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FARMERS' PERCEPTION OF CLIMATE VARIABILITY IMPACTS ON FOOD CROP PRODUCTION AND THEIR ADAPTATION PRACTICES IN SANTA SUB-DIVISION, NORTHWEST REGION, CAMEROON

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ABSTRACT

Food crop farmers in Santa Subdivision, just like in many agricultural areas, have greatly suffered the misery of climate variability. The Farmers' perception of climate variability and the measures they are putting in place to cope with it are still concealed. This study therefore focused on examining how farmers perceive and adapt to climate variability in Santa Subdivision. With the mixed-methods approach, observations, semi-structured questionnaires, interviews, and Focus Group Discussions were used to collect data from 150 food crop farmers randomly selected from four communities. The study used both descriptive and inferential analysis techniques. The chi-square test with a P-value of 0.199 showed that farmers have significant knowledge and understanding of climate variability. Results showed that farmers have adopted adaptation practises such as irrigation, changing planting dates, mixed cropping, diversification of farming activities and the use of agrochemicals. These measures have significantly determined food crop outputs. However, certain factors such as education and training, financial constraints and land tenure system do affect the farmer's ability to adapt. This study therefore recommends the use of sustainable agricultural practises, government subsidy, education and training amongst other measures to improve the adaptive capacity of farmers and to improve on agricultural activities in Santa.

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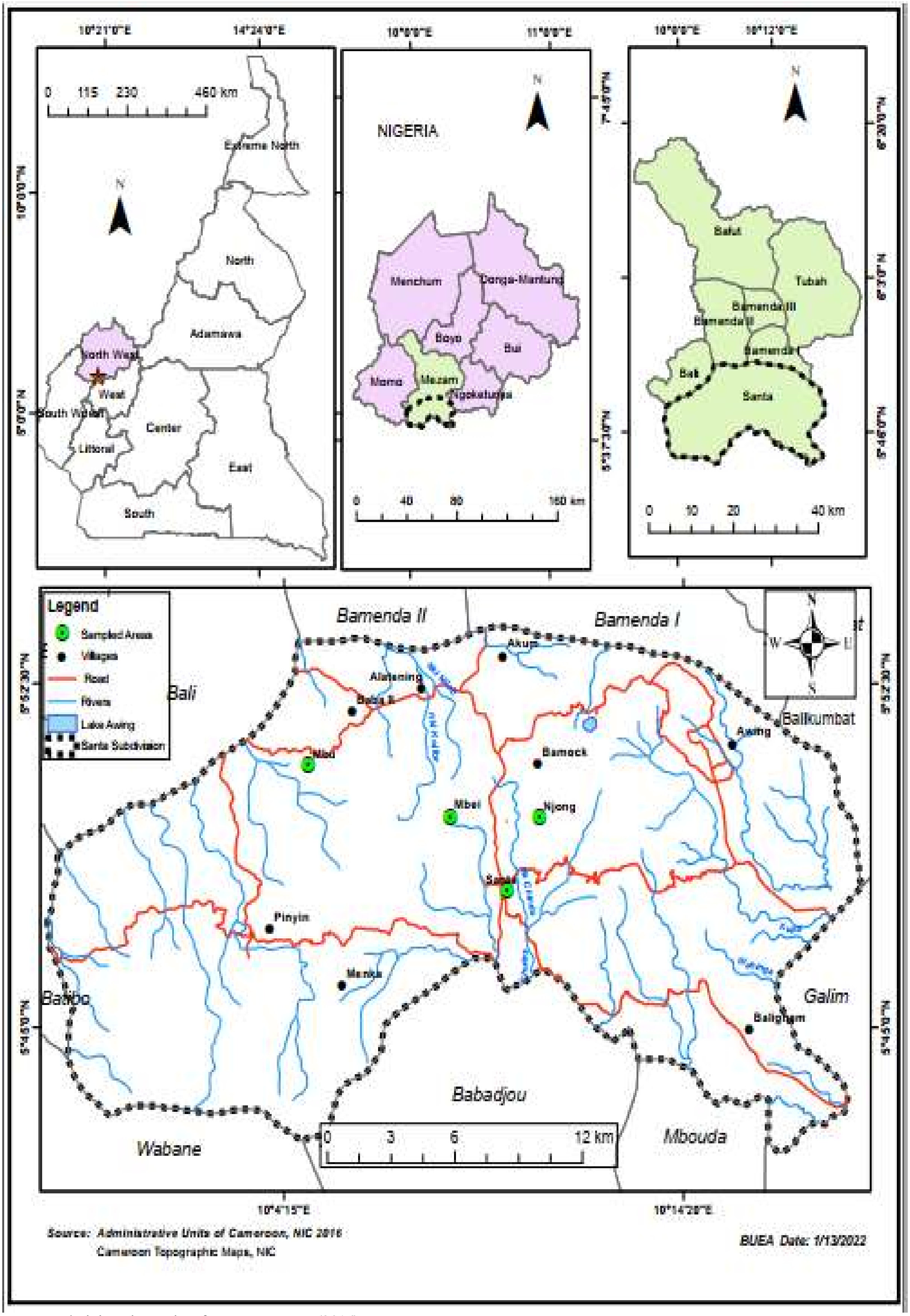
INTRODUCTION

With the rapid increase in the world's population, there is a corresponding increase in food demand owing to concerns about the stability of the global environment (Raza, *et al*., 2019). Humans, through their activities, have increased and are still increasing dangerous Greenhouse gases (GHGs) in the atmosphere, which have altered the atmospheric concentration, thus causing climate variability (IPCC-AR5, 2013). Climate variability impacts are felt differently in different sectors and parts of the world. The significant impacts of climate variability are mostly felt by the agricultural sector. Farmers are very exposed to the impacts brought about by climate variability, as it has drastically affected both their agricultural productivity and their livelihoods. Climate variability has an effect on the wellbeing of crops and determine their growth, making its effects determinant on the food security situation of the regions Ojumu *et al*. (2020 According to the Intergovernmental Panel on Climate Change (IPCC) 2015 Report, developing countries are the most exposed to the effects of climate variability, even though this phenomenon is of global concern. The fact that agriculture is the backbone of Cameroon and that this country is a sub-Saharan African country makes it very vulnerable to climate variability impacts. This vulnerability is due to the fact that, the agricultural sector of this country in general and particularly the major agricultural highlands like Santa Subdivision is rain-fed. Depending on rainfall exposes the activity which is highly climate sensitive. With this, farmers are bringing forth some adaptive measures to cope with the current changes.

