



Case Study

Farmers' Perception of Climate Change: A Case Study from Subsistence Farming in Lalehun Kovama of Kailahun in Eastern Sierra Leone

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Abstract: This study looks at the impact of climate change on subsistence farming. Farmers in the rural areas of Sierra Leone mostly practice subsistence agriculture. A lot of predictions have been done by the scientific community through climatic and crop modeling techniques concerning the impact of climate change on agriculture as well as all other spheres of life. This research aims to explore the knowledge and perceptions of subsistence farmers regarding the impacts of climate change on their farming activities and well-being. This study will broaden the research on subsistence farmers' perceptions of climate change. This study employed a mixed study design (quantitative and qualitative methods). Samples of 77 respondents were selected from a sample frame of 220 heads of households in the area listed for the study. A simple random sampling technique was used. It was revealed in the study that most of the farmers (67.5%) were illiterate and, hence, lacked knowledge of the concept of climate change; some farmers (27.3%) exhibited competencies to sense some of the changes that have occurred in the climatic pattern. The majority of the respondents (49.4%) agreed that the farming calendar for rice as a major crop has changed. This, according to the respondents, was responsible for the low productivity of rice in the study area. There is an urgent need to provide education related to agriculture to empower farmers with the methods and techniques involved in climate-smart agriculture and to sensitize them to the impacts of climate change in extremely rural areas.

Keywords: climate change, impacts, subsistence farming, Sierra Leone

1. Introduction

Climate change is the term used to indicate a long-term shift in the region's average weather patterns, such as rainfall and temperature. Farmers have always adapted to altering environmental, social, and economic situations. However, it is unclear if they will be able to keep up with the alarming level of climate change in the future [1]. These changes will have a more detrimental impact on crop and livestock productivity. Farmers must be informed about climate change to be willing to apply adaptation strategies. In this way, farmers' perceptions of climate change influence not only their planting preferences but also the adoption of adaptation methods.

Subsistence farming is that which is done to feed the farmer and his household using crude tools. The labor is

provided by the farmer and his household members [2]. The produce of this farming is not for sale, except in a situation where yields are in abundance [3]. Subsistence farming is a key dominant farming in sub-Saharan Africa, especially in Sierra Leone [4]. Most of these countries lack the technological advancement to undertake commercialized farming [5]. The majority of the farmers in Sierra Leone are engaged in subsistence farming. Subsistence farming plays a key role in the eradication of hunger and poverty in most rural communities in sub-Saharan Africa as it addresses food security in rural communities [6]. In Sierra Leone, rice is the main crop grown by subsistence farmers to feed their households. Rice is the source of more than 500 calories per person per day for over three billion people worldwide [7]. This means rice is a staple food for over three billion people worldwide, and Sierra Leone is no exemption from the above figure [8]. 90 to 95% of Sierra Leoneans eat rice as their staple food [9], so when rice becomes scarce, the country will experience a food shortage. Most rural communities in Sierra Leone, particularly in Kailahun District, rely solely on subsistence rice farming to ensure food security [10].

Agriculture is the largest sector in Sierra Leone's economy; it employs more than 75% of the labor force in the country and contributes between 35 and 47% of the country's gross domestic product (GDP) [11]. This means farming activities in Sierra Leone are determined by climatic conditions like rainfall, sunshine, humidity, and temperature [12]. However, subsistence farming over the years is said to have been affected by the change in climatic conditions. Furthermore, according to Selvaraju et al. [13], agricultural activities like the slash and burn of farm bushes for farming have been contributing to the change in climate level by emitting carbon dioxide into the atmosphere. Farming activities emit methane gas into the atmosphere, which contributes to the increase in greenhouse gases in the atmosphere, thus resulting in global warming [14]. The rate of greenhouse gas emissions is rising, and the effect includes changes in precipitation patterns, more extreme weather events, and the changing of seasons. However, the increasing rate of climate change, coupled with global population and income growth, threatens food security everywhere [15]. Through various physiological mechanisms, changes in temperature and precipitation tend to reduce crop productivity.

Both photosynthesis and respiration are nonlinear functions of temperature, whereas the relation between the crop development rate and temperature is approximately linear [16]. Although crops develop more quickly in warmer conditions, yields can potentially decline as temperatures increase beyond a certain threshold [17]. In both arid and semi-arid regions, water is regarded as a limiting factor for crop growth [18]. A potential decrease in growing season precipitation can reduce the soil moisture content available to rain-fed crops, and the resulting water stress can lead to a decrease in crop productivity [19]. Therefore, this study is carried out to investigate the impact of climate change on subsistence farmers, which includes their knowledge and perception about climate change, climate-related hazards that affect their well-being and farming activities, and their coping mechanisms as a way of overcoming climate change.

