MINISTRY OF AGRICULTURE AND FORESTRY (MAF)

PROJECT MANAGEMENT UNIT(PMU)
AGRICULTURAL VALUE CHAIN DEVELOPMENT PROJECT
(AVDP)
23 Bo-Torwama road, Bo, Sierra Leone.
Phone: +23276711551 | Email: info@avdp.org.sl

DRAFT BASELINE REPORT ON CLIMATE CHANGE AND ADAPTATION

PREPARED BY

MONTORING AND EVALAUTION UNIT/PLANNING EVALUATION MONITORING AND STATISTICS DIVISION (PEMSD)

Date: DECEMBER 2021

1.0 Summary

This study assessed smallholder farmers' perceptions and adaptation strategies of climate change across various regions of Sierra Leone, their effects, impacts, adaptation, and intervention strategies. The key findings revealed that climate change is mainly caused by human causes (61.1%), lack of knowledge on climate change adaptation strategy (60.8%), climate hazard warning (84.3%) and information from any central authority. climate change influences the onset of rains (80.9%) and cessation of the rains (73.4%). Smallholder farmers struggle to predict planting date (73.8%), experience low crop yield (77.3%), very severe crop losses (51.6%), incurring most of the losses at the vegetation stage (38.2%). They utilize land preparation intervention technology (61.3%) and mixed cropping adaptation strategy (40.4%) to ameliorate climate change. Main effects of climate change include drought (17.8%), flooding (17.3%), reduced crop productivity (16.5%), erratic rainfall (13.8%), increased disease incidence (13.1%), and difficulty in predicting planting dates (11.3%). Key weather challenge indicators include very hot seasons (27.1%), flooding (24.7%), and intermittent drought (23.9%). Results suggest that awareness campaign on climate change should be done. The indigenous knowledge system-based climate change support and interventions should be included in the campaign. Smallholder farmers should be motivated to adopt climate-smart agriculture technologies by creating an enabling policy environment for adaptation. The government should also invest in smallholder farmers skill audits programme so that these farmers would graduate from subsistence farming to commercial farming.

2.0 Introduction

Sierra Leone's economy is mainly agrarian and relies heavily on the agricultural sector for creating jobs for over 61.1% of the population (International Labour Organization (ILO) et al, 2015). Historically, the agricultural sector also contributes the most to the country's Gross Domestic Product (GDP). However, over the last two decades, as the country struggles to recover from a brutal 10-year civil war, the shares of revenue streams from

the extractive industry have been steadily increasing. Particularly, in 2013, the country enjoyed the strongest ever GDP growth rate of 21% which was driven primarily by the increase in iron ore exports. This positive trajectory was cut short with the downturn in iron ore prices and the outbreak of the Ebola Virus Disease (EVD) in 2014. GDP growth rate fell to minus 20.5% in 2015 and has yet to recover to its 2013 and 2014 levels. In 2015-2016, the economy bottomed-out of the effects of the EVD epidemic. GDP growth was recorded at 6.3% in 2016, 3.8% in 2017 and 3.7% in 2018. However, despite the positive outlook promised for 2020, The COVID-19 pandemic stalled all earlier progress that has been made to the Sierra Leonean economy. Current growth rates suggest that the Government of Sierra Leone's policies during COVID -19 helped in minimizing the anticipated shocks to food supplies and the whole economy. Currently, as the pandemic subsides and vaccines are being introduced, development partners are reinvesting in various sectors, like agriculture, health and education to set the stage for economic recovery.

Small farmers carry out the majority of agriculture, employing ancient methods such as "bush fallow" (allowing natural re-vegetation for 5 to 10 years after each cropping period). Sierra Leone, like many other developing countries, is expected to suffer from climate change. It is anticipated that a 2-30°C increase in temperature will put roughly 20-300 million people at risk of hunger, and that global cereal production will fall by 5% for a 20°C increase and 10% for a 100°C increase in temperature. Climate change would reduce protein supplies, and it is already responsible for roughly 150,000 fatalities worldwide. Despite new information in recent years, Sierra Leone's response to climate change impacts is inadequate.

Understanding how and why farmers have reacted to previous climate change is essential for determining how to best support current and future adaptation. In this context, Vincent (2007) stated that knowing how present climatic changes are experienced, interpreted, and responded to at the local level is a critical starting point in evaluating adaptation capability. Exploring what these perceptions are, how they are formed, and how perception influences response are all part of evaluating climate change perception and response (Vedwan and Rhoades, 2001). Broadhead and Howard (2009) emphasized the need of leveraging collected local climatic knowledge to better understand adaptation

decision-making. The objective of this study was to assess smallholder farmers' perception on climate change across the various regions of Sierra Leone, their effects, impacts, adaptation, and intervention strategies.

Over the last four decades, IFAD's portfolio has managed to stay relevant in Sierra Leone by responding to the priorities typical of fragile states like Sierra Leone and aligning the organization's strategy to the country's changing political and economic climate. Since 1979, IFAD has committed US$130.4 million in highly Concessional Loans and Debt Sustainability Grants to eight projects with a key focus on agricultural development, rural development and the provision of financial services. Currently, IFAD has two financed projects in the country, i.e., the Rural Finance and Community Improvement Project II (RFCIPII), which ends in 2022, and the Agricultural Value Chain Development project which ends in 2025.

The Ministry of Agriculture and Forestry (MAF) is currently implementing the Agricultural Value Chain Development Project (AVDP) through a Project Management Unit (PMU). The project will be implemented over six years with the overall goal of improving livelihoods, food security and climate resilience of rural farming households. The project's development objective is to increase incomes for smallholder farmers through the promotion of agriculture as a business. The AVDP will target an estimated 43,000 direct beneficiaries and their families, thereby reaching a total of 258,000 people. The project is been financed by IFAD, the Adaption Fund (AF), OPEC Fund for International Development (OFID), Toni Blair Institute (TBI), the private sector, the Government of Sierra Leone (GoSL) and beneficiaries.

In a bid to have an effective M&E system that is particularly critical for evaluating project results, a baseline survey which determines "pre-intervention" conditions for a defined set of indicators that will be used to assess achievement of intended outcomes and impacts has been regarded as a good starting point. The results of this study will be compared with the same indicators at some point during implementation (mid-term evaluation) and post-operation implementation (final evaluation). Therefore, the baseline forms the basis for a comparison of "before and after" conditions or a measurement of "change over time".

3.0 Project Description

The Adaptation Fund is fully aligned with the three components of the AVDP. This project will deliver the above stated overall goal and development objective through the three mutually reinforcing components: (a) Component 1: Climate-proofed agricultural production and post-harvest combined with livelihood diversification, whose expected outcome is to provide a set of proven best practices on climate resilient rice and cocoa value chains drawing from local and international research and sustainable increase in rice and cocoa production, (b) Component 2: Climate-resilient rural transportation and water infrastructure, whose expected outcome is enhanced and secure access to portable water supply, post- harvest losses reduced and improved access to market by beneficiary communities through climate- proofed rural road network (c) Component 3: Institutional capacity building and policy engagement, whose expected outcome is an improved environment for resilient rice and cocoa value chains as well as EPA and the government capacities enhancement on adaptation to climate change in these sectors.