Having knowledge of farmers' perceptions can help decision-makers better understand the realities of climate variability that are happening at the local scale. This can help in the formulation and implementation of climate-related policies. Briggs' (2013) stated that policies that seek to improve local development cannot exclude local knowledge and perception. Rainfall in Sub-Saharan Africa is characterized by strong variability (Faustin *et al*., 2017); countries such as Chad, Nigeria, Sudan, and Niger have experienced a decrease in rainfall and erratic rainfall temperature patterns over the years. Given the high vulnerability of Santa Cruz to climate variability impacts, adaptation is necessary. Farmers' perception and adaptation work together, as the perception of farmers influences their adaptation choices to cope with the impacts of climate variability. Farmers' understanding of climate variability and adaptation to it is very important to ensure food security and the sustainable livelihood of farmers in Santa Subdivision.

Study Area: Santa Sub Division is located in the North West region of Cameroon, and it lies between latitudes 5^0 42' and 5^0 56' North of the equator and between longitudes 9^0 58' and 10^0 18' East of the Greenwich Meridian (Figure 1). Santa Subdivision shares boundaries in the North with Bamenda City, in the East with Balikumbat and Galim, in the West with Bali, in the south-west with Batibo and Wabane Subdivision, and in the south with Babadjou and Mbouda. . It covers some nine villages, namely, Mbei, Njong, Akum, Mbu (Baforchu), Alatening, Baba II, Awing, Baligham, and Pinyin. Located in the in the Western Highlands of Cameroon, it covers a surface area of about 532.67 km² (Gur *et al*., 2015).



Source: Administrative Units of Cameroon, NIC (2016)

Figure 1. Map of the study area

Santa Subdivision has an Equatorial Mountain type of climate. This climate is characterised by two distinct seasons: the rainy season and the dry season. In this region, the rainy season starts from March to mid-October, with August and September being the months with the highest amounts of rainfall. While the dry season begins from the end of October to mid-March, with December and January being the peak months, The mean annual temperature of the area ranges from 21.80 C to 30.80 C, with an average of about 18.50 C (Santa Agricultural Post-SAP, 2013). The vegetation of this region is montane forest vegetation, which is classified into three subtypes: montane forest, submontane forest, which has been degraded, and domesticated submontane landscape (Fogwe and Bonglam, 2016). The area is characterised by springs, streams, and rivers such as Saptsi, Mewunge, Milieus, Mifi, Nephew, Melung, and many others with mostly dendritic patterns. The major soil types are Gleysols in valley bottoms, Dystric Cambisols in hill slops and Leptic Cambisols in hill summits (Tita *et al*., 2016). The area lies along the Cameroon Volcanic Line and major rocks are basalt (occupying >80% of the area), trachyte and rhyolite (Dioh, 2016) they overlie the granite-gnessic basement (Azinweh, 2020). The total population of Santa Sub Division was 77,406 inhabitants in 2005 (Population Census, 2005), but it was estimated in 2008 to be 99,851 inhabitants (Fogwe, 2014), with a total surface area of about 534 square kilometres.

Problem Statement: Variations in climatic variables have been a threat to agriculture as a whole in Santa Sub Division because they depend on rain-fed agriculture. These changes in the climatic conditions in Santa Cruz, such as increased temperatures, deficiency or excessive rainfall, and extreme climate events, have worsened the existing situation of these farmers, who depend on rain-fed agriculture to improve their livelihoods. As a result, this area has suffered crop yield reductions over the past few years due to the impacts of climate variability. Thus, farmers in Santa Subdivision need to take serious action to cope with the impacts of climate variability on their activities. Unfortunately, we cannot really say for certain whether the farmers have a good knowledge and understanding of this climate variability and its effects on their activities, as well as the measures they are putting in place to cope with these effects. This study therefore aimed to examine farmers' perceptions of climate variability and the adaptation practises they have adopted to cope with it in Santa Subdivision.

METHODOLOGY

The mixed method approach was used, which is both quantitative and qualitative. The primary data on farmer's perceptions of climate variability and their adaptation practises were collected through field observations, the administration of 150 semi-structured questionnaires to randomly selected farmers from four strata: Mbu, Njong, Mbei, and Santa-Matazem, as well as two Focus Group Discussions made up of five farmers each, both males and females, who have resided in the community for a period of at least 35 years. Also, primary data were collected through interviews with personnel from the Santa Subdivisional Delegation of Agriculture and Rural Development and the Santa Community Council. The secondary data on the other hand were obtained from existing literature in journals, articles textbooks, the internet, as well as other researchers. Both inferential statistical (as the Chi Squre) and descriptive statistical (measures of central tendency notably percentile) data analysis methods were used to analyse the data. The Chi square test and Pearson's Correlation analysis were used to analyse the extent to which farmers perceive climate variability as well as how adaptation practises put in place by farmers have determined food crop outputs in Santa Subdivision at a significance level of 0.05.

RESULTS AND DISCUSSION

Farmers' Perception and Adaptation Practices

Study communities, socio demographic, socio-economic and farm characteristics: Amongst the ten villages which make up Santa Subdivision, this study sampled four communities which are Mbu, Njong, Mbei, and Santa-Matazem.

