduction and enhancement of agro-forestry systems are also crucial for household food security and income. Second, planting of trees to protect strong winds; thirdly irrigation system to improving alternative livelihood and income activities is of great importance for communities. Activities such as beekeeping, growing livestock and the sustainable 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, the local market has been organized for commodities (crops and NTFPs), and stable prices communities say, will improve prices and better income from commodities. Furthermore, there is need for access to information about climate change issues 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. The study reveals that, activities aimed at enhancing adaptive and 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 the adaptation from international policies into national policies such as, scientists and researchers need to communicate results and facilitate understanding to other scientists and non-scientists such as policymakers, civil society and forest communities.

Declarations

Ethics approval and consent to participate :

This study was approved by Techinical Training and Research for Development (TTRECED-Cameroon) Tele :+23767974489.There was also prior inform consent during the data collections

Consent for publication:

"Not applicable" in this section

Availability of data and material :

"Please contact author for data requests."

Competing interest:

The authors declare that they have no competing interests."

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Authors contributions:

Tieminie Robinson Nghogekeh: He generates the primary idea of this study and the write up of the paper

Chia Loh Eugene: He structured the manuscript and evaluates the quality of the manuscript

Tieguhong Julius Chupezi :He finalised the reviewed of the paper and structured the manuscript

Nghobuoche Frankline Mayiadieh: Contibuted in data collections and reviewed of the paper

Piabuo Serge Madiefe: He did the data entries and analysis

Tieguhong Rolland Mamboh:He assisted in data collections during the field survy in different villages around BFR.