4.0 Objective of the baseline study

This baseline study provides complementary information to the AVDP baseline study specifically with indicators on climate change, hygiene and women empowerment. These results will be used to gauge the performance of the project during and after implementation. The baseline information will establish benchmarks for assessing changes in the livelihood of project beneficiaries in the 16 districts where the project is being implemented in Sierra Leone.

5.0 Methodology

In this section, the report presents a summary of the methodology that was used for this complementary survey.

With reference to the IFAD COI (Core Outcome Indicators) Guidelines, the general rule of thumb of surveying a sample of 750 treatment units was used instead of the exact sample size calculation. The size of this sample is not proportional to the size of the project, which is why the rule of thumb applies to the Adaptation Fund project: the 750 units represent the minimum number of units surveyed.

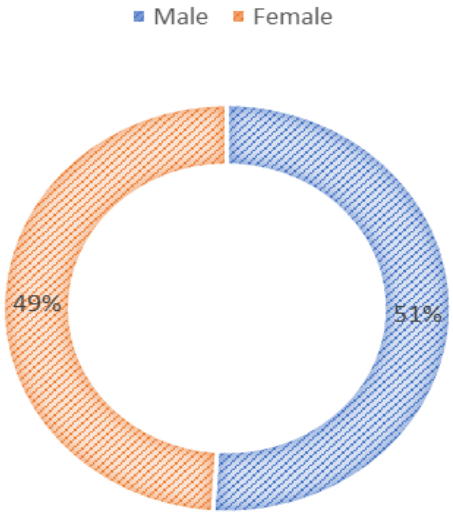
The Open Data Kit (ODK) platform was used for programming the instrument and uploading into android devices. At field level, thirty (30) enumerators collected data using tablets or phones and this information was transmitted to the cloud system on a daily basis. This provided real time data and ensures accuracy of data transmitted.

Household survey research design method was used to elicit information from smallholder farmers engaged in various value chains for assessment of their perceptions of climate change and their adaptation strategies. A total of 732 responded to the semi-structured questionnaires across five provinces of Sierra Leone including Eastern (Kailahun, Kenema and Kono); Northern (Bombali, Falaba, Koinadugu and Tonkolili); Northwest (Kambia, Karene and Port Loko); Southern (Bo, Bonthe, Moyamba and Pujehun); and Western Area (Western Rural) of Sierra Leone.

6.0 Key Results and discussions

Gender of household heads

In explaining this indicator, we present the gender disaggregation of the household heads. As shown in the figure below, 49% of the respondents are female, 51% male and 44% youth. This confirms that there is no significant difference between male and female headed households and the project targeting of youth has surpassed the threshold of 40%.



Marital Status of household heads

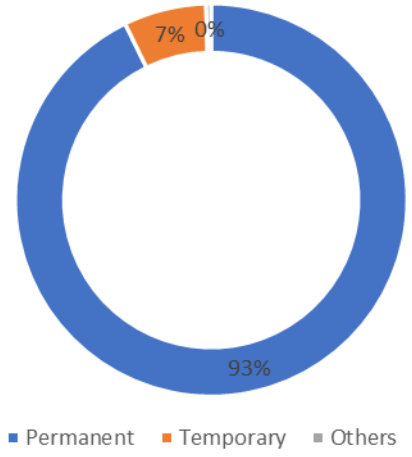
The table below shows results of the marital status of the household heads. Monogamous marriages are dominant with project beneficiaries showing a percentage of 64%. This is followed by polygamous marriages with 22% and widows 7%. It is interesting to note that widows are also being targeted for project support.

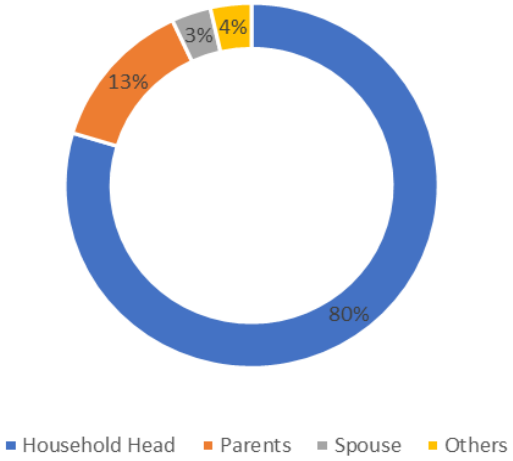
Marital Status	Frequency	Percentage
Monogamous Married	469	64%
Single	33	5%
Polygamous Married	162	22%
Separated	10	1%
Widow	52	7%
Widower	6	1%
Total	**732**	**100%**

Dwelling type and ownership status

Regarding the dwelling type occupied by the respondents, the survey reveals that 93% are permanent structures and 7% temporary structures. The ownership status of the

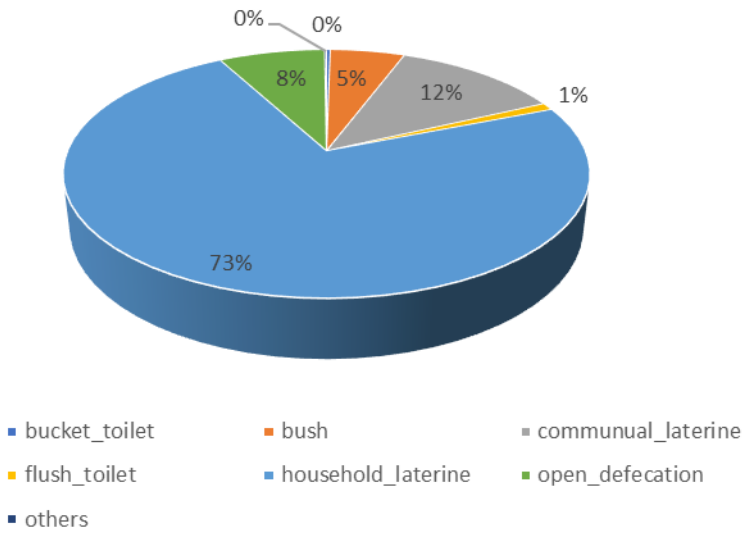
dwelling shows that 80% of the dwellings are owned by household heads, 13% are either owned or inherited from parents and 3% are owned by respondents' spouses.





Access to toilet facility

The figure below depicts that 73% of the respondents used household latrines, 12% have access to community latrines, 8% are still doing open defecation and 5% are using the bush as a means of toilet facility. The fact that people are still into open defecation especially in the bush is a call for concern to have the project design sensitization messages meant to discourage this old practice which is bound to have some health implications.



Main source of Lighting

From the table below, household heads reported a dominant use of Chinese lamps as their main source of lighting which is about 64%, followed by the use of torch lights which is reported at 31%. There are other sources of lighting, reported at 5%.

Main source of lighting	Frequency	Percentage
Chinese Lamp	468	64%
None	2	0%
Others	33	5%
Torch Light	228	31%
Wood	1	0%
Total	**732**	**100%**

Main source of cooking fuel

The results of the survey shows that 94% of the respondents are still using firewood collected from the bush as their main source of cooking fuel. This result confirms the high incidence of deforestation taking place in rural communities. The use of charcoal reported at 4% is also an element of slash and burn agriculture. Respondents are still buying firewood (2%) from people engaged in deforestation which is also providing the incentive for people to continue to deplete the environment.