Table 1. Study Communities

Locality	Frequency	Percentage (%)
Mbu	28	19.0
Njong	30	20.0
Mbei	45	30.0
Santa-Matazem	47	31.0
Total	150	100.0

Table 1 shows that out of 150 respondents, the highest number of respondents came from Santa-Matazem, with 31% of respondents. This was followed by Mbei and Njong with 30% and 20%, respectively. Mbu had the lowest number of respondents, with 19%. This number of respondents corresponded to the population of farmers in each study community. Also, these respondents have varying socio-demographic, socio-economic, and farm characteristics (Table 2).

Table 2. Socio-demographic characteristics of the Respondents

No	Variables	Values	Frequency	Percentage%
1	Gender	Male	70	46.7
		Female	80	53.3
		Total	150	100
2	Age group	<30	14	9.3
		31-40	42	28
		41-50	39	26
		51-60	28	18.7
		60+	27	18
		Total	150	100
3	Level of Education	Never Attended School	8	5.4
		Primary	66	44.0
		Secondary	62	41.3
		University	14	9.3
		Total	150	100.0
4	Household Size	<3	24	16
		4-6	77	51.3
		7-9	37	24.7
		10+	12	8
		Total	150	100

Source: Fieldwork (2022)

It is generally shown that out of the total respondents, 46.7% were males and 53.3% were females. This implies that the majority of the farmers engaged in food crop production in the study area are female, while male farmers constitute the least percentage of farmers. Also, the majority of farmers engaged in food crop production in the study area were between the ages of 31 and 40, as well as 41 and 50, with percentages of 28% and 26%, respectively. This implies that the population of farmers in the study area is generally of economically active age. This explains why Santa Fe is a highly agricultural area. Meanwhile, the next larger category of farmers was those over 60, with 18%. It shows that the population of farmers is gradually ageing. This has the tendency to affect food crop production as they would have less knowledge about environmental changes and ways to adapt to them. Thus, the quantity produced will be lower if more youth do not engage in agriculture.

Furthermore, the majority of the farmers had at least primary education (44.0%). This was followed by farmers who had education up to the secondary level (41.3%). Given that the majority of the farmers attended just primary education and most who attended secondary did not complete it, it has the potential to influence their general perception of climate variability and adaptation strategies as they will mostly adopt non-sustainable traditional strategies instead of sustainable scientific strategies to respond to climate variability. In terms of household size, the majority of the respondents had household sizes that ranged between 4 and 6 people (51.3%). This was followed by those with household sizes that ranged between 7 and 9 people. Farmers with the lowest percentage (8%) were those with household sizes above 10 people. This therefore shows that the average household size here is 7 as opposed to Nchare (2007) who found out that the average size of Arabica coffee producers in Cameroon was 11. The fact that the majority of the farmers have smaller households means a higher use of hired labour as compared to family labour. In addition to the socio-demographic characteristics, the socio-economic and farm-specific characteristics of respondents were also analysed. The farmers have different years in which they have lived in their various communities and have been practising agriculture (Tables 3 and 4).

Tables 3. Farmers Duration in the Community

Duration in the Community		
Number of Years	Frequency	Percentage (%)
<10	34	22.7
11-20	38	25.3
>20	78	52
Total	150	100

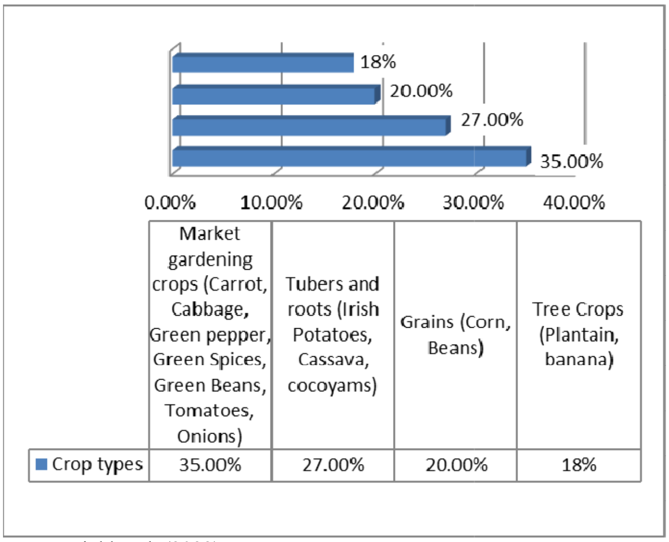
Source: Field Work, 2022

Table 4. and Duration in Agriculture

Duration in Agriculture		
Number of Years	Frequency	Percentage (%)
<10	70	46.7
11-20	42	28
>20	38	25.3
Total	150	100

Source: Field Work, 2022

Out of the total number of respondents (150), 52% and 25.3% have a longer duration of more than 20 years in the community (Table 3) and agriculture (Table 4), respectively. Almost all the respondents with a duration of more than 20 years in these communities are indigenes of these communities who have lived there from birth and are already part of the ageing population of farmers who have traditional perceptions of and adaptation strategies to climate variability. 22.7% and 46.7% of respondents had a duration of time below 10 years in the community and agriculture, respectively, although the majority of these respondents that belong to this group have a duration that ranges from 7 to 10 years. This is explained by the fact that some respondents who have spent less time in the study communities are migrants from neighbouring villages or towns. This also implies that although the majority of the respondents have lived longer in the study communities, they engaged in agriculture only when they had access to a piece of land to cultivate crops. The respondents' duration in the community, to an extent, does not reflect the duration of time they have been engaged in agriculture. Even though one of the seasons that characterises the climate of the study area is marked by low rainfall, crops are cultivated all year. Thus, some of these farmers cultivate more than once a year, and they cultivate mostly market gardening crops and make use of irrigation in periods of water shortages. The different types of food crops cultivated by farmers in Santa Subdivision are shown in Figure 2.