Furthermore, climate change is having a significant impact on both small-scale and large-scale food production. This study is related to the Sustainable Development Goal 13 (SDG-13) goal of providing sustainable agriculture and food security since it analyzes the impact of climate change on farmers in the study area and provides recommendations for the government and stakeholders in the region to develop suitable plans and projects with a focus on adapting subsistence production and making the livelihoods of rural populations more resilient.

Hence, this study will help government and non-governmental organizations that are engaged in disaster management and support to be proactive, as climate-related disasters are becoming more prevalent in the country.

2. Materials and methods

2.1 Research design and instrumentation used

This study was concentrated on subsistence farmers in Lalehun Kovoma as a unit under this investigation. A quantitative research method was employed. Quantitative research gathers numerical information and takes a wide view across a larger populace; also, observations made by the researcher about the study formed part of the data that was collected. A semi-structured questionnaire containing 29 questions (open-ended and closed-ended) was used for data collection, and the data was primarily quantitative.

2.2 Population and sample size

The settlement has a considerable number of people - about 1,760 people, including adults, youths, and children. There were 220 households from the whole population that were engaged in farming. A total of 77 farmers, which make up 35% of the total sample frame (220), were selected. This was done to indicate proper population representation.

2.2.1 Sampling technique

A simple random sampling technique was used in this process, and every household head in that community stood the chance to be interviewed. This was done to reduce bias. In the process of simple random sampling, all the names of household heads in that community were written on a piece of paper and folded up before being placed in a bag.

2.2.2 Data collection procedure

The data collection was approved by the chiefs of the village to allow the researcher to administer questionnaires to the respective participants for the study. Respondents' consent was obtained at the beginning of the survey. A summary of the purpose of the research was also provided before the questionnaire. The targeted duration for each questionnaire to be filled out was about 15 minutes. A total of 80 respondents took part in filling out the survey, and three were not appropriately filled, leading to an aggregate of 77 valid questionnaires that were used and considered substantial for the study.

2.2.3 Analysis and interpretation of data

The computer program IBM SPSS Statistics 23 was used to code the data. The results were presented both in descriptive and analytical form, including frequencies, percentages, graphs, figures, tables, and basic statistics.

3. Results

The results are presented both in descriptive and analytical form, including frequencies, percentages, graphs, figures, tables, and basic statistics.

3.1 Socio-economic and demographic characteristics of respondents

According to Table 1, 66.2% (51) of both categories of respondents (male and female) fall within the age bracket of 41 to 50, while 16.9% (13) of both categories of respondents fall within the age bracket of 31 to 40. 75.3% (58) of the respondents were male, as opposed to 24.7% (19) of females. 97.4% (75) of the respondents were Mende, while Temne and Limba occupied 1.3%, respectively. 68.8% (53) of the respondents practiced Islam as a religion, while 31.2% (24) of the respondents practiced Christianity. This result shows that there are more Muslims than Christians in the study area, which is dominated by the Mende people. 97.4% (75) of the respondents were married, while only 2.6% (2) of the respondents were widows. This shows that in rural areas, farming relies on family labor. The majority of the respondents (67.5%) had no formal education, and only 4% (4) of the respondents had tertiary education. This shows that the majority of the subsistence farmers were uneducated, and henceforth, this will affect the awareness of climate change issues. 75.3% (58) of the respondents were male and were heads of their households. In comparison, 24.7% (19) were females who were the heads of their households. The results clearly show that men are in control as far as rural life is concerned.

Table 1. Socio-economic and demographic characteristics of respondents

Variables	Frequency	Percentage (%)
Age group		
20 to 30 years	6	7.8
31 to 40 years	13	16.9
41 to 50 years	51	66.2
51 to 60 years	5	6.5
61 years and above	2	2.6
Gender		
Male	58	75.3
Female	19	24.7
Religion		
Muslim	53	68.8
Christian	24	31.2
Tribe		
Mende	75	97.4
Temne	1	1.3
Limba	1	1.3
Marital status		
Married	75	97.4
Widowed	2	2.6
Educational status		
Primary education	11	14.3
Secondary education	10	13.0
Tertiary education	4	5.2
No formal education	52	67.5
House head by gender		
Male	58	73.5
Female	19	24.7