Main source of cooking fuel	Frequency	Percentage
Charcoal	28	4%
Collected firewood	685	94%
Electricity	1	0%
Others	1	0%
Purchased firewood	17	2%
Total	732	100%

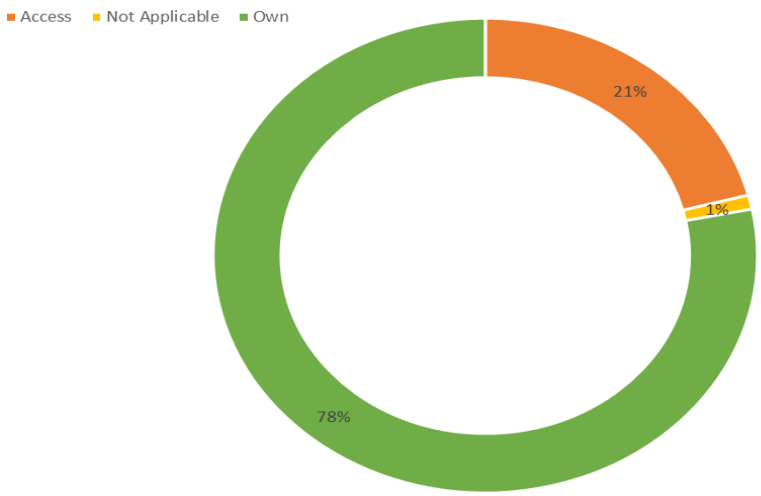
Main source of drinking water

It is established from the survey that the main source of drinking water is boreholes with handpumps, reported at 54%. Surface water (22%) is also revealed as the second main source of drinking water, followed by protected well which is reported at 13%. Based on these results, the project is required to concentrate efforts in reducing percentage of people using surface water as their main source of drinking water.

Main source of drinking water	Frequency	Percentage
handpumps_boreholes	395	54%
i_dont_know_know	1	0%
piped_connection_to_house	4	1%
protected_spring	3	0%
protected_well	93	13%
public_tap_standpipe	46	6%
rain_water_safely_harvested	4	1%
surface_water	163	22%
unprotected_spring	12	2%
unprotected_well	10	1%
water_sachets	1	0%
Total	**732**	**100%**

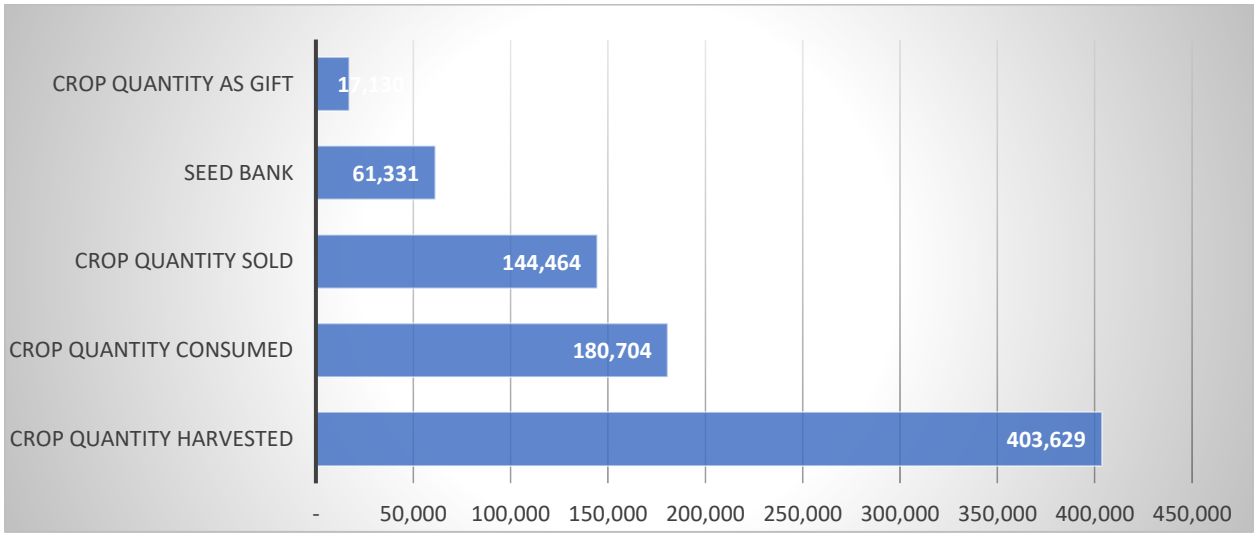
Land ownership status and size

The figure below shows that 78% of the respondents owned agricultural land and 21% have access to land as sharecroppers in the case of inland valley swamps, tree crops and vegetable cultivation. This confirms that majority of the farmers do not have issues with land because land ownership is easier in rural communities. The 1% that is not applicable implies that either farmers inherited land from their parents or purchased land from people within the community. The average land size owned and utilized during the last production season is reported at 5.8ha and 3.3ha respectively.

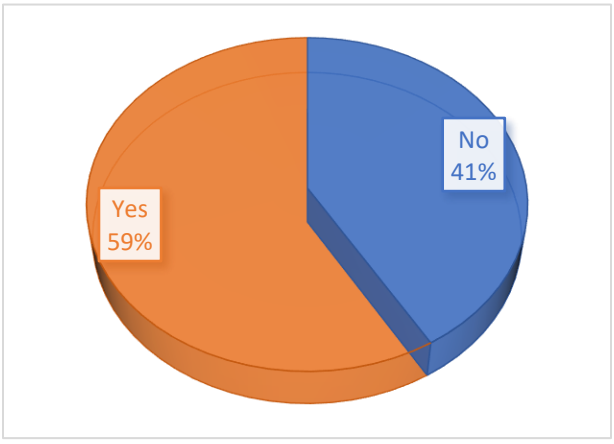


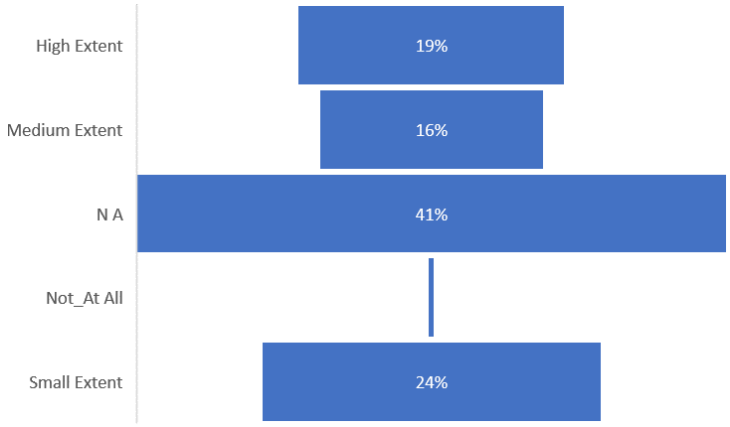
Rice quantity produced, sold and consumed

Based on the results of the survey, 403,629kg of rice was harvested during the last production season (2020/21 production season). From this production figure, 180,704kg was consumed, 144,464kg sold, 61,331kg used for seed bank and 17,130kg given as gift to either friends or relatives. Because consumption is greater than sales, there is need to promote the concept of agribusiness with smallholder farmers and also encourage crop diversification.