Source: Fieldwork (2022)

Figure 2. Different types of food crops cultivated

As presented in Figure 2, it indicated that 35% of the farmers were largely involved in the cultivation of market gardening crops such as green spices, cabbage, carrots, tomatoes, and onions, while 27% cultivated mostly tubers and root crops, which included Irish potatoes, cocoyam, sweet potatoes, and cassava. 20% cultivated grains such as maize and beans, and only 18% cultivated tree food crops such as plantains and bananas. This implies that Santa Subdivision is an area where food crop production is highly practised, especially market gardening, and almost all the farmers practise mixed-cropping. Given that farmers cultivate different quantities of crops; some farmers get more income than others. Tables 5 and 6 represent the average seasonal income and the nature of the income of farmers over the years in the study communities.

Table 5. Average seasonal income

Income Range (FCFA)	Percentage (%)
<50000	3.8
51000-100000	15.4
>100001	80.8
Total	100

Source: Fieldwork (2022)

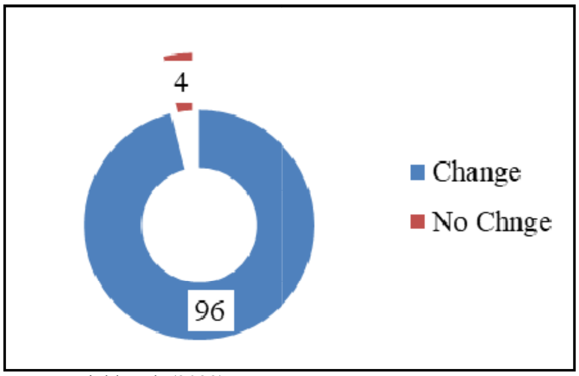
Table 6. Nature of Income over the years

Nature of income	Frequency	Percentage (%)
Increasing	14	9.4
Decreasing	62	41.3
Rising and falling	71	47.3
Never changed	3	2.0
Total	150	100

Source: Fieldwork (2022)

As shown in Table 5, 80.8% of the total respondents had seasonal average incomes above 100.000 FCFA. The least was 3.8% of the total percentage of respondents who had seasonal incomes below 50.000 FCFA. Thus, the majority of the farmers with higher incomes are those with larger farms and/or more farmland. This also indicates that most of these farmers engaged in mixed cropping, marketed their products in other parts of the country, and exported some. With variations in climate, the nature of the average seasonal income of farmers has been changing as well. It is seen that the majority of the respondents (47.3%) have experienced fluctuations in their income over the past years as a result of fluctuations in crop yields and their prices (Table 6). This was followed by 41.3% of respondents whose incomes have been decreasing over the past years. This implies poor crop yields as a result of climate variability. With increasing climate variability, more expenses are put into the farm to improve crop yields, yet the crop yields are still poor and the prices of crops are not stable.

Farmers' perception of climate variability: People have different views and understandings of what climate variability is all about as well as its causes and impacts as shown on Figure 3.

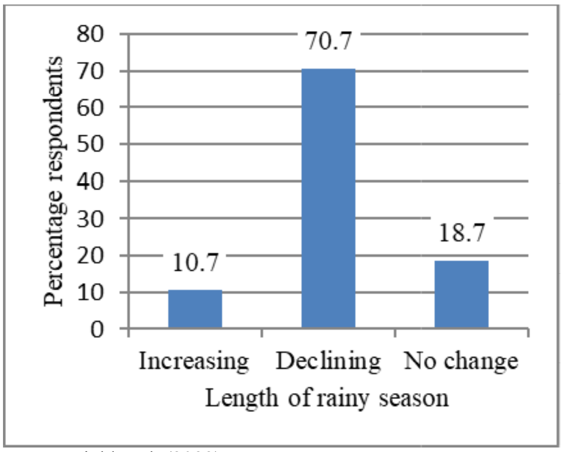


Source: Fieldwork (2022)

Figure 3. Perception of Change in date/ month of start of rainy season

While some farmers have noticed a change in the climatic parameters in their community, others have not noticed any change. These changes include changes in rainfall occurrence and changes in temperature over the years.

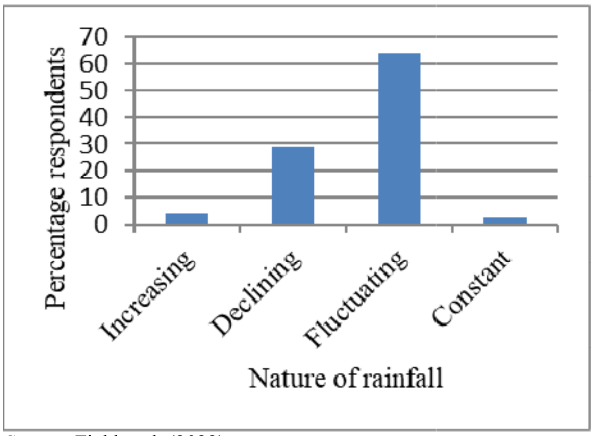
As shown in Figure 3, 96% of respondents have noticed that the date and/or month that the rainy season usually begins has changed. Most respondents identified that they usually expect rain to come on the 15th of March, but over the past years, rain has come late in some years and earlier in other years. Therefore, planting crops during the time when rain is usually expected can lead to poor crop yields because of the absence of water. Only 4% have not noticed this change, but they identified that the rains are usually not reliable during the first month. The length of the rainy season has also varied considerably as a result of climate variability. Summary of responses are shown on Figure 4.



