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The Effects of Bushfires on Farming Industry Among Small-Scale Farmers in Kori Chiefdom, Moyamba District, Sierra Leone

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Abstract: This study analyzed the effect of bush burning on the smallholder farming industry in Kori Chiefdom. The researchers used a structured questionnaire to obtain primary data from three hundred and eighty-four (384) farmers who were selected through a combination of multi-stage and simple random techniques. Cochran's (1977) scientific formula was adopted in selecting the sample size for this research. Descriptive statistics were used to analyze the data. The result indicates that, 56% of the respondents are male, and 59% of the farmers ages fell between 31 and 40 years. Farmers are highly affected by bush burning in 2019 and 2020, with 27.1% and 21%, respectively. Some of the crops the fire destroyed were cassava, groundnuts, pineapples, pepper, and parboiled rice. Land clearing (21.4%) was identified as the major root cause of fire outbreaks, and (34.8%) of the respondents admitted to the practice of bush burning for 1–10 years. The majority of the farmers claimed to have lost household assets valued at NLe1,000 and below, (53.2%) of the respondents accepted the fact that burning creates devastation for agricultural products. The study further showed that 60.9% of the respondents indicated that a lack of fire equipment that can help reduce the spread of fire was one of the main constraints facing their communities in controlling a wide fire outbreak. The study recommended that the town chief in those communities should enforce legislation, local laws should be made against uncontrolled bush burning. The government and international non-governmental organizations should help by providing bushfire equipment and training at the community level, which will help prevent the spread of bushfires if they occur.

Keywords: Agricultural, Bushfire, Community, Farmers, Government, Household, Kori Chiefdom, Smallholder

1. Introduction

Fire has been a close ally of humans for preparing the soil for farming, gathering, and hunting since the beginning of time [1]. Oxygen, fuel (such as plants), and heat sources like illumination, sparks from rock falls, and/or meteorite impacts, however, all contribute to the existence of fire. In African, burning has evolved into the simplest and most practical approach that is frequently used by most people who live in rural areas to carry out their farming activities, as more land is cleared and readied for cultivation, hunting, and animal grazing. According to Ojochenemi et al., (2019), scientists

estimate that people burn over 90 percent of all biomass, with only a minor portion of biomass burning coming from natural fires [2]. The fire typically goes unchecked well beyond the boundaries of the farmlands, destroying nearby wooded or forested areas as well as towns and villages on occasion.

Jamala et al. (2012), claims that bush burning has a negative effect on soil conditions and soil may take much longer to recover [3]. Bush burning method invariably causes the soil to heat up and dry out, destroying the savannah environment in the process. All fires change the biotic, physical, moisture, and temperature features of the soil component, regardless of whether they are produced by a natural disaster or human activity [4]. The effects of biomass burning on the climate are clearly bad. Our lives are significantly impacted by the climate. Today, bush burning is one of the causes of global warming, which is a worldwide issue that affects farmers negatively in their crops cultivations. According to research finding, burning biomass releases greenhouse gases (GHGs) like CO_2, CH_4, and N_2O [5].

Smallholder farmers utilize burning to convert forested land into agricultural land for growing crops and raising livestock [1]. Bush burning is a technique used to burn away natural vegetation from the soil's surface in order to remove it. Hunting, harvesting, improving pasture for grazing animals, managing forests, and improving the flora and fauna in ecosystems that depend on fire for their survival are all benefits of agricultural bush burning (i.e., fire-existence ecosystem). However, the negative impacts of fire can be brought on by human activity that is natural, intentional, unintentional, or careless, and they can have terrible effects on agriculture, the environment, and human livelihood.

Small-scale farmers (SSF) are crucial to the food and nutrition security of most developing nations, including Sierra Leone. Fire is used in various regions of the world, such as Brazil, to harvest crops like sugar cane [1]. Despite its uses, fire has a terrible impact on the globe, destroying everything from agriculture to industry to deteriorating human health. It is currently a significant concern for many nations and is changing the composition and distribution of ecosystems [6].

Agriculture is a broad term used to describe the raising of domesticated animals for use in markets and the production of crops for human use. According to Luca T (2003), a variety of disciplines and activities are engaged in agriculture sector, including livestock management, domestication, horticulture, arboriculture, and viticulture [7]. These are combined to cultivate crops, livestock, farming, pastoralism, and transhumance.

Trees, crops, and animals suffer severe harm as a result of bush burning. Since their repercussions are of public importance, handling them should not be left to farmers alone and should be taken seriously [8]. The majority of fires in Sierra Leone are intentionally started for a variety of reasons, including slash and burn practices in agricultural farms. When a piece of land is used up, farmers go over to another plot, where they brush the land during the start of the dry

season in January and February in order to make room for the planting of their crops. They set the dried plant matter on fire when it has dried. These fires are most common in March and April, just before the start of the crop season in Sierra Leone. Towns, villages, and other properties could unintentionally catch fire as a result of the habit of farmers burning their farmland for planting preparation. The fertility of the soil is noticeably affected when farmland is burned for the purpose of growing crops, this will lead to low agricultural productivity and shortage of agricultural products in the market.

In this study, we aim to explore and understand the impacts of bushfires on the agricultural landscape, the challenges faced by small-scale farmers, and the potential strategies to mitigate these effects. By shedding light on this topic, we hope to contribute to the knowledge base surrounding bushfires and their repercussions on the farming industry, ultimately assisting in the development of sustainable solutions for the affected farmers. This research has shed light on the significant effects of bushfires on the farming industry among small-scale farmers in Kori Chiefdom, Moyamba District, Sierra Leone.

The research findings reveal that these farmers face numerous challenges, including crop loss, reduced soil fertility, financial strain, and decreased food security. However, through our exploration, we have also identified potential solutions to mitigate these effects. By implementing community-based fire management strategies, promoting awareness and education, establishing early warning systems, and adopting improved agricultural practices, it is possible to enhance the resilience and adaptive capacity of small-scale farmers in the face of bushfires.

This research calls for further attention and support from stakeholders, policymakers, and local communities to address the pressing issue of bushfire impacts on the farming industry. Only through collaborative efforts that we can foster sustainable development, protect the livelihoods of small-scale farmers, and ensure the long-term prosperity of the farming industry in Sierra Leone.

This study makes several significant contributions to the field of research, specifically in the context of the effects of bushfires on the farming industry among small-scale farmers. The contributions of this research are as follows:

This study generates new knowledge and understanding of the specific impacts of bushfires on small-scale farmers in the study area. By documenting the challenges faced by farmers, such as crop loss, reduced soil fertility, financial strain, and decreased food security, this research fills a gap in knowledge regarding the localized effects of bushfires on the farming industry.

The research identifies potential strategies to mitigate the effects of bushfires on farming in Sierra Leone. It emphasizes the importance of context-specific approaches, such as community-based fire management strategies, early warning systems, and improved agricultural practices. These findings contribute to the development of tailored interventions that can effectively address the challenges faced by small-scale

farmers in the study area.