Group membership and influence





In terms of group membership, 59% of the respondents belong to producer organizations and 41% confirm that they have never been associated with producer organizations. For those that are members of the producer organizations, only 19% can influence decisions

in the group at a very high level, 16% at medium level and 24% on a smaller scale.

(Number) Percentage of individuals demonstrating an improvement in empowerment

This indicator is a simplified version of the pro-WEAI (Women Empowerment in Agriculture Index). It aims at measuring people's empowerment in the communities where projects are implemented, in the domains relevant to IFAD's operations. This indicator includes 10 of the 12 dimensions for the pro-WEAI, focusing on those IFAD can influence through its supported activities. Similar to the pro-WEAI, these dimensions are mapped to three domains of empowerment: intrinsic agency (power within), instrumental agency (power to), and collective agency (power with) which are linked to the definition of empowerment. The 10 dimensions are mapped to the three domains of agency as follows:

1) **Intrinsic agency**: Autonomy in income, Self-efficacy and Attitudes about intimate partner violence.
2) **Instrumental agency**: Input in productive decisions, Ownership of land and other assets, Access to and decisions on financial services, Control over use of income and Work balance.
3) **Collective agency**: Group membership and Membership in influential groups

Intrinsic Agency	
Autonomy in income	41%
Self-efficacy	78%
Attitudes about intimate partner violence	12%
Average	**43%**
Instrumental Agency	
Productive decisions	35%
Ownership of land	78%
Access to and use of financial services	6%
Control over use of income	41%
Work balance	84%
Average	**49%**
Collective Agency	
Group Membership	59%
Membership in influential groups	57%

Average	**58%**
Final Score	**50%**

From the above computation, the combined score of the three dimensions is 50%. Therefore, the empowerment index is recorded at 50% disaggregated as follows: 49% female and 51% male. This confirms that male respondents are more empowered than their female counterparts.

Percentage of households with improved nutrition Knowledge Attitudes and Practices (KAP). This indicator is disaggregated into three components: Component A, improvement in water and hygiene; Component B, improvement in food safety, hygiene and preparation and Component C, improved child feeding practices and micronutrients intake. The component indicator was calculated based on the answers of each component expressed as a percentage of the number of parameters examined under the component. The average score of the components is then computed to arrive at the KAP combined score. A KAP score of 60% minimum is an indication that the household is expected to have reached the requirements for improved nutrition. The baseline data collected on the components of KAP revealed an average score of 48%, showing a KAP score below the minimum threshold of 60%. The implication is that the project would need to implement activities targeted to improve nutrition.

Component	**Percentage Score**
A. Water and hygiene	51%
B. Food safety, hygiene and preparation	67%
C. Feeding practices/Complementary feeding	27%
Average Score	**48%**

Perceptions of respondents on knowledge of climate change

The perception of respondents on climate change is presented in Table 1. Overall, majority (61.1%) of the respondents attributed climate change to human causes, whereas 0.5% of them attributed climate change to scientific phenomenon. Across the sampled regions, eastern province (29.3%) contributed the highest proportion of respondents that attributed climate change to human causes, whilst respondents of the southern province (1.1%) contributed the lowest to this notion.

Table 1. Perception of smallholder farmers on climate change

Region/District	Others	Spiritual	Human causes	Scientific phenomenon	Grand Total
Eastern	**23 (45.1)**	**96 (41.7)**	**131 (29.3)**	**2 (0)**	**252**
Kailahun	19	1	59	0	79
Kenema	3	85	13	1	102
Kono	1	10	59	1	71
Northern	**1 (2.0)**	**25 (10.9)**	**113 (25.3)**	**0 (0)**	**139**
Bombali	1	1	29	0	31
Falaba	0	7	23	0	30
Koinadugu	0	17	19	0	36
Tonkolili	0	0	42	0	42
Northwest	**12 (23.5)**	**93 (40.4)**	**102 (22.8)**	**2 (50)**	**209**
Kambia	0	0	65	0	65
Karene	1	32	4	2	39
Port Loko	0	12	28	0	40
Southern	**11 (21.6)**	**49 (21.3)**	**5 (1.1)**	**0 (0)**	**65**
Bo	0	4	22	0	26
Bonthe	0	4	22	0	26
Moyamba	15	12	79	0	106
Pujehun	6	3	13	0	22
Western	**9 (17.6)**	**3 (1.3)**	**24 (5.4)**	**0 (0)**	**36**
Western Rural	0	6	42	0	48
Grand Total	**51 (7.0)**	**230 (31.4)**	**447 (61.1)**	**4 (0.5)**	**732 (100)**

Values in brackets are percentages per region

The findings on the knowledge of the respondents on climate change adaptation strategies are presented in Table 2. Generally, 60.8% of the respondents opined that smallholder farmers lack knowledge on climate change adaptation strategy, whereas 39.2% of them revealed that smallholder farmers are knowledgeable of climate change adaptation strategy. Across the sampled regions, eastern province (39.3%) accounted for the highest proportion of respondents with the view that smallholder farmers lack knowledge on climate change adaptation strategy, whilst western area (5.8%) contributed the lowest to this notion. With regards the climate change adaptation strategy knowledge by farmers, respondents of the southern region (36.9%) contributed highest, whereas the least contribution was from those in the western area (0%).

Table 2. Smallholder farmers' knowledge of climate change adaptation strategies

Region/District	No climate change adaptation strategy knowledge by farmers	Climate change adaptation strategy knowledge by farmers	Grand Total
Eastern	**175 (39.3)**	**77 (26.8)**	**252 (34.4)**
Kailahun	18	61	79
Kenema	94	8	102
Kono	63	8	71
Northern	**79 (17.8)**	**60 (20.9)**	**139 (19.0)**
Bombali	31	0	31
Falaba	16	14	30
Koinadugu	4	32	36
Tonkolili	28	14	42
Northwest	**62 (13.9)**	**44 (15.3)**	**106 (14.5)**
Kambia	22	0	22
Karene	33	3	36
Port Loko	7	41	48
Southern	**103 (23.1)**	**106 (36.9)**	**209 (28.6)**
Bo	8	57	65
Bonthe	34	5	39
Moyamba	6	34	40
Pujehun	55	10	65

Western	**26 (5.8)**	**0 (0)**	**26 (3.6)**
Western Rural	26	0	26
Grand Total	**445 (60.8)**	**287 (39.2)**	**732 (100)**

Values in brackets are percentages per region

The perception of respondents on onset of the rains is presented in Table 3. Generally, majority (80.9%) of the smallholder farmers revealed that climate change influences the onset of rains, whereas 19.1% of them opined that it inflicts no change in the onset of the rains. Across the sampled regions, eastern province (41.7%) contributed the highest proportion of respondents that attributed climate change on the onset of rains, whilst respondents of the western area (4.1%) contributed the lowest to this notion.

