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Investigate the Effects of Climate Change on the Agriculture Production of Kazumba Lulu Rural Communities: Cross-Sectional Study

Nshimba Ngoy Kayaya Juiskalyd[1*], Kikumbi Kasongo Bernard[2] Mbuyu Kilembwe Jacques[2]
[1]*Texila American University, School of Public Health, Georgetown, Guyana*
[2]*Agriculture, Université de Kalemie, Kalemie, Democratic Republic of Congo*

Abstract

Climate change represents significant challenges to agricultural production, food security, and livelihoods in rural Communities. This article investigates the effects of climate change on agricultural production in rural Communities and identifies effective adaptation strategies. The study provides insights into the perceptions, experiences, and adaptation strategies of rural Communities in the context of climate change. This study examines the impact of climate change on agricultural production in rural communities, with a focus on the adoption of multiple crop cultivation and adaptation strategies. A cross-sectional survey of 200 household heads of farmers reveals significant insights into the impacts of climate change and the adaptive measures employed by rural farmers. The results show that: - 84% of respondents perceive climate change as a significant threat to agricultural production. - Changes in rain availability affect 30% of respondents, while crop yields and water availability are impacted by 25% and 27.5%, respectively. Food security is also affected, with 17.5% of respondents reporting changes in their food security. - Crop diversification was the most common adaptation strategy (48%), followed by Climate-smart agriculture 5% and irrigation management (2%). 45% of respondents have limited access to climate information, and Insufficient resources. The findings of this study contribute to the existing body of knowledge on climate change and its impact on agriculture. The study provides recommendations for policymakers, practitioners, and researchers to support climate-resilient agriculture development in rural communities. The study's results have implications for food security, sustainable livelihoods, and poverty in rural communities.

Keywords: *Climate, Change, Agriculture, Production, Rural, Communities.*

Introduction

Climate change is a significant menace to agriculture in the world and especially in Africa, affecting crop production, food security, and the livelihoods of rural farmers. This article aims to review the evidence based on the impact of climate change on agricultural production in the Democratic Republic of Congo, particularly in Kazumba Lulu. Climate change is a burning global issue that affects the overall agricultural production, food security, and livelihoods in rural communities [1, 2]. The impact of climate change on agriculture is complicated, with outbreaks of temperatures, varying precipitation patterns, and elevated frequency of excessive weather events affecting crop production, water availability, and soil quality [3, 4]. In global rural communities, climate change can have destructive effects on livelihoods, particularly for smallholder community farmers who rely heavily on agriculture for their living and income [5]. Climate change can lead to reduced crop yields, lower incomes, and increased poverty, making it challenging for rural communities to achieve food security and sustainable livelihoods [6]. Several solutions exist to address the impact of climate change on agriculture: Practices like

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****Corresponding Author: nshimba2014@gmail.com***

conservation agriculture and agroforestry can enhance soil health, improve water management, and increase crop yields [3, 4]. Potent irrigation systems can help community farmers optimize water use, reducing the impact of droughts and water scarcity [5]. Growing diverse crops can enhance farm resilience, improve food security, and increase farmers' incomes [6]. To address these challenges, climate-resilient agriculture practices, such as climate-smart agriculture, irrigation management, and crop diversification, can be effective adaptation strategies [7, 8]. Implementing climate-smart agriculture practices is a promising solution to address the impact of climate change on agriculture. These practices can help farmers adapt to changing weather patterns, improve crop yields, and enhance food security [7, 8]. However, the adoption of these practices requires access to climate information, financial resources, and technical support [9]. Rural communities often lack access to climate data, making it challenging to make informed decisions [9]. Limited financial resources restrict Rural Communities' ability to invest in climate-resilient practices [10]. This study aims to investigate the effects of climate change on agricultural production in rural communities and identify effective adaptation strategies. The study will provide insights into the perceptions, experiences, and adaptation strategies of rural communities in the context of climate change [10-15]. The study will also explore the impact of climate change on crop yields, water availability, and soil quality [16-20]. Additionally, the study will examine the role of climate-resilient agriculture practices in enhancing food security and sustainable livelihoods [21-25]. The findings of this study will contribute to the existing body of knowledge on climate change and agriculture [26-30]. The study will also provide recommendations for policymakers, practitioners, and researchers to support climate-resilient agriculture development in rural communities [31-35].