The research findings provide valuable insights for policymakers and decision-makers in the agricultural sector. By highlighting the impacts of bushfires on the farming industry and suggesting mitigation strategies, this research can inform the development of policies and interventions that prioritize the resilience and well-being of small-scale farmers. It also emphasizes the need for collaborative efforts between government, community organizations, and farmers to address the issue effectively.

This research establishes a foundation for future studies on the effects of bushfires on the farming industry in similar contexts. The identified research gaps and the insights gained from this study can guide future research efforts, allowing for a more comprehensive understanding of the topic and the development of innovative solutions.

Overall, this study contributes to the field of research by providing new knowledge, context-specific solutions, policy implications, and a foundation for future studies. It enhances our understanding of the effects of bushfires on the farming industry among small-scale farmers in Kori Chiefdom, Moyamba District, Sierra Leone and supports efforts to develop sustainable strategies for the agricultural sector.

1.1. Statement of the Problem

In Sierra Leone, unrestrained and careless bush burning has become a yearly occurrence throughout the dry seasons. This is brought on by human endeavours including farming, hunting, and looking for fresh forage for cattle to eat. The resources of the forest and the fauna are seriously harmed by fire. According to Barnabas et al., (2019), all of the crops, animals, microorganisms, insects, birds, reptiles, and mammals that are beneficial have been wiped off [9]. Among these animals, the pollinators and decomposers are especially important. As a result, their extinction upsets the natural balance of the entire habitat. The study area's principal adverse consequences of bush burning have a big socioeconomic impact on the growth and development of the local communities.

The research area's vegetation environment has been impacted in a number of ways by indiscriminate bush burning. The livelihood and survival of both the current and future generations will be in jeopardy if suitable measures are not implemented to stop and control bush burning in the area. Every year, wildfires start, and the majority of them devastate infrastructure, plantation farms, and residential buildings. The long-term effects of unchecked veld fires include a decrease in bio-diversity due to the extinction of flora and fauna, a decrease in soil fertility, an increase in erosion rates and a reduce in infiltration, all of which result in less water for people, livestock, irrigation, fish, and other wildlife. Bush burning is, however, accused of compartmentalizing the soil, lowering crop yields, and allowing invasive species to flourish [10]. Bush fire can have a negative impact on the environment, home farmers' ability to make a living, and agricultural output [11]. According to the researchers' knowledge, no empirical research has been

conducted in this study area to establish how bush burning impacts the farming industry. This study's objective is to assess how bush burning can impact the small-scale farming industry in the Kori Chiefdom, Moyamba District, in the Southern Province of Sierra Leone.

1.2. Significance of the Study

In Sierra Leone, the majority of people work in small-scale agriculture. Given that bush burning is a common method of field preparation, it is crucial to investigate how bush burning affects small-scale farmers as well as how it has impacted agricultural land and farming operations in the study areas. This research will help identify potential alternatives to bush burning. Although numerous studies on how bush burning activities affect people's livelihoods and their security of livelihood have been conducted in various countries, no empirical study has been done to determine how small-scale farmers in the study areas are affected by bush burning in the farming sector.

The researchers believe it is imperative to conduct a study in order to fill this important missing knowledge gap because it has been unknown for a while whether or not the impacts of bush burning on the farming industry among small-scale farmers increased productivity in the study area. All stakeholders, including universities, private research institutions, the government, and nongovernmental organizations (NGO's) concerned with wildfire outbreaks will find value in this study, and it will also serve as a resource for students (references).

1.3. Aim and Objectives of the Study

The broad aim of the study is to assess the effects of bush burning on small-scale farmers in Kori Chiefdom, Moyamba District, in Southern Province, Sierra Leone.

The specific objectives of the study are to:
1) Describe the demographic and socioeconomic characteristics of the selected farmers in the study areas.
2) Identify the causes of wildfire breakout that affect agricultural activities in the study area.
3) Examine the impact of bush burning on the agricultural industry in the study area.

1.4. Research Questions

The general research question of the study is: how does bush burning affects small-scale farmers? Based on this, the following research questions are to be answered:
1) What are the demographic and socioeconomic characteristics of the farmers that determine the wildfire outbreak?
2) What are the causes of the wildfire outbreak in the study area?
3) What are the impacts of bush burning on farming industry among small-scale farmers in the study area?

1.5. Study Hypothesis

The following hypothesis was drawn from the research

questions of the study:

H0: there is no significant effect of bush burning on farming industry among small-scale farmers.

H1: there is a significant effect of bush burning on farming industry among small-scale farmers.

1.6. Scope of the Study

The study was conducted in Kori Chiefdom, Moyamba District, due to the wide spread of agricultural land burning among small-scale farmers in the study area. This research is applicable because farmers are more affected by the burning of agricultural farm land for cultivation.

1.7. Purpose of Study

Bush fire is becoming an integral component of what farmers do in this region. Negative consequences are not at all taken into account. Therefore, it is significant to draw attention to these so that farmers may personally experience and see how damaging bush fire affects the land in general.

2. Materials and Methods

2.1. Description of Study Area

The study area is Kori Chiefdom, located in Moyamba District in the Southern Province of Sierra Leone. It is one of the fourteen (14) chiefdoms in the district, located in the north of the district, with Taiama as the Chiefdom headquarter town [13]. The chiefdom is bounded by five (5) other chiefdoms in the district, namely, Yoni, Fakunya, Kaiyamba, Dasse, and Kamajei. The study area has a total land area of 662.9 km^2. The result of the 2015 national population census put the total population of Kori Chiefdom at 30,514 population density [12]. The ethnic groups of the study area are largely homogeneous, with the Mende forming 65% of the population; the other ethnic groups comprise Fullah, Sherbro, Temne, and Loko. The most commonly practiced religions in the study area are Islam and Christianity [13, 14]. Farming is the predominant occupation of the inhabitants in the study areas. The target population for this study is all small-scale farmers' household heads or representatives in farm-households in Kori Chiefdom.
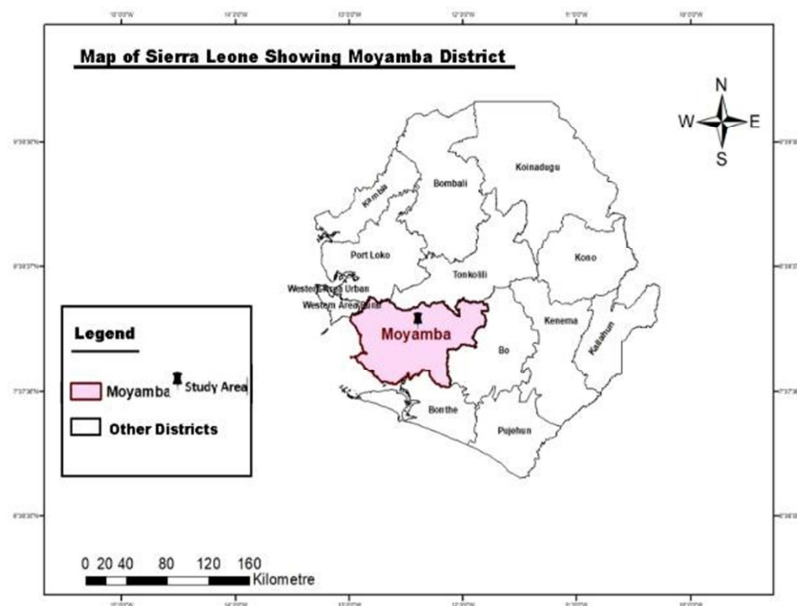

Figure 1. Map of Sierra Leone Showing Moyamba District.