Table 3. Perception of smallholder farmers on onset of the rains

Region/District	No change in the onset of the rains	Change in the onset of the rains	Grand Total
Eastern	**5 (3.5)**	**247 (41.7)**	**252**
Kailahun	5	74	79
Kenema	0	102	102
Kono	0	71	71
Northern	**48 (34.4)**	**91 (15.4)**	**139**
Bombali	29	2	31
Falaba	0	30	30
Koinadugu	3	33	36
Tonkolili	16	26	42
Northwest	**1 (0.7)**	**105 (17.7)**	**106**
Kambia	0	22	22
Karene	1	35	36
Port Loko	0	48	48
Southern	**84 (60.0)**	**125 (21.1)**	**209**
Bo	45	20	65
Bonthe	0	39	39
Moyamba	0	40	40
Pujehun	39	26	65
Western	**2 (1.4)**	**24 (4.1)**	**26**
Western Rural	2	24	26
Grand Total	**140 (19.1)**	**592 (80.9)**	**732 (100)**

Values in brackets are percentages per region

The perception of respondents on cessation of the rains is presented in Table 4. Generally, majority (73.4%) of the smallholder farmers revealed that climate change affects the cessation of rains, whereas 26.6% of them opined that it inflicts no change in the cessation of the rains. Across the sampled regions, eastern province (45.3%) contributed the highest proportion of respondents that attributed climate change on the cessation of rains, whilst respondents of the western area (3.7%) contributed the lowest to this notion.

Table 4. Perception of smallholder farmers on cessation of the rains

Region/District	No change in the cessation of the rains	Change in the cessation of the rains	Grand Total
Eastern	**9 (4.6)**	**243 (45.3)**	**252**
Kailahun	6	73	79
Kenema	1	101	102
Kono	2	69	71
Northern	**86 (44.1)**	**53 (9.9)**	**139**
Bombali	30	1	31
Falaba	1	29	30
Koinadugu	29	7	36
Tonkolili	26	16	42
Northwest	**5 (2.6)**	**101 (18.8)**	**106**
Kambia	4	18	22
Karene	1	35	36
Port Loko	0	48	48
Southern	**89 (45.6)**	**120 (22.3)**	**209**
Bo	49	16	65
Bonthe	0	39	39
Moyamba	0	40	40
Pujehun	40	25	65
Western	**6 (3.1)**	**20 (3.7)**	**26**
Western Rural	6	20	26
Grand Total	**195 (26.6)**	**537 (73.4)**	**732 (100)**

Values in brackets are percentages per region

The perception of respondents on planting date predictability is presented in Table 5. Generally, majority (73.8%) of the respondents revealed that smallholder farmers struggle to predict planting date, whereas 26.2% of them opined that they do not struggle to predict planting date. Across the sampled regions, eastern province (90.0%) contributed the highest proportion of smallholder farmers that attributed climate change to difficulty to predict planting date, whilst respondents of the western area (3.5%) contributed the lowest to this notion.

Table 5. Perception of smallholder farmers on planting date prediction

Region/District	No struggle to predict planting date	Struggle to predict planting date	Grand Total
Eastern	**45 (88.2)**	**207 (90.0)**	**252**
Kailahun	2	77	79
Kenema	37	65	102
Kono	6	65	71
Northern	**38 (74.5)**	**101 (43.9)**	**139**
Bombali	27	4	31
Falaba	2	28	30
Koinadugu	0	36	36
Tonkolili	9	33	42
Northwest	**50 (98.0)**	**56 (24.3)**	**106**
Kambia	9	13	22
Karene	31	5	36
Port Loko	10	38	48
Southern	**41 (80.4)**	**168 (73.0)**	**209**
Bo	5	60	65
Bonthe	3	36	39
Moyamba	2	38	40
Pujehun	31	34	65
Western	**18 (35.3)**	**8 (3.5)**	**26**
Western Rural	18	8	26
Grand Total	**192 (26.2)**	**540 (73.8)**	**732 (100)**

Values in brackets are percentages per region

The perception of respondents on stage of crop loss is presented in Table 6. Generally, majority (38.2%) of the respondents revealed vegetation stage as the most critical stage of crop loss, followed by the reproductive stage (32.3%), whereas 9.9% of them opined seed formation stage as the least critical stage of crop loss. Across the sampled regions, southern province (42.1%) contributed the highest proportion of smallholder farmers that attributed critical stage of crop loss to vegetation stage, whilst respondents of the northern province (7.9%) contributed the lowest to this notion.

Table 6. Perception of smallholder farmers on stage of crop loss

Region/District	Germination stage	Reproduction stage	Seed formation stage	Vegetation stage	Grand Total
Eastern	**19 (17.1)**	**98 (53.6)**	**9 (16.1)**	**59 (27.3)**	**185**
Kailahun	0	0	1	36	37
Kenema	0	51	8	22	81
Kono	19	47	0	1	67
Northern	**31 (27.9)**	**33 (18.0)**	**7 (12.5)**	**17 (7.9)**	**88**
Bombali	29	1	0	1	31
Falaba	0	0	5	1	6
Koinadugu	0	21	2	13	36
Tonkolili	2	11	0	2	15
Northwest	**29 (26.1)**	**13 (7.1)**	**29 (18.0)**	**27 (12.5)**	**98**
Kambia	3	2	0	11	16
Karene	14	6	5	11	36
Port Loko	12	5	24	5	46
Southern	**32 (28.8)**	**36 (19.7)**	**11 (19.6)**	**91 (42.1)**	**170**
Bo	18	2	0	42	62
Bonthe	9	3	0	24	36
Moyamba	4	25	0	11	40
Pujehun	1	6	11	14	32
Western	**0 (0)**	**3 (1.6)**	**0 (0)**	**22 (10.2)**	**25**
Western Rural	0	3	0	22	25

Grand Total	**111 (19.6)**	**183 (32.3)**	**56 (9.9)**	**216 (38.2)**	**566 (100)**

Values in brackets are percentages per region

The perception of smallholder farmers on low crop yield is presented in Table 7. Generally, majority (77.3%) of the respondents experienced low crop yield over the past 10 years, whereas 22.7% of them did not experience low crop yield over the past 10 years. Across the sampled regions, eastern province (32.7%) contributed the highest proportion of smallholder farmers that experienced low crop yield over the past 10 years due to climate change, whilst respondents of the western area (4.4%) contributed the lowest to this notion. These findings suggest that the smallholder farmers have experienced weather changes in the last 10 years.

Table 7. Perception of smallholder farmers on low crop yield

Region/District	No experience of low crop yield over the past 10 years	Experience low crop yield over the past 10 years	Grand Total
Eastern	**67 (40.4)**	**185 (32.7)**	**252**
Kailahun	42	37	79
Kenema	21	81	102
Kono	4	67	71
Northern	**51 (30.7)**	**88 (15.5)**	**139**
Bombali	0	31	31
Falaba	24	6	30
Koinadugu	0	36	36
Tonkolili	27	15	42
Northwest	**8 (4.8)**	**98 (17.3)**	**106**
Kambia	6	16	22
Karene	0	36	36
Port Loko	2	46	48
Southern	**39 (23.5)**	**170 (30.0)**	**209**
Bo	3	62	65
Bonthe	3	36	39
Moyamba	0	40	40
Pujehun	33	32	65
Western	**1 (0.6)**	**25 (4.4)**	**26**
Western Rural	1	25	26

Grand Total	**166 (22.7)**	**566 (77.3)**	**732 (100)**

Values in brackets are percentages per region

The perception of smallholder farmers on severity of crop loss is presented in Table 8. Generally, majority (51.6%) of the respondents experienced very severe crop losses, followed by moderately severe (38.2%), whereas 10.2% of them experienced no severe losses. Across the sampled regions, eastern province (47.6%) contributed the highest proportion of smallholder farmers that experienced very severe crop losses due to climate change, whilst respondents of the western area (2.1%) contributed the lowest to this notion.