3.2 *The knowledge and perception of farmers about climate change*

Table 2 reveals that 62.3% of the farmers said they have heard about the word “climate change”, while 37.7% said they have not heard about it. The above results show that the majority of the farmers have heard about climate change. Also, in Table 2, 57.1% of the respondents chose radio as a medium for hearing about climate change, as opposed to 1.3% who chose the newspaper. 63.6% of the respondents said they did not know what climate change is, and 2.60% of the respondents said it is the work of God to change the climate of the earth. This result clearly shows that there is poor sensitization and awareness in rural areas concerning climate change issues. Table 2 also shows that 75.32% of respondents said there has been an increase in the trend of rainfall for the past five years, while 1.30% of respondents said that the trend of rainfall is unpredictable. The reason for the above percentage (75.32%) was that many farmers said that for the past few years they experienced nine months of rainfall, starting from March to November. The table above also reveals that 53.3% of respondents said there was an increase in temperature for the last five years, while 1.30% of respondents said the temperature has been constant for the last five years. 57.1% of the farmers that were interviewed said the wind caused a lot of havoc in their plantations, as tall trees fell on their plantations and destroyed them. 42.9%

of the farmers disagree with the fact that the wind was disastrous. Finally, Table 2 above reveals that 94.8% of the farmers agreed that drought had shown up in that community, while 5.2% said “no”. According to the respondents, the community experienced six months of no rainfall in that community from 2015 to 2016.

Table 2. The knowledge and perception of farmers with regard to climate change

Questions	Frequency	Percentage (%)
Have you heard about climate change?		
Yes	48	62.3
No	29	37.7
Medium of hearing climate change		
Radio	44	57.1
Newspaper	1	1.3
Friends and family members	3	3.9
Never heard about it	0	0.0
Understanding the concept of climate change		
Change in the weather pattern	21	27.3
Variations in the weather pattern	5	6.5
It is the work of God to change the climate of the earth	2	2.6
Don't know	49	63.6
Perception about the trend of rainfall in the last five years		
Increasing	58	75.3
Decreasing	3	3.9
Fluctuating	15	19.5
Unpredictable	1	1.3
Perception about the trend of temperature in the last five years		
Increasing	41	53.3
Decreasing	2	2.6
Fluctuating	33	42.9
Constant	1	1.3
Perception about the nature of winds in the last five years		
Disastrous	44	57.1
Less disastrous	33	42.9
Perception about the drought experienced in the last five years		
Yes	73	94.8
No	4	5.2

3.3 The trend of farming and crop productivity under climate variability

In Table 3, 40.3% of respondents said they practiced shifting cultivation, while only 2.6% of farmers said they practiced mixed farming. 80.5% of respondents got their land through inheritance, as compared to communal, which is 1.3%. The reason for the above result (80.5%) is that this particular community is in a typical rural setting, where people inherit land from their great-grandfathers. 58.4% of respondents cultivated upland only, as opposed to 1.3% of respondents for swamp land. This means the area is dominated by upland farmers.

Table 3. The trend of farming and crop productivity under climate variability

Questions	Frequency	Percentage (%)
System of farming practiced by farmers		
Mixed farming	2	2.6
Mono cropping	5	6.5
Crop rotation	21	27.3
Continuous cropping	18	23.4
Shifting cultivation	31	40.3
Method of acquiring land by farmers		
Leasing	14	18.2
Inheritance	62	80.5
Communal	1	1.3
The ecology of the land cultivated		
Swamp land only	1	1.3
Upland only	45	58.4
Mixed ecology (both upland and swamp land)	31	40.3
The three major crops cultivated in the last five years		
Rice	70	91.0
Cassava	5	6.5
Groundnut	2	2.6
Do you know the farming calendar for the three major crops cultivated?		
Yes	59	76.6
No	18	23.4
Perceptions of farmers if the farming calendar has changed for the major crops		
Yes	38	49.4
No	21	27.3
No idea	18	23.4
Do you experience any change in the yields of crops as a result of the change in the farming calendar?		
Yes	38	49.4
No	39	50.6
Can you ascertain the level of change in the yields of crops as a result of the change in the farming calendar?		
One to two 50 kg bags of loss	14	18.0
Three to four 50 kg bags of loss	23	30.0
Five and above 50 kg bag of loss	1	1.0
No idea	39	51.0
What was responsible for the change in the farming calendar?		
Climate change	37	48.1
No idea	40	51.9