Figure 2. Map of Moyamba District Showing Study Area.

2.2. Sampling Techniques

The researchers used a multiple-stage random sampling method. In the first stage, a purposive sampling technique was adopted in selecting eighteen (18) villages in Kori Chiefdoms (which include Mokonde, Mosongo, Jolohun, Kangahun, Kondebotihun, Semabu, Bonganema, Foya, Mongoro, Waima, Lago, Mokaba, Mambayema, Ndabu, Vaama, Yandu, Fogbo, and Manjehun) in the study area because of the high concentration of farmers in those areas, as well as the prevalence of bush burning activities in those communities. Twenty-four (24) farmers from each of those villages were randomly chosen as responders in the second stage of the study. The Cochran (1977) formula was used to determine the sample size, which results in a total of three hundred and eighty-four (384) respondents.

$$n_0 = \frac{z^2 pq}{e^2} \qquad (1)$$

where, n_0 is the sample size, z is the selected critical value of desired confidence level (which is found in the z table), p is the estimated proportion of an attribute that is present in the population, q = 1 − p and e is the desired level of precision (i.e., the margin of error) [15, 16].

For this study, researchers assume the maximum variability is equal to 50% (*p* = 0.5) and taking 95% confidence level with ±5% precision, the calculation for required sample size will be as follows: *p* =0.5 and hence q=1− 0.5; e=0.05; z=1.96

$$n_0 = \frac{(1.96)^2 (0.5)(0.5)}{(0.05)^2} = 384.16 \; = 384$$

Therefore, the population we are interested in studying for this research is a random sample of 384 small farmer households. Age (young and old), sex (men and women), and enterprise (crop farmers and mixed farmers) were all represented in the sample.

The primary data for the study were gathered by means of a structured questionnaire, and secondary data, which were typically other studies on the consequences of wildfire outbreaks on small-scale farmers in developing nations throughout time, were used in this investigation. Among other things, academic journals, newspapers, Google Scholar, novels, and magazines were used as data sources. To have a deeper understanding of the subject, each piece was thoroughly read and critically examined.

2.3. Methods of Data Analysis

The statistical models, such as tables, charts, and graphs, were used to analyses and show the field data. Both qualitative and quantitative methodologies were employed in order to get a suitable balance of data analysis. This is done to guarantee that the research is relevant in all respects and that the results and suggestions are appropriate. All calculations, charts, and other statistical analyses were performed using Excel and the SPSS (Statistical Package for Social Sciences).

3. Results and Discussion

3.1. Socio-Economic and Demographic Characteristics of Respondents

The field study results are presented in this part in connection to the socioeconomic and demographic details of the survey respondents. Age, sex, marital status, level of education, household size, farm size, farming experience, agricultural extension services, and participants' occupation are all categories of particular interest to the researchers under this section. These topics are further described below.

3.1.1. The Socio-Economic Characteristics of Respondents

The marital status, family size, farm size, farming experience, and agricultural extension services of the respondents was investigated, and the results are represented in table 1 below.

Table 1. *Distribution of Respondents according to their Socio-Economic Characteristics.*

Variables	Frequency	Percentage
Single	102	26.6
Divorced	215	55.9
Marital Status		
Widowed & Widower	43	11.2
Total	384	100
Family Size		
1–5	128	33.3
6–12	186	48.4
12 and above	70	18.3
Total	384	100
Farm Size		
0.1–1.00	126	33
1.01–1.50	102	26.5
1.51–2.00	89	23.1
2.00 and above	67	17.4
Total	384	100
Farming Experience		
1–10	132	34.4
11–20	112	29.2
21–30	90	23.4
32 and above	50	13
Total	384	100
Agricultural Extension Services		
>1	142	37
1	52	13.5
2	84	21.9
3	106	27.6
Total	384	100

Data Source: Field survey, March, 2023

According to table 1 results of the respondents' gender distribution, 215 (56%) of the farmers were married, 102 (26.6%) were single, 43 (11.2%) were widowed or widowers, and 24 (6.3%) were divorced. Similarly, Abdul Salami Bah et al. (2022) noted this [13]. Farmers' livelihoods can be significantly boosted or improved by taking responsibility in their farming households. Married couples give partners

access to a variety of amenities and possibilities in remote villages [13, 17].

Families of 6 to 12 people made up the bulk of respondents (48.4%), while families of 12 or more people made up the least percentage of respondents (17.4%). This finding suggests that there are many households in the research area. According to Bah et al. (2022), large household sizes emerge as a crucial contributor to labour availability [13]. The study highlights that farmers actively embrace large-scale production on their farms, capitalizing on the advantages offered by abundant manpower. This not only enhances productivity but also promotes efficient resource allocation, fostering sustainable agricultural practices.

The bulk of responders (33%) stated that they had one hectare or less. According to the farming experience question, 34.4 percent of the respondents had between one and ten years' worth of farming experience, and 13% had more than 31 years. In the end least, Table 1 showed that the vast majority (37 percent) of respondents had never contacted the agent(s) providing agricultural extension services. The remainder, or 27.6%, stated that they had three or more extension services.

3.1.2. Sex Distribution

The results of the investigation of the respondents' sexes are shown in figure one below.
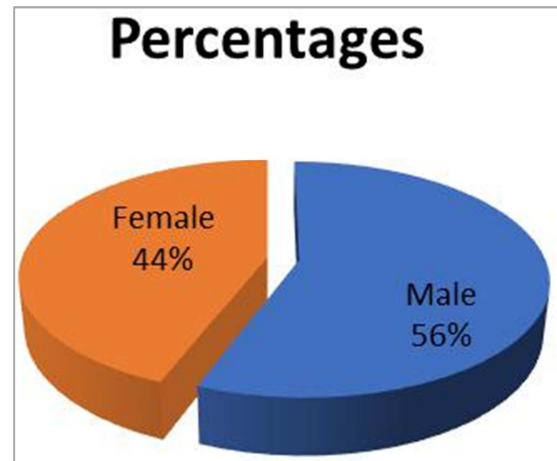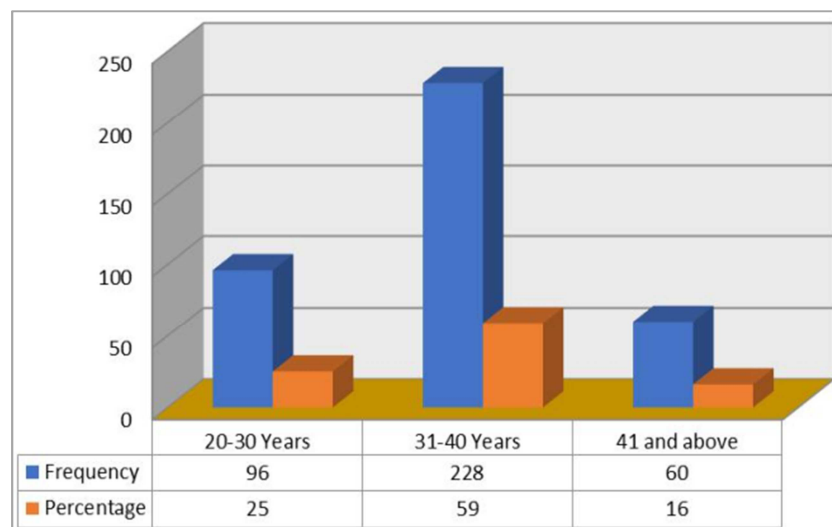