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Figures

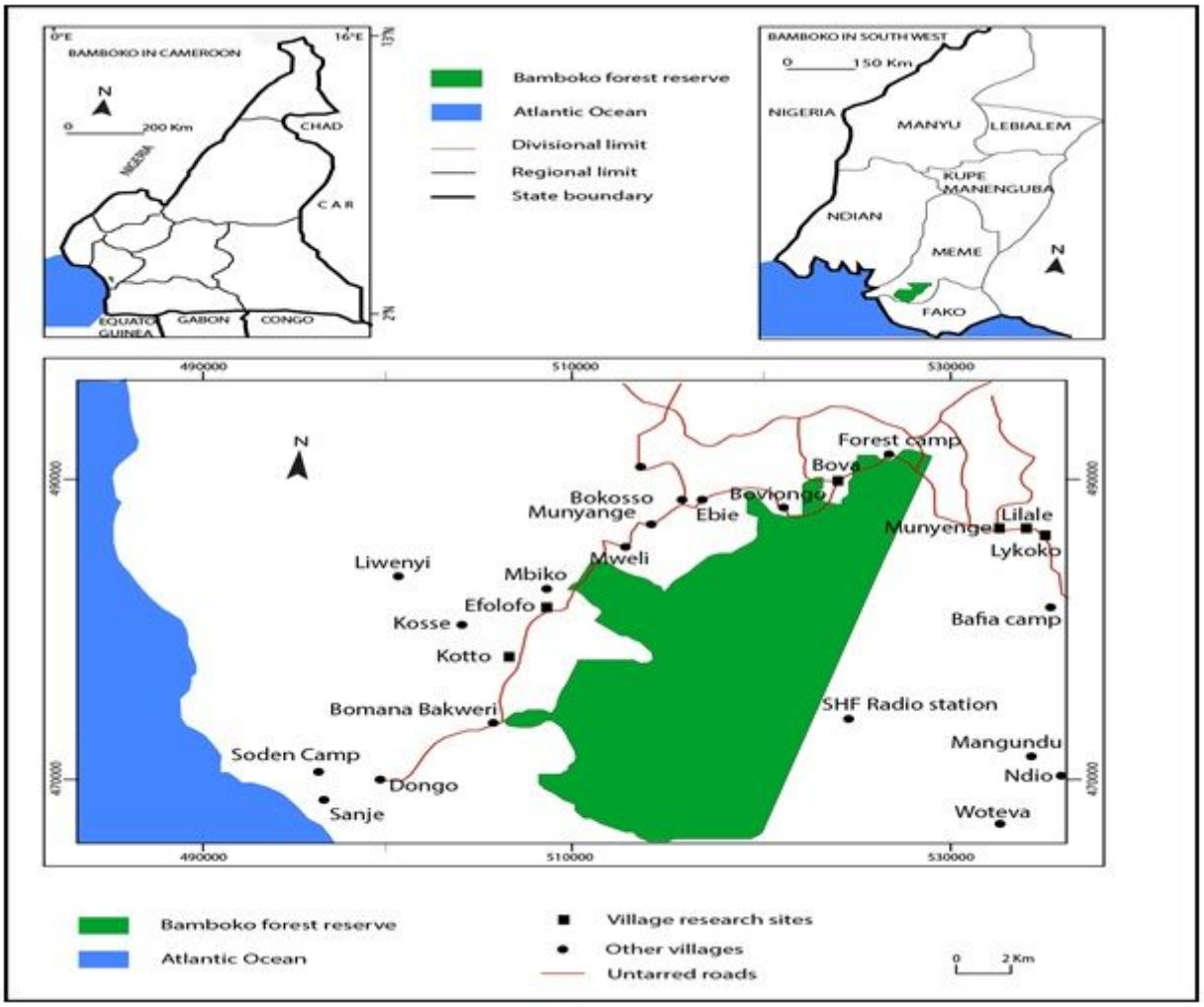

Figure 1

Lay out map of the Study area

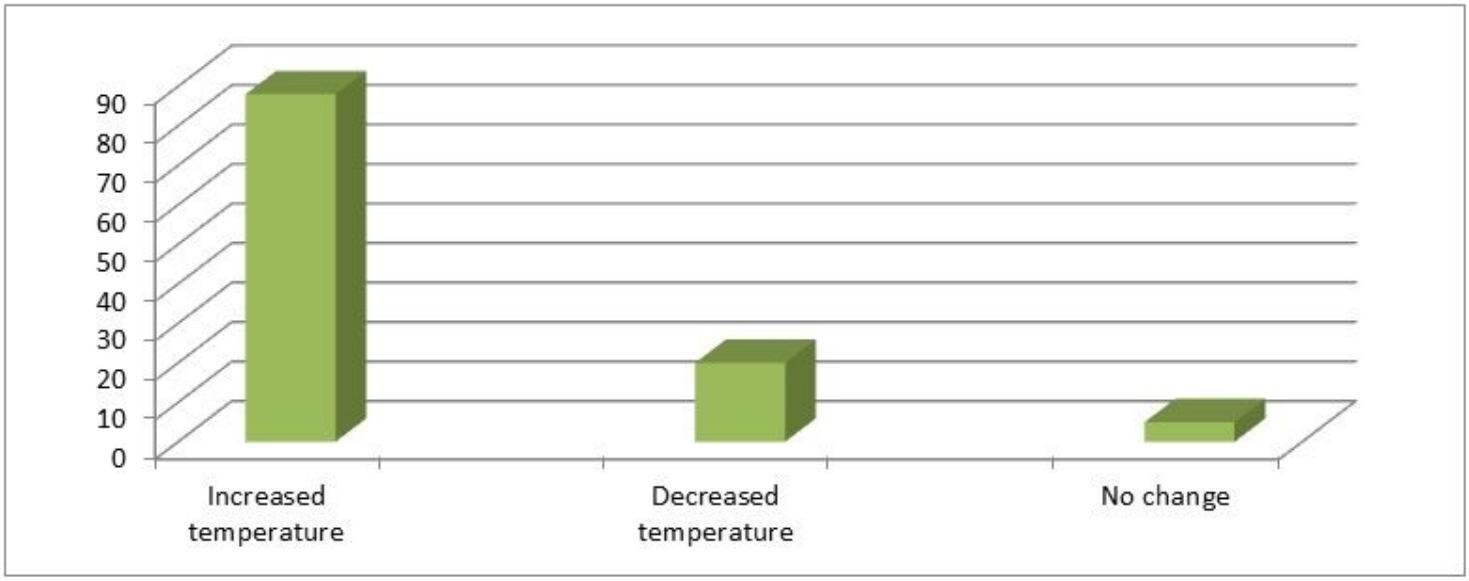

Figure 2