The majority of the respondents (91.0%) cultivated rice as a first crop, 6.5% cultivated cassava, and 2.6% cultivated groundnut. 76.6% (59) of respondents said they knew the farming calendar for their major crops, as compared to 23.4% (18) that did not know the farming calendar for their crops cultivated. According to the results, the majority of the respondents know the farming calendar of their major crops. 49.4% of the respondents said that the farming calendar has changed, most especially for rice, which is the most cultivable first crop in the study area. 23.4% said they had no idea. When the farmers were asked if they knew the farming calendar caused a change in the yields of crops, 50.6% of the respondents said “no” or “no idea”, as opposed to 49.4% who said “yes”. This result is following the National Adaptation Programme of Action (NAPA) country report in Sierra Leone (2012). In that report, it was clearly stated that climate change will have to affect rain-fed crops in the country. 30% of the respondents said that they experienced a total loss of three to four 50 kg bags as a result of the change in the farming calendar, and 1% said a loss of five or more bags was experienced. Finally, 51.9% of the respondents said “no idea”, as opposed to 48.1% who said climate change is a known factor responsible for the change in the farming calendar. This also clearly shows that the majority of rural farmers lack knowledge of the concept of climate change.

3.4 Some key aspects of farming that enable good productivity of crop yields

In Table 4, 98.7% of farmers said they prepare their land well for farming, as opposed to 1.3% who said “no”. All the farmers that were interviewed said they broadcast their seeds well, and 97.4% of the farmers said they weed their main crops. When asked about the use of pesticides and insecticides, no farmer agreed to have used them, which means 100% said “no”. 45.5% of the farmers did viability tests on the major crops grown, while 54.5% said “no”. 67.5% of the farmers harvested their crops properly, while 32.5% said “no”. 29.9% of farmers said they store their crops properly. When asked how he did it, one farmer said he used Julei (a native leaf of a plant in Mende) leaf to cover his crop yields, which will keep rodents like rats away from his stored yields. 70.1% said they have no storage facility for their crop yields. 75.3% of the farmers fenced their major crops, while 24.7% said “no”. No farmer in the study ever used fertilizer on the main crops grown.

Table 4. Some key aspects of farming that enable good productivity of crop yields

Key aspects of farming	Yes		No		Total	
	Frequency	%	Frequency	%	Frequency	%
Well preparation of land for the cultivation of the major crop	76	98.7%	1	1.3%	77	100.0%
Well broadcasting of seed or planting of seedlings	77	100%	0	0.0%	77	100.0%
Proper weeding on major crops	75	97.4%	2	2.6%	77	100.0%
Using pesticides and insecticides to kill pests and insects on crops	0	0.0%	77	100.0%	77	100.0%
Viability tests on the seeds of the major crops grown	35	45.5%	42	54.5%	77	100.0%
Proper harvesting of crops	52	67.5%	25	32.5%	77	100.0%
Proper storage of crop yields to avoid rodent attacks	23	29.9%	54	70.1%	77	100.0%
Fencing of major crops	58	75.3%	19	24.7%	77	100.0%
Fertilizer usage on major crops	0	0.0%	77	100.0%	77	100.0%

3.5 Climate-related hazards that affect farming activities and farmers' well-being

In Table 5, 62.3% of farmers said they knew about climate-related hazards, as opposed to 37.7% who did not. When asked about their understanding of the concept, 40.3% said it is a natural process caused by God, as opposed to 3.9% who said it is the severe action of the weather that caused the loss of lives and properties. 97.4% of the respondents said that the common hazards mentioned earlier affected their household, as opposed to 2.6% who said “no”.

When asked about the hazards that affected the respondents the most, 64.9% said flooding, making it the hazard with the most significant effect in the last five years.

Table 5. Climatic-related hazards that affect farming activities and farmers' well-being

Questions	Frequency	Percentage (%)
Do you know about climate-related hazards?		
Yes	48	62.3
No	29	37.7
What are climatic-related hazards?		
A loss to humanity caused by weather variations	5	6.5
It is a natural process caused by God	31	40.3
It is the severe action of weather that caused the loss of lives and properties	3	3.9
No idea	0	0.0
Did any climatic hazards affect your household?		
Yes	75	97.4
No	2	2.6
Which of the climatic-related hazards affects your household most?		
Flooding	50	64.9
Drought	16	20.8
Pests and diseases	9	11.7
Not applicable	0	0.0

3.6 Size of land in acreage cultivated by farmers in the last five years

Figure 1 represents the acreage of land cultivated by subsistence farmers in the last five years (2012 to 2016). According to the graphs, there is a striking similarity in the amount of land cultivated in the last five years. In 2012, 37.66% of respondents cultivated two acres of land, as opposed to 6.49% who cultivated five and six acres of land, respectively. In 2013, 37.66% of respondents cultivated two acres of land, as opposed to 1.30% who cultivated five and six acres of land, respectively. In 2014, 44.16% of respondents cultivated two acres of land, as opposed to 3.90% who cultivated five acres of land. In 2015, 45.5% of respondents cultivated two acres of land, as opposed to 2.60% of respondents who cultivated five and six acres of land, respectively. In 2016, 41.56% of respondents cultivated two acres of land, as opposed to 1.30% who cultivated six acres of land.