Figure 3. *Sex Distributions of Respondents.*

Data Source: Field survey, March, 2023 Figure 3: Sex Distributions of Respondents

In terms of respondents' gender, 215 (56 percent) were men, while just 169 (or 44 percent) were women. This means that men are more engaged in farming than women. This suggests that men are disproportionately overrepresented in the farming industry.

3.1.3. Age Distribution

The age of the respondents was equally important and was investigated; the findings are presented in figure 4 below.

Data Source: Field survey, March, 2023
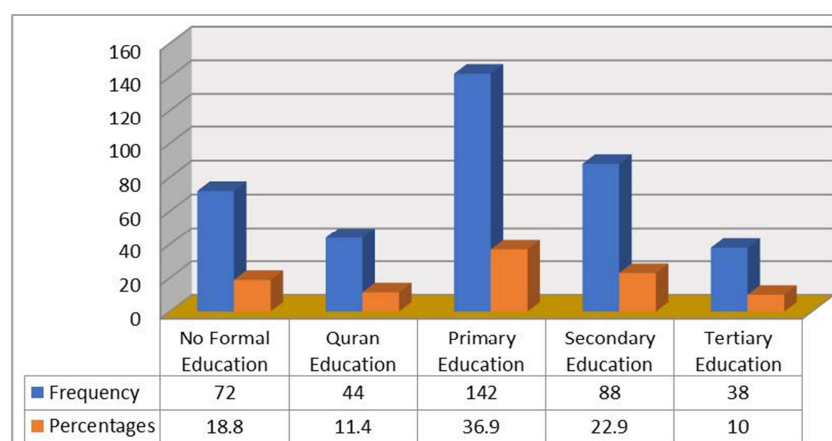
Figure 4. *Age Distributions of Respondents.*

According to the data in figure 4, the majority of respondents (228, or 59%), are between the ages of 31 and 40, followed by 96 respondents (25%), who are between the ages of 20 and 30, and 60 respondents (16%), who recorded an age of 41 years or higher. However, the farmers' average age of 59% suggests that young people (ages 31 to 40) were heavily involved in farming operations in most villages. This may be due to the requirement for hard labour in rural areas for such activities. The majority of our farming operations in Sierra Leone include a labour-intensive system. According to Abdul Salami Bah et al. (2022), a similar suggestion is made. According to him, the type of agricultural activity or activities to be engaged in would depend on the workforce's age distribution of farmers, as reported by Abdul Salami Bah et al. (2022).

3.1.4. Educational Status

The educational status of the respondents was investigated,

and the results are represented in figure 5 below.

	No Formal Education	Quran Education	Primary Education	Secondary Education	Tertiary Education
■ Frequency	72	44	142	88	38
■ Percentages	18.8	11.4	36.9	22.9	10

Data Source: Field survey, March, 2023

Figure 5. *Educational Status Distributions of Respondents.*

According to figure 5 findings, 36.9% of the respondents had only completed their primary school, 88 (22.9%) had completed their secondary school, only 11.4 percent of respondents indicated they had received Quranic instruction, while 18.8 percent said they had never attended a formal school, and 38 (10%) had certificates or higher degrees in Agriculture Science. Research conducted by Onoja et al., (2011) demonstrates that individuals with higher levels of education exhibit a greater inclination to embrace new technologies and innovations expeditiously [18]. This finding highlights the pivotal role of education in cultivating a receptive mindset towards emerging advancements. By actively embracing new technologies, educated individuals not only contribute to their own personal growth but also drive societal progress, fostering a culture of innovation and facilitating the rapid adoption of transformative solutions. Farmers with educational backgrounds can also raise agricultural output by using their innovative ideas, which can increase the supply of agricultural goods available for sale in the markets.

3.1.5. Occupation of Respondents

The occupational status of respondents was also investigated and presented in table 2 below.

Table 2. *Distributions of Respondents Occupation in the research area.*

Variable	Yes		No	
	Frequency	Percentage	Frequency	Percentage
Agriculture Activities				
Crop Cultivation/Farming	368	95.8	16	4.2
Cassava Processing (Gari, Fufu)	153	39.8	231	60.2
Fishing	85	22.1	299	77.9
Hunting	343	89.3	41	10.7
Rearing of Livestock Non-Agriculture	332	86.5	52	13.5
Activities Trading/Business	362	94.3	22	5.7
Teachers	64	16.7	320	83.3
Other Government Workers	41	10.7	343	89.3
Bike Riders/Drivers	184	47.9	200	52.1

Data Source: Field survey, March, 2023

The occupation of each respondent is shown in the table 2 above, with the majority (368, or 95.8%) working in crop production or farming in the study region. 343 (89.3%) of the respondents also hunt, it was further discovered. 86.5%, or 332 respondents, were involved in raising animals such chickens, pigs, cows, goats, and sheep. In addition, 299 respondents (77.9%) said they never go fishing. According to the report, 231 (60.2%) of the farmers did not process their cassava. Some of the respondents stated that they typically sell cassava by bag once their crops have been harvested on the farm and have reached the harvest stage.

In the study area, trading and commerce were seen as commonplace activities. The majority of respondents 362 (94.3%) engaged in petty trading, while 22 (5.7%) never engaged in it. Additionally, it was shown that 64 respondents (16.7%) rely solely on income from teaching professions,
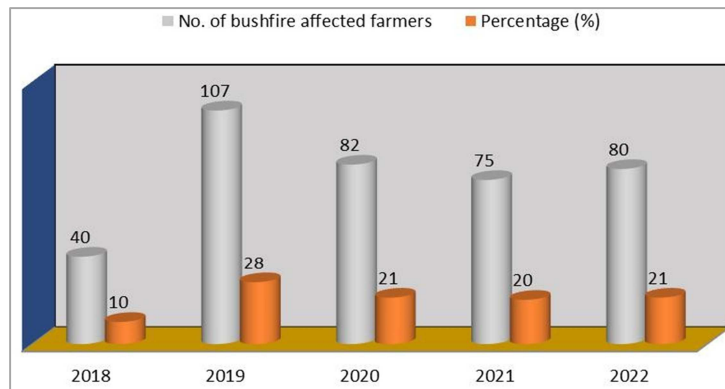
compared to 320 respondents (83.3%) who never work as teachers. According to the study, 343 (89.3%) of the respondents had no other government or INGO jobs, while 41 (10.7%) of the respondents worked at Njala University and other local NGOs to pay their bills and support their families.