local perceptions on changes in temperature around the BFR

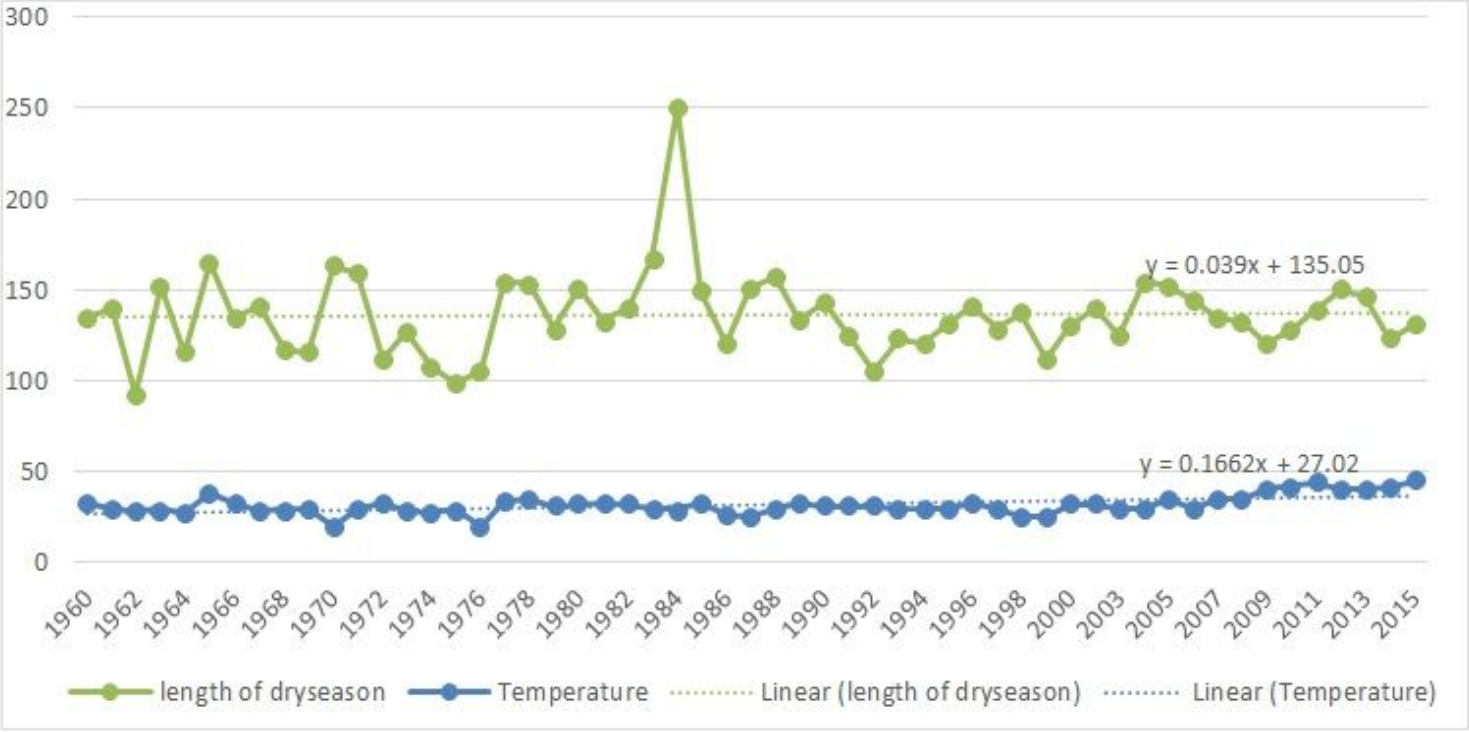

Figure 3

Average annual temperature around BFR from 1971 to 2015

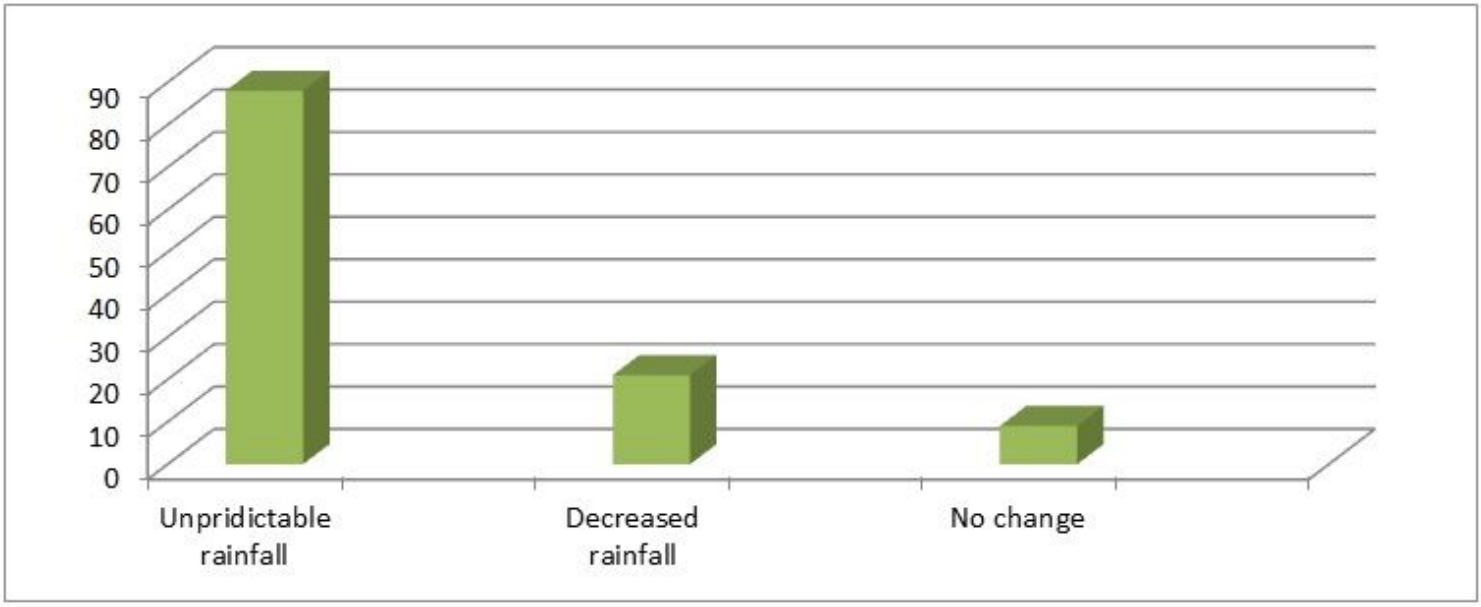