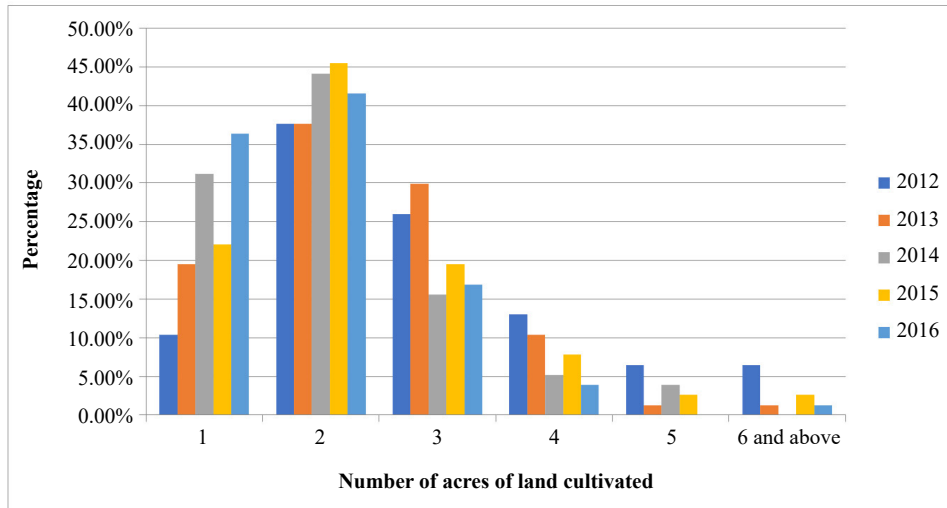


Figure 1. A histogram showing the size of land in terms of acreage cultivated by farmers in the last five years

3.7 Coping strategies amid climatic shocks

Figure 2 shows that 91% of respondents (farmers) said that they were practicing mixed cropping to get better yields of other crops planted with the major crop, which is rice. 3% said they have now dug water wells to get drinking water during the drought.

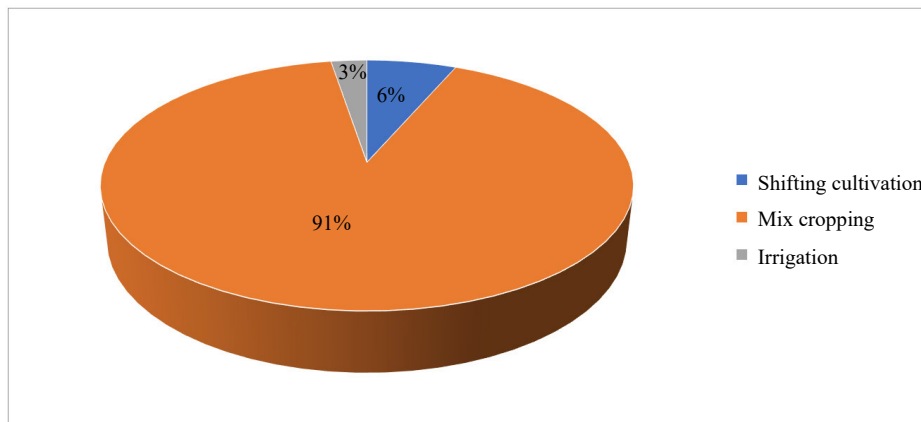


Figure 2. A pie chart showing the coping strategies adopted by subsistence farmers amid climate change

4. Discussion

The discussion has a key focus on the socioeconomic and demographic characteristics of respondents, the knowledge and perception of subsistence farmers about climate change, the trend of farming and crop productivity under climatic variability, climatic-related hazards that affect farming activities, and farmers' well-being and the coping strategies adopted by farmers to survive climate variability in their farming activities. The demographic characteristics are considered to have diverse effects on farmers' perceptions of climate change and their capacity to adapt. The farmer's age reflects their farming experience. Over half of the respondents were in the middle-aged group (62.2%), which signifies the most active age group in farming activities in the area. Attaining higher education levels helps farmers to access information on improved technology and resources. Most of the farmers in this study were illiterate,

as 67.5% of the respondents did not attend school, thereby indicating a high illiteracy level. Almost all the respondents were married. Marriage is a symbol of a typical rural setting in which the man marries to get farm labor from his children. All the respondents in the study area did farming as a source of food, and the sale of crop yields was the key source of income.