In conclusion, 184 (47.9%) of the respondents reported engaging in transportation business (riding a bike or driving a car) as a livelihood activity, whereas 200 (52.1% of the respondents) reported not engaging in such activities to earn their survival in the research region. This study provides substantial support for the recommendation put forth by Aluko et al. (2019), who conducted a closely related study.

3.2. Respondents Experience on Bush Burning

This section presents the finding of the research on respondents' experience on bush burning. Areas of particular interest were respondents experience on bush burning, causes of bushfires and number of farms destroyed by bush burning.
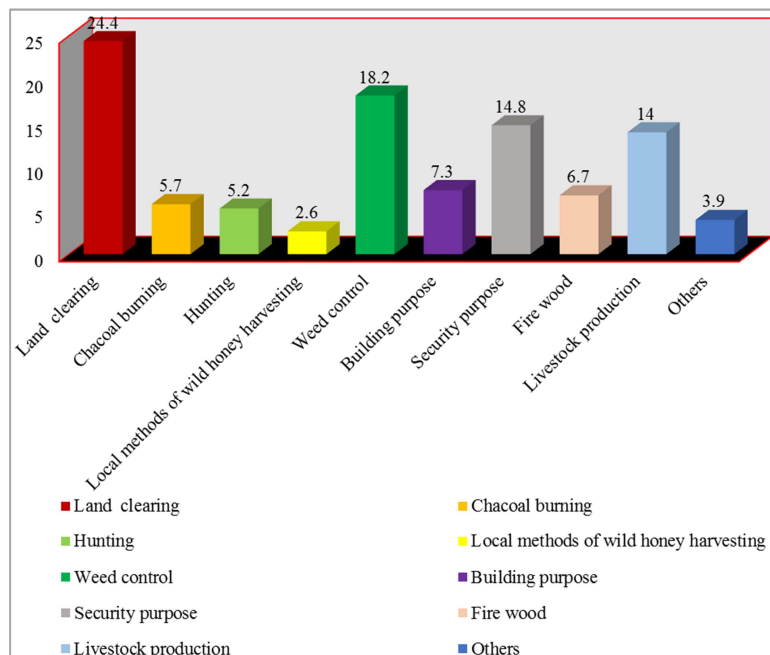

Data Source: Field survey, March, 2023

Figure 6. Respondent's experience of bush burning from 2018-2022.

According to Figure 6 data showed that farmers in the research areas had suffered as a result of bush burning over the course of the study period (2018–2022). According to the data, bush fires destroyed 28% farmer farms in 2019, in 2020 (21%) and in 2022 (21%) respectively. In 2018, 10% farmer farms were also destroyed by bush fires. According to the majority of farmers who participated in focus groups discussion, bush fires have caused them to lose crops including cassava, groundnuts, pepper, and parboiled rice in the farm house.

3.2.1. Causes of Bush Burning

This section presents the findings of the causes of bush burning in the study area and it is presented in a multiple response in figure 7 below.

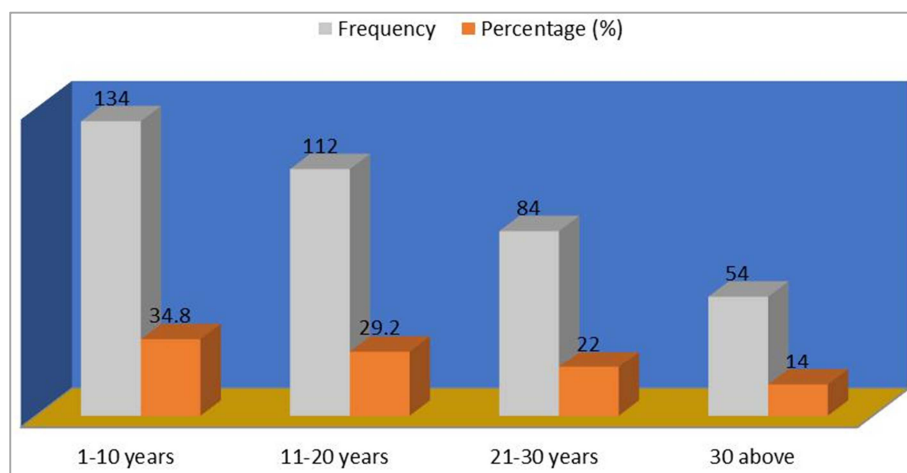
Data Source: Field survey, March, 2023

Figure 7. Distribution Showing Causes of Bush Burning.

According to Figure 7, the data showed that the top reason for bushfires in the area (21.4%) was land clearing. Bush burning is a land clearing approach since it involves less resources and labour, according to Adewole et al., (2010) [20]. Furthermore, as shown in Figure 7, the second majority of respondents (18%) cited weed control as their primary motivation, while the remaining respondents (14.8%, 14.1%, 7.3%, 6.8%, 5.7%, 5.2%, and 3.9%) cited security, livestock protection, building needs, firewood, charcoal burning, hunting, and other motivations, respectively. Bush fire also serves helpful objectives, according to Ambe, et al. (2015) which were quoted by Ezihe et al., (2020). The majority of farmers in Sierra Leone adopt burning techniques since they are the least expensive way to prepare their land for farming.

3.2.2. Number of Years in Bush Burning Practice

This section presents the findings of the number of years respondents have been practicing bush burning in the study areas, and it is presented in multiple responses in figure 8 below.

Data Source: Field survey, March, 2023

Figure 8. Distribution of Respondents Years Practicing Bush Burning.

According to the data in Figure 8, (34.8%) of the respondents acknowledged burning bushes for 1–10 years, while the remaining (29.2%) of the respondents claimed to have burned bushes for 11–20 years. A further 84 (22%) claimed to have been burning bushes for between 11 and 30 years, while 54 (14%) were 30 years of age or older.

3.2.3. Estimated Value of Assets Owned by Household and Assets Lost from Bush Burning

This section presents the findings of the estimated value of assets owned by households and assets lost from bush burning in the study areas, which are presented in Table 3 below.

Table 3. Distribution showing the total Value of Household Asset and the Value Asset lost.

Values in New Leones (NLE)	Frequency	Percentage (%)
1,000 below	158	41.1
1,001 to 2,000	85	22.1
2,001 to 3,000	63	16.4
3,001 to 4,000	41	10.7
4,001 to 5,000	22	5.7
5,001 above	15	4
		Mean
Value of Household Farmers Assets		NLE 68,982.43
Value of Household Farmers Assets Burnt Percentage of Farmers		NLE 3,573.32
Assets lost		7.64%

Data Source: Field survey, March, 2023.

According to table 3, the majority of farmer household heads (41.1%) claimed to have lost household assets worth NLE 1,000 or less, 22.1%) claimed they lost assets worth NLE 1,000 to 2,000, and 16.4%, 10.7%, 5.7%, and 4% respectively claimed they lost assets worth NLE 2,000 to 3,000, NLE 3,000 to 4,000, NLE 4,000 to 5,00 and NLE 5,000 or more. The respondents' household assets are thought to be worth a total of NLE 68,982.43 in total.