Figure 4

local perceptions on changes in rainfall patterns around the BFR

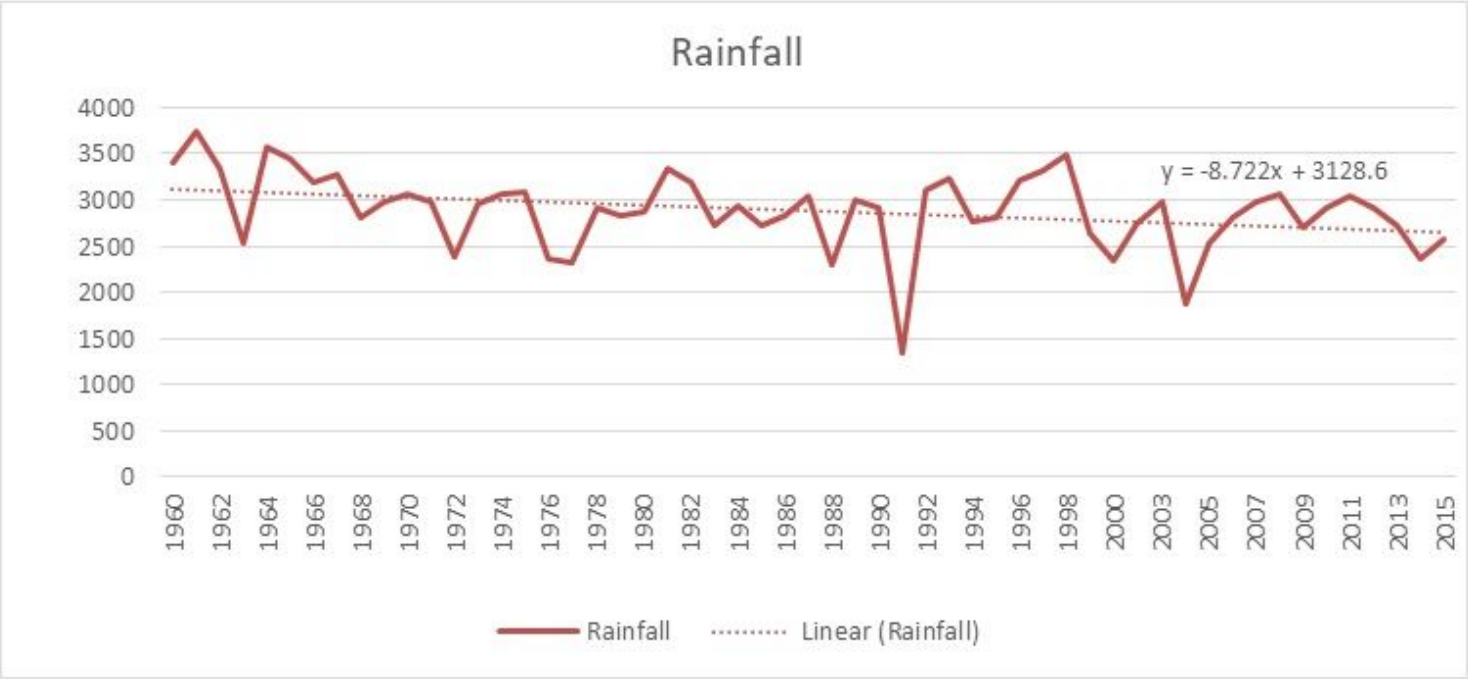

Figure 5

Average annual rainfall around BFR from 1960 to 2015