Source: Fieldwork (2022)

Figure 4. Perception of Length of rainy season

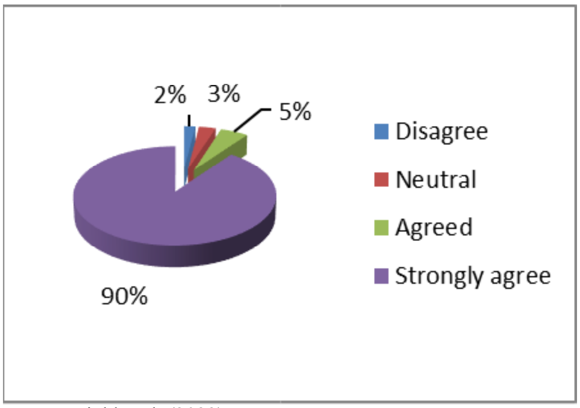
Results on Figure 4 showed that 70.7% of respondents have noticed a decrease in the length of the rainy season, while 10.7% have noticed an increase in the length of the rainy season in their community (Figure 4). This means that the majority of the farmers have noticed that even though the rainy season starts later than usually expected, it ends earlier. It means a reduction in the growing season, which has an impact on food crops, mostly those with longer growing seasons like maize. The respondents (18.7%) who noticed no change in the rainy season length pointed out that there is just a shift in the dates of the rainy season and not a change in the length. Farmers' perceptions of the nature of the rainfall amounts and temperatures over the past years also vary (Figures 5 and 6).



Source: Fieldwork (2022)

Figure 5. Perception of the nature of rainfall

Figure 5 shows that 64% of respondents mostly identified fluctuations in the nature or amount of rainfall over the past years, followed by 21.3% who noticed a decline. Meanwhile, very few respondents (4% and 2.7%) identified an increase or no change in the nature or amount of rainfall, respectively. This means that even though they have varying perceptions of the nature of rainfall, the majority of them have identified climate variability. Although most respondents noticed fluctuations in the past years, a good number of them identified that most of these years were characterised by a decrease in rainfall amounts as compared to years with an increase. Therefore, most years were water stressed, thus affecting food crops as there was insufficient water for the crops. Figure 6 summarises farmers' perception of temperature variability.



Source: Fieldwork (2022)

Figure 6. Perception on Increase in Temperature

On Figure 6 it si noted that out of 150 respondents, 90% strongly agreed that temperatures have increased over the past few years. Meanwhile, only 2% of respondents disagreed that temperatures have increased in their communities over the past few years. Apart from perceiving decreases in rainfall and increases in temperature over the years, farmers also perceived climatic extremes affecting food crop yields as well as possible causes of climate variability in Santa Subdivision (Figure 7 and Table 7).

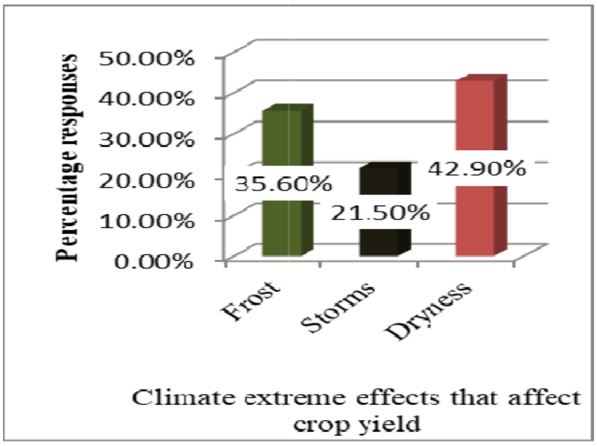


Figure 7. Perceived Climatic extreme

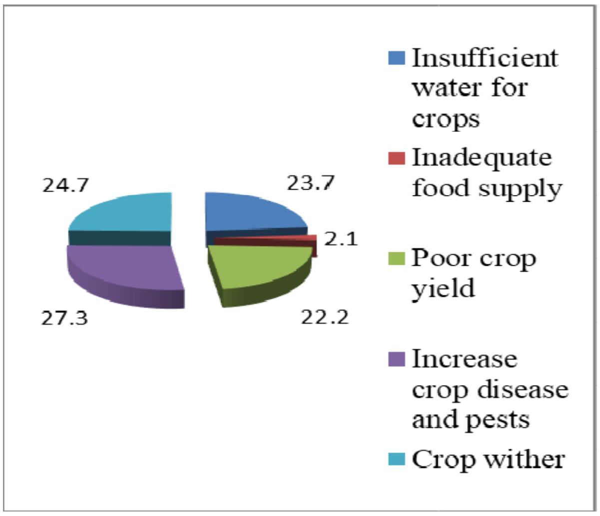
Table 7. Perceived causes of climate variability

Cause	Frequency	Percentage (%)	Percentage of cases (%)
Natural changes	122	50.4	81.3%
Deforestation	72	29.8	48
Industrialization	14	5.8	9.3
Poor agricultural practices	34	14	22.7
Total	242	100	161.3

Source: Fieldwork (2022)

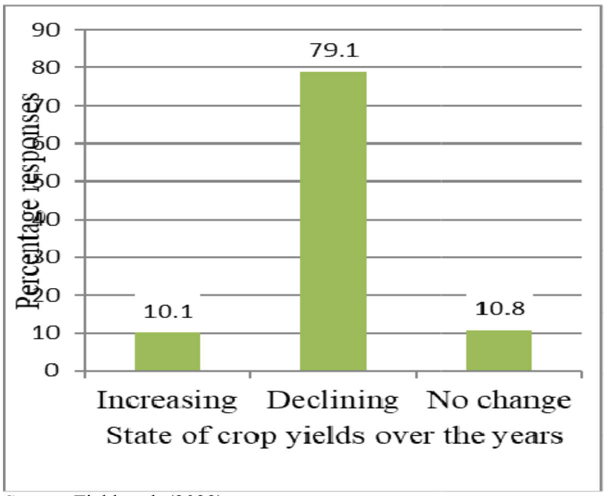
Figure 7 shows that 42.9% and 35.6% of respondents identified dryness and frost, respectively, as climatic extremes that are greatly affecting food crop yields in the study area. Therefore, as a result of the decrease in rainfall, there have been longer periods of dryness and intense cold over the past few years as compared to earlier years. Although limited rainfall is common in the Subdivision, it does not occur every year. This was supported by responses from the FGDs, which stated that *"Some years have experienced a lot of dryness, especially during the dry season, such as years ranging between 2008 and 2015 and recently 2019 and 2020"*. Even though some of these years experienced high rainfall during the rainy season, their dry seasons became drier and colder. The implication was insufficient water for crop growth, crop withering, pests, and diseases, which have generally led to poor food crop yields, especially tubers and market gardening yields.Again, 21.5% of respondents identified storms as a climatic extreme event that has been levelling crops to the ground and distracting crop growth, most especially tree crops and grains. However, another climatic extreme identified by the respondents, although not very common, is hail, which hits crops, destroying the leaves and affecting yields. Meanwhile, Table 7 shows that the majority of respondents attributed climate variability to natural changes in the climatic parameters (50.4%). Most respondents also attributed climate variability to anthropogenic factors such as deforestation, poor agricultural practises, and industrialization (29.8%, 14%, and 5.8%, respectively). Some farmers who attributed climate variability to natural changes also pointed out that, apart from natural changes, humans are also responsible for this climate variability, as confirmed by Tata, 2016.