3.2.4. The Effects of Bush Burning on Production Levels

This section investigated the agriculture crops that are highly affected by bushfires on the study areas.

***Table 4.** Quantity of crops harvested in bush burning affected farms and non-bush burning affected farms.*

Acreages	Type of Crops	Bush burning affected farm	Non-bush burning affected farm
1	Cassava	20 bags	27 bags
1	Millet	6 bags	12 bags
1	Yam	700 tubers	1100 tubers
1	Cow Pea	4 bags	7 bags
1	Groundnut	8 bags	13 bags

Data Source: Field survey, March, 2023.

Some of the farmed crops in the study areas were identified by the data, including cassava, millet, yam, cowpea, and groundnut. It also demonstrates the typical amount harvested each crop following the bushfires, which is one hundred (100) kg. Table 4 shows the average harvest disparities between farms impacted by bushfires and farms that were unaffected by the blazes: 20 bags of cassava, 6 bags of millet, 700 tubers of yam, 4 bags of cowpea, and 8 bags of groundnuts were harvested from an acre of cassava. The results also showed that, on average, an acre of cassava would yield 27 bags, an acre of millet would yield 12 bags, an acre of yam would yield 1100 tubers, an acre of cowpea would yield 7 bags, and an acre of groundnut would provide 13 bags of produce when there were no bushfires. According to key informant findings and focus group discussions, bushfires have overwhelmingly negative effects on agricultural crop productivity. They burn crops and pastures, deplete soil fertility, creep desertification, and force wild animals to migrate to other communities' forest reserves.

Given that bushfires result in pasture loss, deforestation, and animal mortality, focus group discussions and key informant interviews further revealed that the impact of bushfires on livestock was substantial. The obtained results partially align with the findings of Ezihe et al., (2020), emphasizing the detrimental impact of natural disturbances [11], such as bushfires, on forest acreage. The study highlights that these disturbances not only inflict harm to trees but also pose a significant threat to crop productivity. By corroborating previous research, this study contributes to a deeper understanding of the multifaceted consequences of natural disturbances on both forested areas and agricultural output.

3.3. The General Effects of Bush Burning in the Community by the Respondents

This section investigated the continued effects of bush burning in the community by the respondents.

***Table 5.** The general effects of bush burning in the community by the respondents.*

Variable	Significant	Less Significant	Absence
Devastation of Agricultural Production	204 (53.2%)	148 (38.5%)	32 (8.3)
Devastation of soil Texture & component	289 (75.3%)	95 (24.7%)	0 (0)
Toxification of Surrounding	342 (89.1%)	42 (10.9%)	0 (0)
Pathways to respiratory sickness	355 (92.4%)	29 (7.6%)	0 (0)
Devastation of wild and non-wildlife animal	384 (100%)	0 (0)	0 (0)

Data Source: Field survey, March, 2023

According to the information in Table 5, the majority of respondents (204, or 53.2%) agreed that fire causes damage to agricultural products. 289 (75.3%) of the 384 respondents agreed with the assertion that bush fire damages soil texture and constituents, which results in subpar yields for the majority of agricultural products. According to the study, the majority of farmers (342, or 89.1%) thought that bush burning contributed to the pollution of the environment. Only 42 (10.9%) of the respondents thought that bush burning had a less significant impact on the pollution of the environment. While 355 (92.4%) of the respondents thought that dry cough and other respiratory illnesses are linked to bush fire. This result concurs with Muge et al. (2015), who found that 31.4% of participants indicated that a dry cough is the most typical lower respiratory symptom related with bush fire [21]. It was also discovered that 384 respondents (100%) agreed that bush burning could cause the extinction of both wild and domestic animals in the study locations.
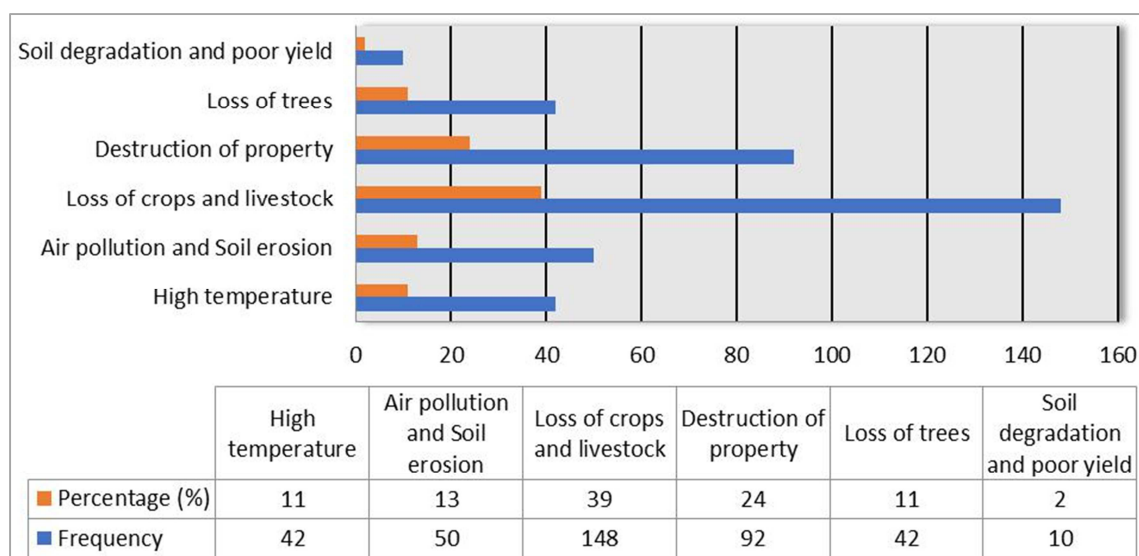
3.4. Awareness on the Negative Effects of Bush Burning to Farmers

This section presents the findings on the awareness of the negative effects of bush burning among farmers in the study area, and it is presented in multiple responses.