Table 8. Perception of smallholder farmers on severity of crop loss

Region/District	Moderately severe	Not severe	Very severe	Grand Total
Eastern	**46 (21.3)**	**0 (0)**	**139 (47.6)**	**185**
Kailahun	15	0	22	37
Kenema	31	0	50	81
Kono	0	0	67	67
Northern	**52 (24.1)**	**2 (3.4)**	**34 (11.6)**	**88**
Bombali	29	0	2	31
Falaba	6	0	0	6
Koinadugu	3	2	31	36
Tonkolili	14	0	1	15
Northwest	**35 (16.2)**	**0 (0)**	**63 (21.6)**	**98**
Kambia	9	0	7	16
Karene	17	0	19	36
Port Loko	9	0	37	46
Southern	**64 (29.6)**	**56 (96.6)**	**50 (17.1)**	**170**
Bo	8	53	1	62
Bonthe	26	0	10	36
Moyamba	3	0	37	40
Pujehun	27	3	2	32
Western	**19 (8.8)**	**0 (0)**	**6 (2.1)**	**25**
Western Rural	19	0	6	25
Grand Total	**216 (38.2)**	**58 (10.2)**	**292 (51.6)**	**566 (100)**

Values in brackets are percentages per region

Findings on the perception of smallholder farmers on climate hazard warning and information from any central authority is presented in Table 9. Generally, majority (84.3%) of the respondents received no climate hazard warning and information from any central authority, whereas 15.7% of the respondents opined that they received climate hazard warning and information from central authority. Across the sampled regions, eastern province (36.8%) contributed the highest proportion of smallholder farmers that opined that no climate hazard warning and information were received from any central authority, whilst respondents of the western area (4.2%) contributed the lowest to this notion. According to Etwire (2012), agricultural extension officers are the closest resource of information and support to advise farmers on how to make informed decisions to cope and adapt better to climate change. However, findings in this study revealed that extension officers did not provide any services on climate change, possibly due to lack of adequate resources and equipment to share such knowledge.

Table 9. Perception on climate hazard warning and information from any central authority

Region/District	No climate hazard warning and information from any central authority	Climate hazard warning and information from any central authority	Grand Total
Eastern	**227 (36.8)**	**25 (21.7)**	**252**
Kailahun	62	17	79
Kenema	95	7	102
Kono	70	1	71
Northern	**137 (22.2)**	**2 (1.7)**	**139**
Bombali	31	0	31
Falaba	30	0	30
Koinadugu	35	1	36
Tonkolili	41	1	42
Northwest	**72 (11.7)**	**34 (29.6)**	**106**
Kambia	22	0	22
Karene	33	3	36
Port Loko	17	31	48
Southern	**155 (25.1)**	**54 (47.0)**	**209**
Bo	22	43	65
Bonthe	29	10	39
Moyamba	39	1	40
Pujehun	65	0	65
Western	**26 (4.2)**	**0 (0)**	**26**
Western Rural	26	0	26

Grand Total	**617 (84.3)**	**115 (15.7)**	**732 (100)**

Values in brackets are percentages per region

Climate change interventions and adaptation of respondents in the study area

Findings on the perception of smallholder farmers on intervention technologies to ameliorate climate change is presented in Table 10. Generally, majority (61.3%) of the respondents utilize land preparation as one of the key intervention technologies to ameliorate climate change, whereas 0.1% of the respondents opined that they utilize contract farming to ameliorate climate change. Across the sampled regions, eastern province (43.2%) contributed the highest proportion of smallholder farmers that utilize land preparation as one of the key intervention technologies to ameliorate climate change, whereas respondents of the western area (0.2%) contributed the lowest to this notion.

Findings on the perception of smallholder farmers on adaptation strategies to ameliorate climate change is presented in Table 11. Generally, majority (40.4%) of the respondents use mixed cropping as one of the key adaptation strategies to ameliorate climate change, whereas 0.3% of the respondents adopt irrigation technique to ameliorate climate change. Across the sampled regions, eastern province (54.3%) contributed the highest proportion of smallholder farmers that utilize land preparation as one of the key intervention technologies to ameliorate climate change, whereas respondents of the western area (0%) contributed the lowest to this notion.

Effects and impacts of climate change in the study area

Findings on the perception of smallholder farmers on the adverse effects of climate change at the various study areas is presented in Table 12. Generally, majority (17.8%) of the respondents experience increased drought as the leading effects of climate change, followed by increased flooding (17.3%), reduce crop productivity (16.5%), erratic rainfall (13.8%), increased disease incidence (13.1%), difficulty in predicting planting dates (11.3%), whereas 10.2% of the respondents opined that they experienced food insecurity due to climate change. Across the sampled regions, eastern province contributed the highest proportion of smallholder farmers that experience increased

drought (47.2%), increase flooding (51.0%), disease incidence (49.0%), reduce crop productivity (35.6%) and food insecurity (29.9%) as the key effects of climate change, whereas respondents of the western area, which contributed 0-1.4% to the notion of adverse effects of climate change had the lowest.

Findings on the perception of smallholder farmers on major changes in weather across regions is presented in Table 13. Generally, majority (27.1%) of the respondents experience very hot seasons as the major mean percent climate change in weather across regions, followed by increased flooding (24.7%), intermittent drought (23.9%), prolonged droughts (14.8%), very wet seasons (8.8%), whereas 0.8% of the respondents opined that they experienced no change. Across the sampled regions, eastern province contributed the highest proportion of smallholder farmers that experience very hot seasons (33.1%), flooding (42.5%), prolonged droughts (64.7%) and intermittent drought (31.5%) as the key effects of climate change, whereas respondents of the southern province contributed highest for very wet seasons (35.4%) and no change (64.3%), whereas the western area contributed the lowest to the notion of major changes in weather due to climate change, which ranged from 0.8-9.5%. These findings imply that smallholder farmers are experiencing adverse effects of climate change and major changes in weather information that necessitate interventions by relevant climate change agencies.