Objectives

This present study aims to investigate the effects of climate change on agricultural production in rural communities and identify effective adaptation strategies.

To provide a thorough examination of the effects of climate change on agricultural production in rural communities, focusing on multiple crop cultivation and adaptation strategies.

The Novel Contributions of the study are to provide quantitative evidence of the impacts of climate change on agricultural production in rural communities.

The study contributes to the limited body of knowledge on climate change and agriculture in the Kazumba Lulu rural area, providing valuable insights for policymakers and practitioners. The study's findings provide valuable insights for policymakers and practitioners seeking to support climate-resilient agriculture development in rural communities, specifically in Kazumba Lulu.

Materials and Methods

1. Description of the Site

Kazumba Lulu is located in Songa Rural Health Zone (ZS), territory of Kamina, Haut-Lomami province in the Democratic Republic of Congo. The relief is characterized by a mountain range on the clayey-sandy soil. The climate is tropical with two alternating seasons: a dry season from mid-April to mid-August, and a rainy season from mid-August to mid-April. The vegetation is dominated by grassy savannah and forest in some places. The community is accessible by road and rail, which connects it to the town of Kamina at about 150 km away. The accessibility by road and rail is difficult due to the very advanced state of disrepair of the national road and the rails, which date from the colonial era, which consequently hurts the income of the

population. The majority of the population lives thanks to agriculture, small livestock, small trade, hunting, artisanal fishing, and some seasonal activities (mushroom picking and the collection of caterpillars and winged ants, etc.). The community has a lean season of 3 months from September to November. And food becomes scarce as a result of the preparatory work of the fields, the abundant rains, and the sowing, which makes the markets more unstable and already causes an increase in the price of this food product, which is the staple food. Households have less access to this food and become more food insecure, with the risk of developing malnutrition [36].

2. **Description of the experiment**.

This cross-sectional study design is designed to capture detailed information on climate change perceptions, agricultural production, and adaptation strategies, with a sample size of 200 rural community participants.

3. Description of statistical methods

The Study Population: A Descriptive statistic for categorical variables was carried out in the Kazumba Lulu Rural Farmers Community, where the questionnaire was conducted following the target population for the study in the Kazumba Lulu community.

4. Sampling Method

The probability sampling approach is recommended and used here to ensure representativeness and reduce bias. We used the Random sampling method to select the 200 respondents for the present study, so that every farmer has an equal chance of being selected from a complete list of farmers.

5. Data Collection

A validated and standardized questionnaire was used for data gathering, and interviews were carried out by the researcher and the interviewers to collect information on hard copy (paper) and electronic (smartphone).

The Types of Interviews were structured and standardized to enable the ten interviewers to ask each respondent the same questions in the same manner. All questions were set in advance, with the possible choice of answers.

The interviewers observed closely the interview directives, and the responses were noted or written down. Only interview those participants who fit the sampling criteria, in such a way that a limited range of responses is extracted.

6. Data Analysis

To analyze our data from the 200 samples, we used the frequency counts from our questionnaire and calculated the percentages. Using Excel, the results were presented in tables and figures (bar charts). The Frequency counts report the number of occurrences of each category or response in our data collection. Percentages convert these frequencies into proportions of the total sample, making it easier to interpret and compare. Tables and figures in this study complement each other by highlighting different features of the data collected.

Results

The results of the present study are presented in percentages from the table to the charts. Here we are presenting the table results from tables one to five.

Out of 200 respondents who participated actively in the study questionnaire, here are the observations and findings collected from the study:

Table 1 and Figure 1 enumerate the Demographic characteristics of respondents by sex: Male 60%; Female 40%; and by age: 18-24 years 15%; 25-34 years 25%; 35-44 years 30%; 45-54 years 20%; 55+ Years 10%.

Out of 200 participants, these are the observations and findings of the research study represented in tables and figures.

Table 1 enumerates the demographic information of the sample. Males accounted for

60 % of the respondents, females 40%, 18-24 years 15%, 25-34 years 25%, 35-44 years 30%, 45-54 years 20%, 55+ years 10%. The most common age ranges from 25-34 and 35-44, accounting for 55%.