Figure 9, shows the results of numerous responses about the harm that bush burning causes to farmers. The respondents are aware of the detrimental effects of agricultural and livestock loss (148, 39%), property destruction (92, 24%), soil erosion (50, 13%), and tree loss (42, 11%). The respondents are less aware of the detrimental effects it has, which include high temperatures (41%), degraded soil, and subpar yields (2%), on the other hand. According to the results, the respondents gave little thought to the detrimental impacts of high temperatures, soil deterioration, and other detrimental aspects that they were unaware of. Ambe et al. (2015) and Aluko et al. (2019), highlighted the critical need for raising awareness regarding

the detrimental consequences of bushfires [10, 19]. Their research emphasizes the imperative of educating communities about the far-reaching impacts of bushfires, not only in terms of immediate destruction but also the long-term

ecological, economic, and social implications. By emphasizing the urgency of increasing awareness, this study underscores the importance of proactive measures and preparedness to mitigate the devastating effects of bushfires.
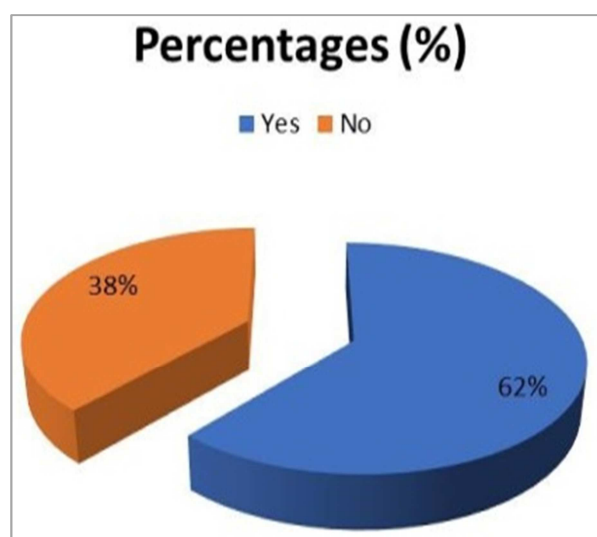
Data Source: Field survey, March, 2023

Figure 9. Distribution of the past interventions to minimize bush burning.

3.5. Past Interventions to Minimize Bush Burning

This section presents the findings of past interventions to minimize the incidence of bush burning in the study area.

Data Source: Field survey, March, 2023

Figure 10. Distribution of the past interventions to minimize bush burning.

The results showed that 239 (62%) of the respondents said they were taking measures to reduce the outbreak of bushfires in their community, while 145 (38%) said they weren't. According to the data, these interventions included bushfire sensitization programs and community bylaws.

3.6. The Constraints Farmers Face to Prevent Bush Burning

This section presents the findings on the constraints in reducing bushfires in the study area in multiple-response questions.

Table 6. *Distribution of the Constraints Farmers Face to Prevent Bush Burning.*

Constraints	Frequency	Percentage
Lack of community fire group	58	15.1
Lack of proper sensitization	12	3.1
Lack of fire equipment	234	60.9
Lack of local training in bushfires	80	20.9
Total	384	100

Data Source: Field survey, March, 2023.

Table 6 contains multiple-choice questions for respondents to explore the barriers to minimizing bushfires; the vast majority 234 (60.9%) of respondents indicate a lack of fire equipment in their community, which can help prevent the spread of fire to other neighbourhoods; 80 (20.9%) of respondents say they lack local training in their neighbourhoods, which can help prevent the wide spread of bushfires; and 58 (15.1%) of respondents talked about a lack of community-based fire prevention programs. According to the conclusions from the focus group discussions, the absence of fire equipment and local training on how to stop bushfires from spreading to all communities were the biggest obstacles to minimizing bushfires in the different areas.

3.7. Measures to Minimize the Incidence of Bushfires

In multiple-choice questions, the results of this section's research on strategies for lowering the frequency of bushfires in the study area are presented.

Table 7. *Distribution of the Measures to Reduce the Incidence of Bush Burning.*

Measures	Frequency	Percentage
Formation of community anti-bushfire group	34	8.9
Involvement of Community Authority	32	8.3
Implementation of Community bye laws	166	43.2
Emphasize on Community Sensitization	42	11
Provision of bushfires equipment and training at community level	110	28.6
Total	384	100

Data Source: Field survey, March, 2023.

Table 7 shows the results of multiple responses regarding measures to lessen the frequency of bushfires in the study areas. 166 (43.2%) of the respondents mentioned the implementation of community bye laws, which will help to reduce the needless sitting up of bushfires in most grass fields by hunters and cattle rearers, and 110 (28.6%) respondents mentioned the provision of bushfires equipment and training at the community level, which will help to prevent the wide spread of bushfires if i. 34 (8.9%) of the respondents identified the formation of a community anti-bushfires group at the local level, and 32 (8.3%) of the respondents identified the importance of community sensitization discussing the negative effects of bushfires on agricultural productivity and farmers' income.

4. Summary, Conclusion and Recommendation

The study's results are outlined in this section in respect to its goals. It draws findings, makes suggestions, and provides solutions for the problem at hand (reducing the rate of wildfire outbreak in the farming sector among small-scale farmers). This was accomplished by learning about the basic backgrounds of farmers and holding a focus group discussion to examine the reasons why wildfires have broken out in the farming sector, affecting farmers in the research area, and the effects of such outbreaks on the local agricultural industry.

4.1. Summary of Findings

4.1.1. Socio-Economic and Demographic Characteristics of Respondent (Farmers)

Males made up 56% of the small-scale farmers, while females made up 44%. Because of land ownership (women have less access to farmland), labor, inputs, and financial options, it shows that in farming communities, men are more involved in farming activities than women. In terms of age, the majority (59%) of respondents are between the ages of 31 and 40. Following them are 25% who are between the ages of 20 and 30 and 16% who are between the ages of 41 and over. This suggests that the younger farmers made up the majority. We also talk about the respondents' educational backgrounds: among farmers, primary education accounts for 36.9% of their education, followed by secondary education for 22.9%, no formal education for 18.8%, Quran study for 11.4%, and higher education for 10%. This shows that most farming communities have access to schools and a high level of education awareness. The marital situation of the farmers was also looked into; the majority of the farmers (55.9%) are married, while 26.6% are single, 11.2% are widows, and the remaining 6.3% are divorced. According to the research, farming communities have a higher proportion of married couples than other types of populations.

The majority of families in the study region and the farming villages are those with six to twelve members (48.4%), followed by those with one to five members (33.3%), and those with twelve (12) or more family members (18.3%). This suggests that the majority of the farming settlements in the study area have a sizable population because farming requires a lot of labour.

According to study, the majority of farmers (76.7%) are the family's head, while just 23.3% are dependent. This demonstrates that agrarian communities are dominated by household heads. According to the study's findings, the majority of respondents (33 percent) said they had a property of less than 1 hectare. According to the respondents' farming experience, 34.4 percent had between one and ten years of experience, while 13 percent had more than 31 years. Technical proficiency and experience have a good link.

Finally, Table 1 showed that the vast majority (37 percent) of respondents had never contacted the agent(s) providing agricultural extension services. However, the remaining group (27.6%), (21.9%), and (13.5%) claimed to offer extension services for 3, 2, and 1 year, respectively. This is consistent with the publication work by [11].

The occupation of the respondents is shown in Table 2, with the majority (368, or 95.8%) working in crop production or farming in the study region. 343 (89.3%) of the respondents also hunt, it was further discovered 86.5%, or 332 respondents, were involved in raising animals such cows, goats, sheep, and pigs. In addition, 299 respondents (77.9%) said they never go fishing. According to the report, 231 (60.2%) of the farmers did not process their cassava. Some of the respondents stated that they typically sell cassava by bag once their crops have been harvested on the farm and have reached the harvest stage.

In the study area, trading and commerce were seen as commonplace activities. The majority of respondents 362

(94.3%) engaged in petty trading, while 22 (5.7%) never engaged in it. Additionally, it was shown that 64 respondents (16.7%) rely solely on income from teaching professions, compared to 320 respondents (83.3%) who never work as teachers. According to the study, 343 (89.3%) of the respondents had no other government or INGO jobs, while 41 (10.7%) of the respondents worked at Njala University and other local NGOs to pay their bills and support their families.