In this study, the majority of the farmers have heard the words “climate change” through radio stations as a medium. But the majority of them lacked knowledge of the concept of climate change, which might be attributed to the illiteracy level of the farmers and the poor extension services in rural areas. This result is in line with the findings of Mbwambo et al. [20], which revealed that 57% of sampled farmers had heard about climate change on the radio.

Despite their low knowledge of climate change issues, respondents were able to sense the trend of change in some climatic factors such as the level of rainfall, temperature, wind, and drought. This result is in line with previous findings [21, 22], which show that farmers lack knowledge about the concept of climate change but can sense climatic variations. In the context of disaster, many farmers reported that the wind caused such severe damage in their plantations that they had to consider the wind as a disastrous agent. This result is supported by the findings of Flaig [23], which revealed that farmers were able to identify the nature of the wind that destroyed their farming activities as a climate-related hazard.

As this study was geared towards subsistence farming, it was evident in the result that shifting cultivation was the most practiced farming system in the region. The majority of the farmers acquired land for farming through inheritance, and rice was the major crop cultivated by almost all the farmers, followed by cassava and groundnut. Pipers, yams, beans, cucumbers, and maize were cultivated as second and third crops. This finding is similar to that of the study done by Food and Agriculture Organization of the United Nations (FAO) et al. [24], which found that rice is the major crop cultivated by most farmers in Sierra Leone.

Most of the farmers in this study asserted that the change in the farming calendar had occurred. Farmers in this part of the country exhibited competence by stating that the farming calendar has changed and attributing it to being one of the factors responsible for the low productivity of rain-fed crops like rice. The majority of respondents said they had experienced a total loss of five to six 50 kg bags of crop yields as a result of the change in the farming calendar. This result is in line with the findings of Apriyana et al. [25]. In their report, it was clearly stated that there will be an overall decrease in future cereal crop yields as a result of projected changes in temperature and precipitation that will enable a change in the farming calendar for rain-fed crops.

In terms of crop productivity, the researcher did not only concentrate on climate change impacts, but other variables were considered to be responsible for the low productivity of crops. It was evident from the findings that most of the farmers prepared their farms well, broadcast their seeds well, constantly carried out weeding on the farm, fenced major crops, and harvested crops properly. However, most of the farmers never practiced the use of fertilizers on their crops, proper storage to avert rodent attacks, or viability tests on the major crops grown, which were the major factors responsible for the low productivity of crop yields. The majority of the respondents agreed that flooding, drought, pests and diseases, and wildfires were the common climatic-related hazards that have affected them. However, drought and flooding were the main hazards that destroyed tree crops like cacao, coffee, oil palm, and kola. The result is in line with that of Olanrewaju et al. [26], where the respondents highlighted flooding and drought as the two major climatic-related hazards that affected upper and lower Nigerian regions [27].

5. Conclusion

In this study, the evaluation of farmers’ perceptions about climate change revealed that it is an increasing catastrophe affecting their livelihood in areas such as declining crop and livestock yields, and about 97% of the farmers in the region have been affected, especially by flooding. Farmers should be educated on farming skills and procedures to increase their awareness of climate change-related issues. Organizations involved in disaster management and support should be proactive, as climate hazards are becoming more common in the region.

5.1 Policy recommendations

Farmers should be given adult education relating to agriculture to improve their skills and methods in farming. This will capacitate the farmers’ knowledge of climate change issues. There should be the provision of climate-smart

agriculture in all regions of the country to upgrade farmers' skills in the latest farming techniques under climate change conditions. This will avert hunger in the country in time to come. The government and non-governmental organizations that are engaged in disaster management and support should be proactive, as climate-related disasters are becoming more prevalent in the country. The combined manufacturing and marketing chains for selected staple crops (rice and manatees) and for exporting plants (cocoa and coffee) should be actively and reliably promoted. This would increase subsistence farming eradication in the country as promised by the Sierra Leone government in its National Sustainable Agricultural Development Plan (NSADP, 2010-2030).

Conflict of interest

The authors have no competing interests.

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