Table 1. Demographic Characteristics of Respondents

Variables	Characteristic	Frequency	Percentage
Sex	Male	120/200	60%
	Female	80/200	40%
Age	18-24 years	30/200	15%
	25-34 years	50/200	25%
	35-44 years	60/200	30%
	45-54 years	40/200	20%
	55+ years	20/200	10%

Note: *Categories under demographic characteristics: gender and age range. -Frequencies represent the number of respondents in each category. - Percentages are calculated from the total sample size (N=200).*

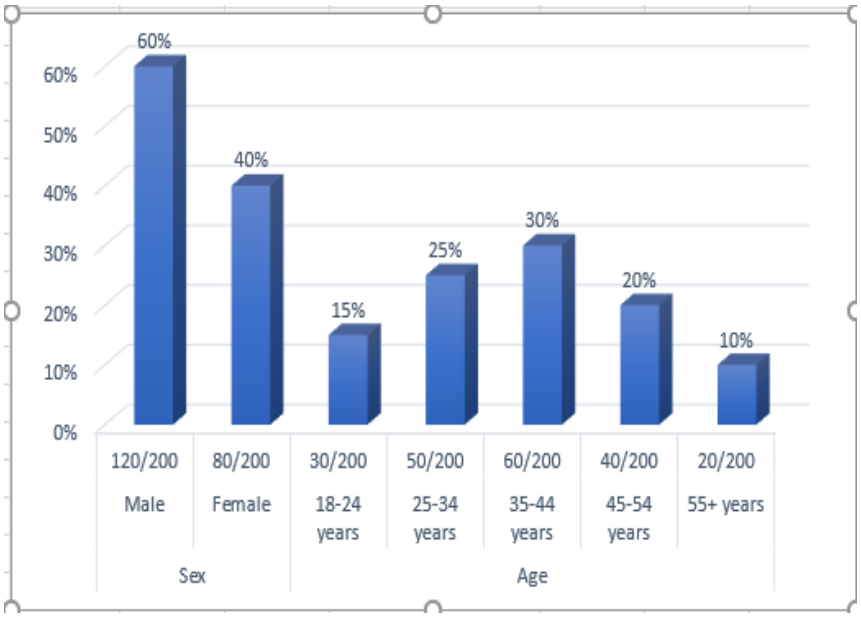

Figure 1. Demographic Characteristics of Respondents

Note: *This figure displays the demographic distribution of respondents (N = 200). The sample consisted of 60% males and 40% females. Age groups were distributed as follows:18-24 years (15%), 25-34 years (25%), 35-44 years (30%), 45-54 years (20%), and 55+ years (10%). The combined age groups 25-34 and 35-44 represent the majority at 55%.*

Table 2 and Figure 2 list the Climate Change Perceptions of respondents: Aware of climate change 42.5%; Not aware of climate change 7.5%, and respondents who believe climate change affects agriculture 41.5%, and do not believe climate change affects agriculture 6%.

Table 2 lists the Climate Change Perceptions of respondents: aware of climate change (42.5%), not aware of climate change (7.5%), and those who believe climate change affects agriculture (41.5%), as well as those who do not believe climate change affects agriculture (6%).

Table 2. The Climate Change Perceptions

Variables	Characteristic	Frequency	Percentage
Awareness of Climate Change	Aware of climate change	85/200	42.5%
	Not aware of climate change	15/200	7.5%
Belief that Climate Change Affects Agriculture	Believe climate change affects agriculture	83/200	41.5%
	Do not believe climate change affects agriculture	12/200	6%

Note: *Climate Change Perceptions Categories: awareness& recognition of climate change. -Frequencies represents the perception of respondents in each category. - Percentages are calculated from the total sample size (N=200).*