Farmers' perceptions of the impacts of climate variability on food crops: With varying perceptions, most of these farmers identified multiple effects on their crops, as shown in Figure 8, as well as the declining state of crop yields over the past years in Santa Subdivision (Figure 8).



Source: Fieldwork (2022)

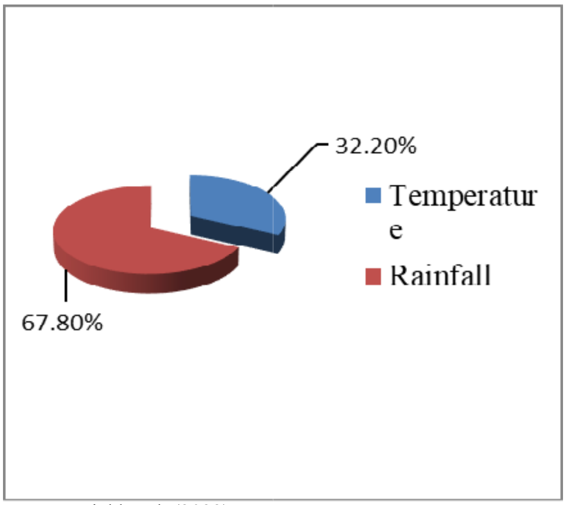
Figure 8. Perceived effects of climate variability



Source: Fieldwork (2022)

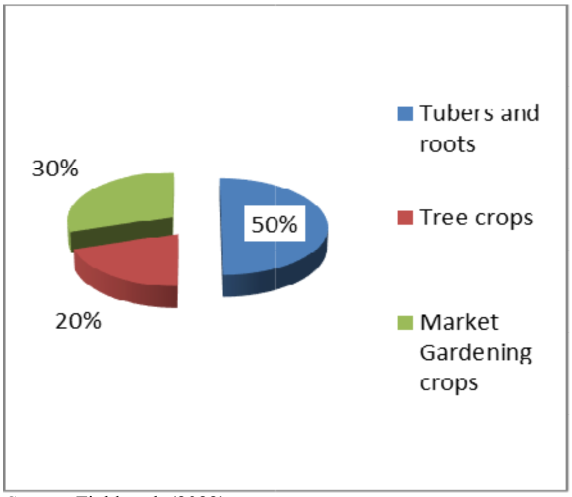
Figure 9. Perceived state of yields over the years

Figure 8 shows that out of the total number of respondents, 27.3%, 24.7%, 23.7%, and 22.2% identified increases in crop diseases and pests, crop wither, insufficient water for crops, and poor crop yields, respectively, as the most common effects of climate variability on food crop production in their community. All these effects were acknowledged by almost all the respondents, but they ranked them from the most common to the least common. This therefore means that the effects of climate variability on food crops complement each other, as food crops are suffering from insect pests such as caterpillars, cutworms, weevils, and diseases like blight, as well as crop wither as a result of insufficient water, which in turn leads to poor crop yields. Another effect of climate variability that farmers identified was soil erosion as a result of high-intensity rainfall of shorter duration. Generally, the climate of Santa Subdivision is varying, with a significant drop in yields over the past few years. These results are similar in one way or another to the results of the studies carried out in Ghana by Appiah & Guodaar, (2022). As shown in Figure 9, the majority of the respondents (79.7%) in the communities under study noticed a decline in their crop yields as compared to those who noticed an increase (10.1%) or no change (10.8%). Thus, variations in temperature and rainfall over the past few years have generally led to decreasing crop yields. Declining crop yields over the years have led to decreasing farmer incomes. Although climate variability affects all types of food crops, tubers (50%) and market gardening crops (30%) are more highly affected than others (Figure 10).



Source: Fieldwork (2022)

Figure 10. Perceived food crop mostly affected



Source: Fieldwork (2022)

Figure 11. Perceived variable highly affecting food crop production

A good number of respondents revealed that tubers and market gardening crops, especially Irish potatoes, celery, cabbage, and leeks, are highly affected by variations in climate. They pointed out that crop insect pests such as caterpillars and weevils and diseases such as blight and chlorosis always destroy these crops, leading to a drop in yields and an increase in prices as a result of the effects of frost and limited rainfall. Farmers also perceived the climatic variables affecting food crops differently. Out of the total number of respondents, 67.80% identified that food crops are mostly affected by variations in rainfall as compared to 32.20% who identified that variations in temperatures affect food crops the most in the study communities, as shown in Figure 11. Therefore, with unreliable rainfall, crops, especially food crops, face a lot of challenges, such as insufficient water for growth, pests and diseases, crop wither, poor fruiting, and many other challenges from the planting stage to harvesting. All these challenges have generally led to decreasing crop yields over the years. A good number of respondents revealed that tubers and market gardening crops, especially Irish potatoes, celery, cabbage, and leeks, are highly affected by variations in climate. They pointed out that crop insect pests such as caterpillars and weevils and diseases such as blight and chlorosis always destroy these crops, leading to a drop in yields and an increase in prices as a result of the effects of frost and limited rainfall. Farmers also perceived the climatic variables affecting food crops differently. Out of the total number of respondents, 67.80% identified that food crops are mostly affected by variations in rainfall as compared to 32.20% who identified that variations in temperatures affect food crops the most in the study communities, as shown in Figure 11. Therefore, with unreliable rainfall, crops, especially food crops, face a lot of challenges, such as insufficient water for growth, pests and diseases, crop wither, poor fruiting, and many other challenges from the planting stage to harvesting. All these challenges have generally led to decreasing crop yields over the years.