Lastly, 184 (47.9%) of the respondents reported engaging in transportation business (riding a bike or driving a car) as a livelihood activity, whereas 200 (52.1% of the respondents) reported not engaging in such activities to earn their survival in the research region. This study supports the recommendation given by Aluko et al. (2019), who conducted a related study. This shows that farmers have a variety of extra revenue streams, which helps to improve the housing situation in rural communities.

4.1.2. Causes of Wildfire Breakout That Affect Agricultural Activities in the Study Area

According to the research, the data showed that the top reason for bushfires in the area (21.4%) was land clearing. Bush burning is a land clearing approach since it involves less resources and labour, according to [20]. Furthermore, as shown in Figure 2, the second majority of respondents (18%) cited weed control as their primary motivation, while the remaining respondents (14.8%, 14.1%, 7.3%, 6.8%, 5.7%, 5.2%, and 3.9%) cited security, livestock protection, building needs, firewood, charcoal burning, hunting, and other motivations, respectively. Bush fire also serves helpful objectives, according to Ambe et al. (2015), which were quoted by Ezihe et al. (2020). The majority of farmers in Sierra Leone adopt burning techniques since they are the least expensive way to prepare their land for farming. According to the focus group discussion, the respondents said that local practices of gathering wild honey and smoking and dropping cigarettes, lighting fires in open spaces, cooking in bushes, raking and burning farms, and lighting fires in open areas all contribute to the spread of wildfires. Additionally, hunters will burn bush to gain access to animals that will come feed on new plant leaves after one to two weeks of burning. The spread of fire particles from one area of farm land to another, according to the respondents, is another way that some young people who burn charcoal start wildfires. Finally, several Fulas set fire to their "werah" because of worry that wild creatures might harm them and their animals while they were constructing the community's football grounds. And the dry season is typically when it occurs. It follows from the data that farmers in the research area are impacted by each of these wildfire outbreak factors.

4.1.3. The Impact of Bush Burning on Agricultural Industry in Study Area

According to the information in Table 5, the majority of respondents (204, or 53.2%) agreed that fire causes damage to agricultural products. 289 (75.3%) of the 384 respondents agreed with the assertion that bush fire damages soil texture

and constituents, which results in subpar yields for the majority of agricultural products. According to the study, the majority of farmers (342, or 89.1%) thought that bush burning contributed to the pollution of the environment. Only 42 (10.9%) of the respondents thought that bush burning had a less significant impact on the pollution of the environment. In the survey, 355 (92.4%) of the community respondents believed that respiratory conditions like a dry cough could be aggravated by bushfires. This conclusion is consistent with [21], who found that 31.4% of participants identified dry cough as the most prevalent lower respiratory symptom related to bush burning. It was also discovered that 384 respondents (100%) agreed that bush burning could cause the extinction of both wild and domestic animals in the study locations. According to the focus group participants, a wildfire outbreak in farming activities in the study area results in food shortages, environmental pollution, a lack of planting materials, and the destruction of homes within communities. This increases the workload for farmers who are still clearing brush or who have just finished clearing brush but the leaves have not yet dried for proper burning. It also results in low harvests, immaturity of the farmland, and an excessive amount of weeding for the farmers [22]. This result suggests that farmers are not producing enough food through their farming endeavours because there is no suitable soil for growing because the soil is exposed to intense sunlight and rain, and because the majority of their agricultural assets have been destroyed by fires.

4.2. Conclusion

According to the findings of the study, more respondents participated in agricultural than non-agricultural activities. The primary agricultural activity of the respondents was farming, while the majority of the study's participants engaged in trading as their primary non-agricultural activity. The outcome also showed that bush-burning had a negative impact on the residents' sources of income and their state of health. In the research area, the prevalence of illnesses including respiratory and other airborne diseases/infections rose, making it necessary for residents to take constant medicine in order to survive. The study area's respondents reported that the livelihood activities had an impact on their sense of food security.

4.3. Recommendations

Based on the research conducted on the effects of bushfires on the farming industry among small-scale farmers in Kori Chiefdom, Moyamba District, Sierra Leone, here are highlight of some recommendations for the government and community:

The government through the Ministry of Agriculture should develop and implement an effective early warning system to alert farmers and communities about potential bushfires. This can be done through the use of modern technology like mobile apps, SMS alerts, or community-based communication networks.

Promotion of sustainable land management practices; educate and encourage small-scale farmers to adopt sustainable land management practices such as agroforestry, contour plowing, and mulching. These practices can help reduce the risk of bushfires and protect the fertility of the soil.

Establish community training programs; organize training programs to equip farmers with knowledge and skills on fire prevention, firefighting techniques, and emergency preparedness. Collaborate with local agricultural extension services and non-governmental organizations to provide hands-on training and resources.

Develop insurance schemes; the Ministry of Agriculture/community leaders should collaborate with insurance companies to develop affordable and accessible insurance schemes specifically tailored for small-scale farmers affected by bushfires. This can help mitigate the financial losses incurred due to crop damage or loss caused by bushfires.

Strengthen community fire management committees; establish and support community fire management committees composed of local farmers, community leaders, and relevant stakeholders. These committees can coordinate efforts, raise awareness, and facilitate community-level initiatives to prevent and respond to bushfires effectively.

Limitation and Directions for Future Research

The scope of the study area is the limitation of this research work. Focusing solely on one specific chiefdom and district may not capture the broader implications of bushfires on the farming industry in other regions of Sierra Leone. Therefore, the findings and conclusions derived from this research may not be fully representative of the entire country.

For future research, it is essential to expand the study's geographical scope to include multiple chiefdoms and districts within Sierra Leone. This would provide a more comprehensive understanding of the effects of bushfires on the farming industry across different regions, considering variations in land types, farming practices, and socio-economic factors. Additionally, conducting longitudinal studies that span multiple years would enable researchers to investigate the long-term effects of bushfires on small-scale farmers, including their ability to recover and adapt to such events.

Furthermore, exploring the underlying causes of bushfires in the district as a whole and identifying potential preventive measures and strategies could be an important direction for future research. This could involve investigating factors such as climate change, land-use practices, community awareness, and the effectiveness of fire management systems. Understanding the causes and prevention of bushfires would not only contribute to mitigating their impact on the farming industry but also help in developing appropriate policies and interventions to support small-scale farmers in fire-prone regions.

Lastly, incorporating the socio-economic aspects of the farming industry into future research would provide a more holistic understanding of the effects of bushfires. This could involve examining the economic losses incurred by farmers, their coping mechanisms, and the social implications on local communities. By considering the broader socio-economic context, future research can contribute to the development of targeted interventions and support systems to enhance the resilience of small-scale farmers in the face of bushfires.

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Acknowledgments

Conflicts of Interest

The authors of this research work declare that they have no competing monetary interests or personal relationships that could have appeared to influence the work reported in this paper.

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