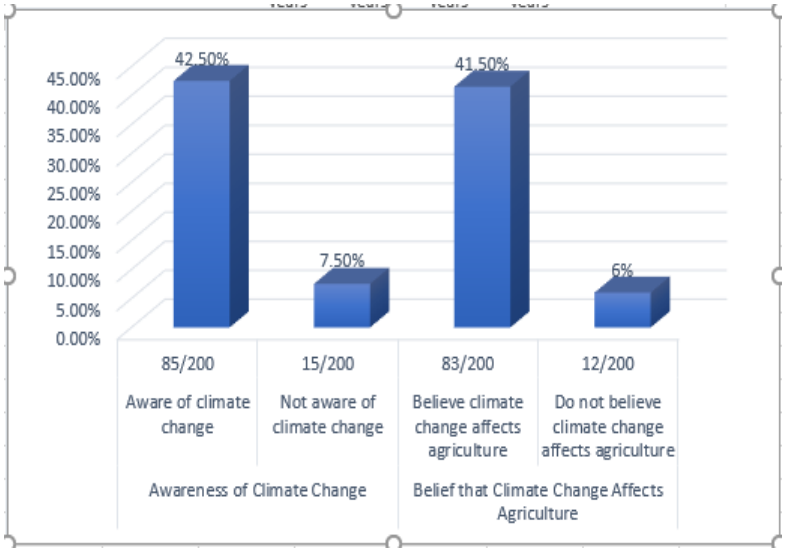

Figure 2. The Climate Change Perceptions

Note: *This figure illustrates respondents' awareness and beliefs regarding climate change (N = 200). Forty-two-point-five percent (42.5%) of respondents are aware of climate change, while 7.5% are not. Additionally, 41.5% believe that climate change affects agriculture, whereas 6% do not.*

Table 3 and Figure 3 list Climate change impact on respondents: Impact on rain availability 30%, Impact on crop yields 25%, Impact on water availability 27.5%, Impact on food security 17.5%.

Table 3 lists the Climate change impact on respondents' observations: Impact on rain availability 30%, Impact on crop yields 50%, Impact on water availability 27.5%, Impact on food security 17.5 %.

Table 3. Climate Change Impact

Variables	Characteristic	Frequency	Percentage
Perceived Impact on Rain Availability	Impact on rain availability	60/200	30%
Perceived Impact on crop yields	Impact on crop yields	50/200	25%
Perceived Impact on Water Availability	Impact on water availability	55/200	27.5%
Perceived Impact on Food Security	Impact on food security	35/200	17.5%

Note: *Climate Change Impact Categories: rain, crop, water, food. -Frequencies represent the influence of climate in each category. - Percentages are calculated from the total sample size (N=200) of acceptance*

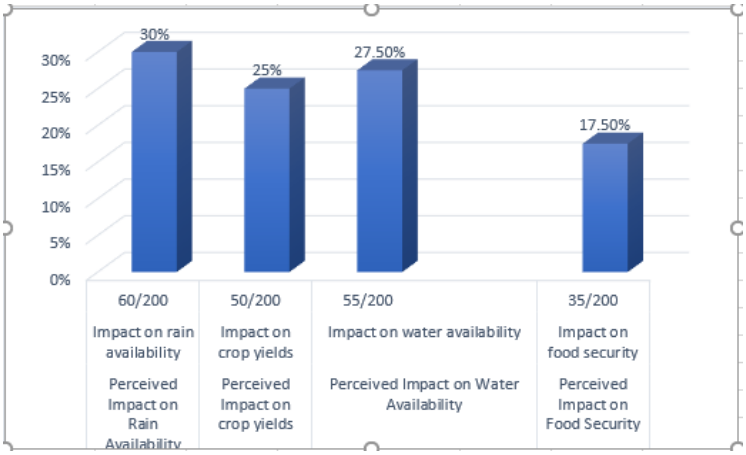

Figure 3. Climate Change Impact

Note: *This figure illustrates respondents' observations of climate change impacts (N = 160). The impacts include rain availability (30%), crop yields (50%), water availability (27.5%), and food security (17.5%).*

Table 4 and Figure 4 list the Agricultural Production of respondents cultivating Cassava 25%, Groundnuts 25%, Maize 25%, Beans 16%, Potatoes 5%, Rice 2%, and soybeans 2%.

Table 4 lists the Agricultural Production of respondents, who cultivate Cassava (25%), Groundnuts (25%), Maize (25%), Beans (16%), Potatoes (5%), Rice (2%), and Soybeans (2%).

Table 4. Agricultural Production

Variables	Characteristic	Frequency	Percentage
Crop Types Cultivated	Cassava	50/200	25%
	Groundnuts	50/200	25%
	Maize	50/200	25%
	Beans	32/200	16%
	Potatoes	10/200	5%
	Rice	4/200	2%
	Soybeans	4/200	2%

Note: *Agriculture Production Categories: types of crops cultivated. -Frequencies represent the production of respondents in each category. - Percentages are calculated from the total sample size (N=200).*