Table 10. Perception of smallholder farmers on intervention technologies to ameliorate climate change

Region/District	BCS	CF	CR	FAT	IPM	IC	LP	Mulching	Record keeping	Row planting	Seed rating	Seed selection	Terracing on own farm	Grand Total
Eastern	**0 (0)**	**0 (0)**	**0 (0)**	**37 (49.3)**	**0 (0)**	**17 (29.8)**	**194 (43.2)**	**0 (0)**	**0 (0)**	**3 (10.3)**	**1 (20.0)**	**0 (0)**	**0 (0)**	**252**
Kailahun	0	0	0	0	0	0	78	0	0	0	1	0	0	79
Kenema	0	0	0	37	0	17	45	0	0	3	0	0	0	102
Kono	0	0	0	0	0	0	71	0	0	0	0	0	0	71
Northern	**0 (0)**	**0 (0)**	**25 (64.1)**	**8 (10.7)**	**0 (0)**	**23 (40.4)**	**48 (10.7)**	**24 (80.0)**	**0 (0)**	**8 (27.6)**	**1 (20.0)**	**1 (6.7)**	**1 (20.0)**	**139**
Bombali	0	0	0	5	0	0	25	0	0	1	0	0	0	31
Falaba	0	0	2	1	0	2	8	16	0	0	0	0	1	30
Koinadugu	0	0	22	1	0	6	5	1	0	0	0	1	0	36
Tonkolili	0	0	1	1	0	15	10	7	0	7	1	0	0	42
Northwest	**1 (50)**	**0 (0)**	**0 (0)**	**5 (6.7)**	**0 (0)**	**1 (1.8)**	**91 (20.3)**	**0 (0)**	**0 (0)**	**1 (3.4)**	**1 (20.0)**	**6 (40.0)**	**0 (0)**	**106**

Kambia	1	0	0	2	0	0	13	0	0	1	0	5	0	22
Karene	0	0	0	3	0	1	31	0	0	0	1	0	0	36
Port Loko	0	0	0	0	0	0	47	0	0	0	0	1	0	48
Southern	**1 (50)**	**1 (100)**	**14 (35.9)**	**4 (5.3)**	**4 (100)**	**16 (28.1)**	**115 (25.6)**	**6 (20.0)**	**21 (100)**	**14 (48.3)**	**2 (40.0)**	**7 (46.7)**	**4 (80.0)**	**209**
Bo	1	0	12	4	4	4	0	0	21	12	0	3	4	65
Bonthe	0	0	0	0	0	0	39	0	0	0	0	0	0	39
Moyamba	0	0	0	0	0	0	36	0	0	0	2	2	0	40
Pujehun	0	1	2	0	0	12	40	6	0	2	0	2	0	65
Western	**0 (0)**	**0 (0)**	**0 (0)**	**21 (28.0)**	**0 (0)**	**0 (0)**	**1 (0.2)**	**0 (0)**	**0 (0)**	**3 (10.3)**	**0 (0)**	**1 (6.7)**	**0 (0)**	**26**
Western Rural	0	0	0	21	0	0	1	0	0	3	0	1	0	26
Grand Total	**2 (0.3)**	**1 (0.1)**	**39 (5.3)**	**75 (10.2)**	**4 (0.5)**	**57 (7.8)**	**449 (61.3)**	**30 (4.1)**	**21 (2.9)**	**29 (4.0)**	**5 (0.7)**	**15 (2.0)**	**5 (0.7)**	**732 (100)**

BCS=Biological control systems; CF=contract farming; CR=Crop rotation; FAT=Fertilizer application technique; IPM=Integrated pest management; IC=inter cropping; LP=land preparation. Values in brackets are percentages per region

Table 11. Perception of smallholder farmers on adaptation strategies to ameliorate climate change

Region/District	AI	CCC	CPD	CRS	ISCT	IRS	IWC	MC	Others	PTSS	Use drought early maturing crop varieties	Use other varieties	Grand Total
Eastern	**0 (0)**	**1 (5.3)**	**10 (19.6)**	**0 (0)**	**0 (0)**	**1 (14.3)**	**0 (0)**	**63 (54.3)**	**1 (25.0)**	**0 (0)**	**0 (0)**	**1 (25.0)**	**77**
Kailahun	0	1	3	0	0	1	0	55	1	0	0	0	61
Kenema	0	0	7	0	0	0	0	0	0	0	0	1	8
Kono	0	0	0	0	0	0	0	8	0	0	0	0	8
Northern	**0 (0)**	**1 (5.3)**	**20 (39.2)**	**9 (52.9)**	**1 (33.3)**	**2 (28.6))**	**6 (75.0)**	**17 (14.7)**	**0 (0)**	**1 (1.9)**	**3 (75.0)**	**0 (0)**	**60**
Bombali	0	0	0	0	0	0	0	0	0	0	0	0	0
Falaba	0	0	4	1	0	1	6	0	0	1	1	0	14
Koinadugu	0	1	16	6	0	1	0	8	0	0	0	0	32
Tonkolili	0	0	0	2	1	0	0	9	0	0	2	0	14
Northwest	**1 (100)**	**1 (5.3)**	**5 (9.8)**	**0 (0)**	**1 (33.3)**	**0 (0)**	**2 (25.0)**	**25 (21.6)**	**0 (0)**	**7 (13.2)**	**1 (25.0)**	**1 (25.0)**	**44**

Kambia	0	0	0	0	0	0	0	0	0	0	0	0	0
Karene	0	0	0	0	0	0	0	3	0	0	0	0	3
Port Loko	1	1	5	0	1	0	2	22	0	7	1	1	41
Southern	**0 (0)**	**16 (84.2)**	**16 (31.4)**	**8 (47.1)**	**1 (33.3)**	**4 (57.1)**	**0 (0)**	**11 (9.5)**	**3 (75.0)**	**45 (84.9)**	**0 (0)**	**2 (50.0)**	**106**
Bo	0	0	0	6	1	3	0	2	1	44	0	0	57
Bonthe	0	0	1	0	0	1	0	2	0	1	0	0	5
Moyamba	0	16	15	0	0	0	0	0	1	0	0	2	34
Pujehun	0	0	0	2	0	0	0	7	1	0	0	0	10
Western	**0(0)**	**0 (0)**	**0 (0)**	**0 (0)**	**0 (0)**	**0 (0)**	**0 (0)**	**0 (0)**	**0 (0)**	**0 (0)**	**0 (0)**	**0 (0)**	**0**
Western Rural	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	**1 (0.3)**	**19 (6.6)**	**51 (17.8)**	**17 (5.9)**	**3 (1.0)**	**7 (2.4)**	**8 (2.8)**	**116 (40.4)**	**4 (1.4)**	**53 (18.5)**	**4 (1.4)**	**4 (1.4)**	**287 (100)**

AI=adoption of irrigation; CCC=change of cropping calendar; CPD=change planting dates; CRS=crop rotation system; ISCT=implement soil conservation techniques; IRS=improved resistant varieties; IWC=increase water conservation; MC=mixed cropping; PTSS=plant trees for shading and shelter. Values in brackets are percentages per region

Table 12. Perception of smallholder farmers on the adverse effects of climate change

Region/District	Increase Flooding	Increase Drought	Disease Incidence	Reduce Crop Productivity	Food Insecurity	Erratic Rainfall	Difficulty in Predicting Planting Dates	Grand Total
Eastern	**212 (51.0)**	**201 (47.2)**	**157 (49.8)**	**141 (35.6)**	**73 (29.9)**	**79 (23.9)**	**160 (59.0)**	**1023**
Kailahun	65	50	35	57	34	32	9	282
Kenema	91	89	74	27	3	18	91	393
Kono	56	62	48	57	36	29	60	348
Northern	**64 (15.4)**	**79 (18.5)**	**64 (20.3)**	**111 (28.0)**	**68 (27.9)**	**88 (26.7)**	**61 (22.5)**	**535**
Bombali	0	17	25	26	25	1	1	95
Falaba	4	13	4	18	6	25	11	81
Koinadugu	28	21	4	31	1	28	21	134
Tonkolili	32	28	31	36	36	34	28	225
Northwest	**45 (10.8)**	**60 (14.1)**	**32 (10.2)**	**55 (13.9)**	**36 (14.8))**	**64 (19.4)**	**3 (1.1)**	**295**
Kambia	2	14	12	7	9	4	2	50
Karene	3	8	8	11	6	12	0	48
Port Loko	40	38	12	37	21	48	1	197
Southern	**90 (21.6)**	**80 (18.8)**	**60 (19.0)**	**87 (22.0)**	**67 (27.5)**	**97 (29.4)**	**45 (16.6)**	**526**