Summary of Farmers' perception of climate variability

Test statistics: Chi Square

Test variables;

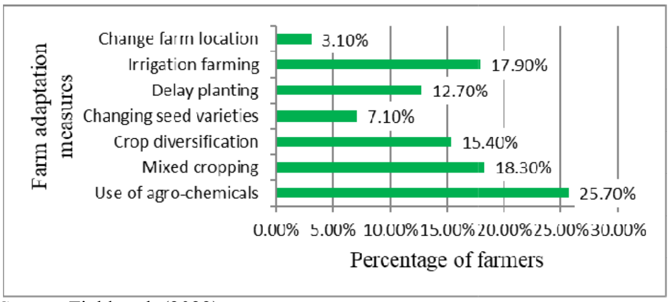
1. Farmers' perception on nature of rainfall
2. Farmers' perception on nature of temperature

Table 8 shows that the P-value is 0.199 at a significant level of 0.05. Therefore, it is indicated that famers in Santa Subdivision have a significant knowledge and understanding of climate variability

Table 8. Chi Square Tests on farmers' perception of climate variability

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	6.000[a]	4	.199
Likelihood Ratio	6.592	4	.159
Linear-by-Linear Association	.187	1	.666
N of Valid Cases	3		

9 cells (100.0%) have expected count less than 5.
The minimum expected count is .33.
Source: Fieldwork (2022)

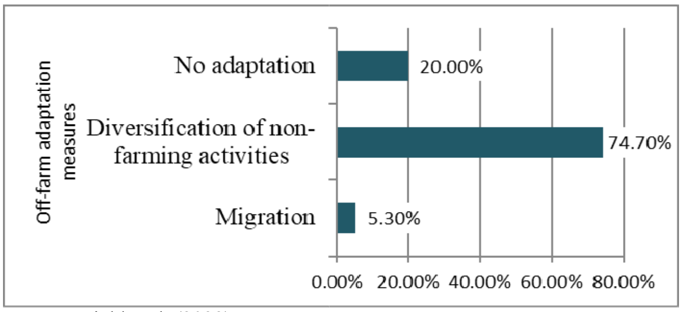


Source: Fieldwork (2022)

Figure 12. Farm adaptation measures

Farmers' Adaptation to Climate Variability: Due to the variability in climate, farmers in Santa Subdivision have put in place adaptation practises that help them cope with its effects (Figure 12). Each farmer cultivating food crops in the study area identified not just one but multiple adaptation measures they have been using. Figure 12 shows that the use of agro-chemicals and organic fertilisers, as well as changes in farm location, were seen as the major (25%) and least (3.1%) adaptation strategies in the study area, respectively. This means that the majority of the farmers, instead of changing their farm location because of soil fertility loss, used a combination of agrochemicals such as chemical fertilisers, pesticides, and insecticides, as well as organic manure (Compus manure), to maintain soil fertility. Mixed cropping was also indicated by some farmers (18.3%) as an adaptation measure to climate variability. It was observed that food crop producers plant different food crops on a piece of land, such as mixing some market gardening crops like celery and leeks with grains, tree crops, and tubers. This is because mixing these crops reduces the impact of climate variability and the problem of land tenure. Also, 17.9% of the total respondents used irrigation farming as an adaptation practise to climate variability impacts, especially during the dry season. Farmers who practised irrigation farming were farmers who were engaged in market gardening and/or farmers who had farm lands beside streams or rivers. Meanwhile, farmers who did not practise irrigation were mostly farmers who were engaged only in the cultivation of tubers, grains, and tree crops and had farmland in highland areas far from water points. Some also identified the shortage of water for irrigation over the past years because the volume of water in streams and rivers has dropped. Again, grains and tubers, for example, are mostly cultivated during the rainy season, although during the dry season they are mostly cultivated in swamps, as confirmed by one of the personnel at the Sub divisional Delegation of Agriculture for Santa Subdivision during an interview session: Farmers *hardly practise maize irrigation in Santa because it is very costly. Farmers cultivate grains during the dry season only in swamps".*

Furthermore, 15.4% of respondents practised the cultivation of different crops on the same piece of land during different planting seasons (crop diversification), while 12.7% delayed planting when rains did not come early. This means that some farmers always wait for the rain to start falling and become reliable before planting. Farmers explain that they usually delay planting so as to avoid ground seed spoilage, crop withering, pests, and diseases that attack crops due to insufficient moisture. Meanwhile other farmers who were not practising this indicated that when they do dry-seeding and rains come in a regular pattern, crops do well. Changing seed varieties as one of the adaptation measures to climate variability was adopted by a few farmers (7.1%). There has been the multiplication of basic seeds of high variety such as "paramerars", "ATP" and "IRA" (Irish potatoes, maize, beans) that are resistant to some changes in climate by MIDENO-TDC, the Santa agricultural and few elderly farmers. On the other hand, farmers who have not been changing their seed varieties explained that buying multiplied seeds adds up to their expenses, and they do not always have the opportunity to receive these seeds when they are being subsidised. Apart from farm adaptation measures, farmers also adopted off-farm adaptation measures to cope with the effects of climate variability (Figure 13).