Bo	24	6	12	4	9	19	2	76
Bonthe	27	21	17	28	18	27	1	139
Moyamba	25	38	18	32	16	35	31	195
Pujehun	14	15	13	23	24	16	11	116
Western	**5 (1.2)**	**6 (1.4)**	**2 (0.6)**	**2 (0.0)**	**0 (0)**	**2 (0.6)**	**2 (0.7)**	**19**
Western Rural	5	6	2	2	0	2	2	19
Grand Total	**416 (17.3)**	**426 (17.8)**	**315 (13.1)**	**396 (16.5)**	**244 (10.2)**	**330 (13.8)**	**271 (11.3)**	**2398 (100)**

Values in brackets are percentages per region

Table 13. Perception of smallholder farmers on major changes in weather across regions

Region/District	Floods	Prolonged droughts	Intermittent drought	Very hot seasons	Very wet seasons	No Change	Grand Total
Eastern	**188 (42.5)**	**172 (64.7)**	**135 (31.5)**	**161 (33.1)**	**35 (22.2)**	**2 (14.3)**	**693**
Kailahun	74	19	13	64	27	1	198
Kenema	100	82	51	26	0	1	260
Kono	14	71	71	71	8	0	235
Northern	**49 (11.1)**	**47 (17.7)**	**109 (25.4)**	**98 (20.2)**	**23 (14.6)**	**0 (0)**	**326**
Bombali	0	4	27	30	0	0	61
Falaba	1	9	30	1	0	0	41
Koinadugu	27	12	20	34	1	0	94
Tonkolili	21	22	32	33	22	0	130
Northwest	**52 (11.7)**	**16 (6.0)**	**78 (18.2)**	**100 (20.6)**	**29 (18.4)**	**2 (14.3)**	**277**
Kambia	7	7	10	22	0	0	46
Karene	6	5	24	31	5	2	73
Port Loko	39	4	44	47	24	0	158
Southern	**147 (33.2)**	**29 (10.9)**	**103 (24.0)**	**105 (21.6)**	**56 (35.4)**	**9 (64.3)**	**449**
Bo	57	1	0	0	25	4	87
Bonthe	29	22	23	30	4	1	109
Moyamba	16	4	34	22	1	0	77
Pujehun	45	2	46	53	26	4	176

Western	**7 (1.6)**	**2 (0.8)**	**4 (0.9)**	**22 (4.5)**	**15 (9.5)**	**1 (7.1)**	**51**
Western Rural	7	2	4	22	15	1	51
Grand Total	**443 (24.7)**	**266 (14.8)**	**429 (23.9)**	**486 (27.1)**	**158 (8.8)**	**14 (0.8)**	**1796 (100)**

Values in brackets are percentages per region

Findings on the perception of smallholder farmers on the main impacts on major changes in weather over the last 10 years is presented in Table 14. Generally, majority (91.5%) of the respondents revealed crop failure as the main impact on major changes in weather over the last 10 years, whereas 0.7% of the respondents opined that livestock deaths is the lowest impact on major changes in weather over the last 10 years. Across the sampled regions, eastern province (37.6%) contributed the highest proportion of smallholder farmers that revealed crop failure as the main impact on major changes in weather over the last 10 years, whilst respondents of the western area (3.6%) contributed the lowest to this notion.

Table 14. Main impacts of major changes in weather over the last 10 years

Region/District	Crop failure	Food insecurity	Human disease outbreak	Livestock deaths	Grand Total
Eastern	**252 (37.6)**	**0 (0)**	**0 (0)**	**0 (0)**	**252**
Kailahun	79	0	0	0	79
Kenema	102	0	0	0	102
Kono	71	0	0	0	71
Northern	**138 (20.6)**	**0 (0)**	**0 (0)**	**1 (20.0)**	**139**
Bombali	31	0	0	0	31
Falaba	30	0	0	0	30

Koinadugu	35	0	0	1	36
Tonkolili	42	0	0	0	42
Northwest	**95 (14.2)**	**8 (19.0)**	**1 (6.7)**	**2 (40.0)**	**106**
Kambia	20	2	0	0	22
Karene	34	1	1	0	36
Port Loko	41	5	0	2	48
Southern	**161 (24.0)**	**34 (81.0)**	**12 (80.0)**	**2 (40.0)**	**209**
Bo	52	1	12	0	65
Bonthe	38	0	0	1	39
Moyamba	39	1	0	0	40
Pujehun	32	32	0	1	65
Western	**24 (3.6)**	**0 (0)**	**2 (13.3)**	**0 (0)**	**26**
Western Rural	24	0	2	0	26
Grand Total	**670 (91.5)**	**42 (5.7)**	**15 (2.1)**	**5 (0.7)**	**732 (100)**

Values in brackets are percentages per region

7.0 Conclusions

This study demonstrated that the perceptions of smallholder farmers on climate change, its effects, impacts, adaptation and intervention strategies varied among regions of Sierra Leone. The eastern province contributed highest to the notions that climate change is due to human causes, lack of knowledge on climate change adaptation strategy, lack of climate hazard warning and information from any central authority. Its effects and impacts include variability in the onset and cessation of rains, difficulty to predict planting date, low crop yield, crop failure, very severe crop losses, very hot seasons, intermittent and prolonged droughts, increased drought, flooding, disease incidence, food insecurity and reduced crop productivity. One of the key intervention technologies used by smallholder

farmers to ameliorate climate change is land preparation. The western area opined the lowest to these notions. Moreover, the southern and eastern provinces established that the critical stages of crop loss were vegetation and reproductive stages, respectively, whereas the northern province and the western area opined lowest on this notion, respectively. Information on such regional variability on climate change will guide climate change intervention strategies needed for implementation at regional level. Most of the smallholder farmers in Sierra Leone were not aware of climate change interventions and support systems. The smallholder farmers experienced a serious lack of information that would help them to adapt and improve their farming systems. As a result, some of the farmers adapted to the changing climate using information shared among themselves and their indigenous knowledge systems.

8.0 Recommendation

Based on the results obtained in this study, the following recommendations can be deduced:

i. There is need to bring awareness of climate change, its effects on crop and animal production, implications and adaptation strategies to the farmers. This campaign is needed most in the eastern, southern and northern provinces.

ii. Indigenous knowledge system-based climate change support and interventions should be provided to empower farmers with capacity to withstand climate change challenges.

iii. There is need to include climate change interventions on the agenda of the ministry of agriculture and forestry, agricultural research institutions and agricultural universities so that extension officers are adequately trained and equipped to enable them to assist farmers.

iv. The government should also invest in smallholder farmers skill audits programme, provide farming inputs such as good quality seeds and seedlings that are climate resilient in the long run, so that these farmers graduate from just being subsistence farmers and food producers to commercial farmers.