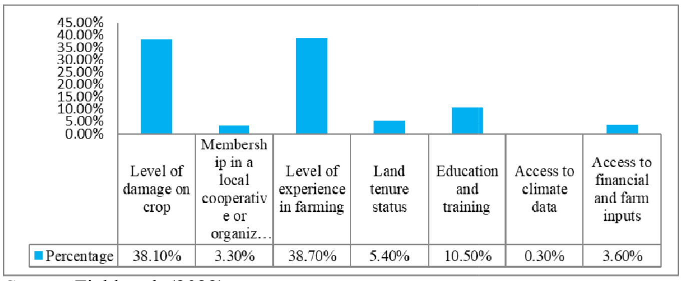


Source: Fieldwork (2022)

Figure 13. Off-farm adaptation measures

Diversification into non-farming activities was the most common off-farm adaptation measure in Santa Subdivision, as 74.7% of respondents diversified into activities such as business operation, hair dressing, fashion designing, trading, and many others. Thus, agriculture is their main activity and source of income, while these other activities are secondary sources of income. Meanwhile, farmers who have not been practising off-farm adaptation (20%) are greatly affected by the shocks of climate variability. Thus, most farmers have been employing both farm and off-farm adaptation measures, as confirmed by Divine and Lawrence (2021) in Ghana and Mbuli *et al.* (2021) in Cameroon.

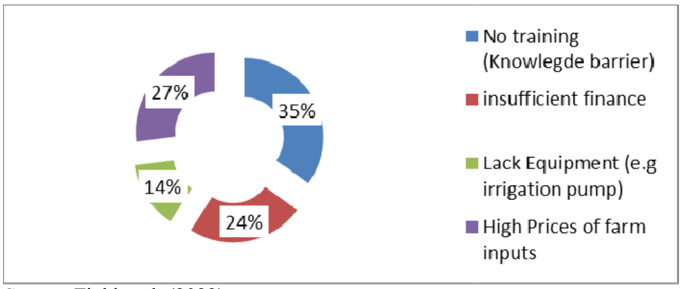
Factors influencing adaptation and Constraints to farmers' adaptation: Farmers have different adaptation strategies. These choices are influenced by a number of factors, as shown in Figure 14.



Source: Fieldwork (2022)

Figure 14. Factors influencing Farmers' Adaptation measures

The level of experience in farming and the level of crop damage were the major factors affecting the choices of farmers' adaptation strategies, with 38.7% and 38.1%, respectively (Figure 14). A possible reason may be due to their low level of education and training, as only 10.5% of the total respondents were influenced by the education and training on climate variability adaptation measures they received. Meanwhile, only 0.3% identified that access to climate data influenced the choice of adaptation measures. This shows that farmers do not receive any early warning systems about the state of their climate. Several constraints on farmers' adaptation abilities were also identified (Figure 15).



Source: Fieldwork (2022)

Figure 15. Constraints to farmers' ability to adapt

Lack of training and education was the major constraint to farmers' adaptive ability, as 35% of respondents affirmed it (Figure 15). Farmers are therefore not trained and educated on the best adaptation techniques and how to use them effectively. 27% and 24% of respondents identified high prices of farm inputs like agrochemicals and insufficient finance, respectively, as constraints to their adaptation ability. This implies that inadequate finance reduces the ability to acquire training and purchase farm inputs and equipment. Meanwhile, 14% identified that a lack of adaptation equipment, such as irrigation and storage equipment, affects their ability to adapt to climate variability.

Summary of farmers, adaptation impacts on food crop yields

Test statistics: Chi Square

Test statistics: Pearson's correlation: Variables: Crop output without significant adaptation measures and food crop output with significant adaptation measures.

Table 9. Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	12.000[a]	9	.213
Likelihood Ratio	11.090	9	.270
Linear-by-Linear Association	.001	1	.977
N of Valid Cases	4		

16 cells (100.0%) have expected count less than 5.
The minimum expected count is .25.
Source: Fieldwork (2022)

The Person Chi square test conducted indicates that the P-value is 0.213 at a significance level of 0.05. Thus, adaptation practises put in place by farmers have significantly impacted the output of food crop yields in Santa Subdivision.

CONCLUSION

The study examined farmers' perceptions of climate variability and adaptation practises put in place by farmers. Farmers perceived a decrease in rainfall and an increase in temperature. Therefore, food crops face a lot of challenges, which have generally led to decreasing crop yields over the years. As a result of this, the majority of farmers in Santa Subdivision, if not all, have been putting in place adaptation measures, which have led to slide increases in some crop yields. With a Level of significance of 0.05, all farmers in the study area have significant knowledge and understanding of climate variability, and the adaptation practises put in place by these farmers have significantly determined the output of food crop yields. Although the adaptation measures put in place by these farmers are mostly local and have not been very effective, this study therefore recommended that:

Research institutes should multiply more varieties that resist changes in climatic conditions and also provide effective training on sustainable adaptation measures that can effectively reduce climate variability effects on food crop production in Santa Barbara. Policymakers should always allow the participation of food crop farmers in any climate adaptation programme and climate-related policy implementation. There should be subsidisation of farm inputs such as storage facilities, agro-chemicals, and irrigation equipment, as well as the provision of financial support to farmers in Santa Subdivision by the government of Cameroon, the ministry of Agriculture and Rural development, and NGOs involved in agriculture. Moreover, climatic data and early warning systems should be made available to farmers to help them plan their activities according to variations in climatic parameters. Nevertheless, this study also brought forth some efficient adaptation strategies that can help farmers in Santa Subdivision and Cameroon in general sustainably adapt to climate variability. These efficient adaptation strategies included the practise of agroforestry, the integration of livestock-crop farming, the application of integrated pest management, and reduced or non-soil tillage to avoid erosion.

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