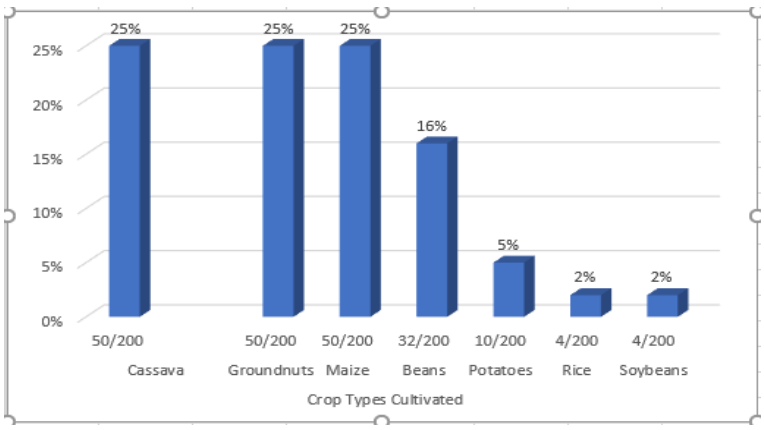

Figure 4. Agricultural Production

Note: *This figure illustrates the types of crops cultivated by respondents (N = 160). Cassava, groundnuts, and maize each account for 25% of cultivation, followed by beans at 16%, potatoes at 5%, and rice and soybeans each at 2%.*

Table 5 and Figure 5 list the agriculture practices of respondents: not receiving climate information, 25%; not using necessary resources, 25%; and respondents practicing Climate-smart agriculture, 5%; Crop diversification, 48%; and Irrigation management, 2%.

Table 5 lists the Adaptation Strategies of respondents: not receiving climate information, 25%, not using necessary resources 25%, and respondents practicing Climate-smart agriculture 5%, Crop diversification 48%, and Irrigation management 2%.

Table 5. Agriculture Practices

Variables	Characteristic	Frequency	Percentage
Reception of Climate Information	not receiving climate information*	50/200	25%
Use of Necessary Resources for Adaptation	not using necessary resources**	40/200	20%
Practice of Climate-Smart Agriculture	Climate-smart agriculture	10/200	5%
Practice of Crop Diversification	Crop diversification	96/200	48%
Practice of Irrigation Management	Irrigation management	4/200	2%

Note: *Agriculture Production Categories: crop type practice. -*Frequencies represent the updated status of respondents. -**Frequencies represent the equipment status of respondents. Frequencies represent the strategies of respondents in each category. Percentages are calculated from the total sample size (N=200).*

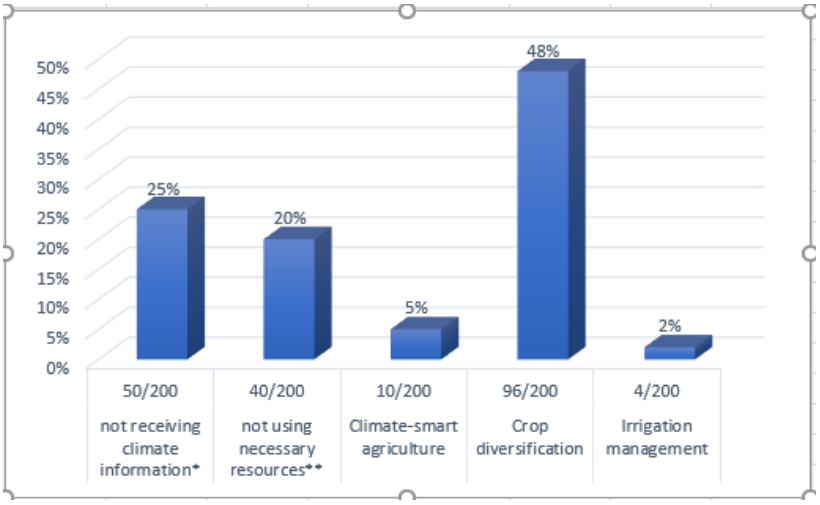

Figure 5. Agriculture Practices

Note: *This figure presents the adaptation strategies related to climate change among respondents (N = 160). Twenty-five percent (25%) of respondents reported not receiving climate information, and 25% reported not using necessary resources. Among those adopting strategies, 48% practice crop diversification, 5% engage in climate-smart agriculture, and 2% use irrigation management.*

Discussion

The discussion of the study has been done according to the objectives of the study, to investigate the effects of climate change on agricultural production in rural communities, focusing on multiple crop cultivation and

adaptation strategies. Out of 200 respondents to the study questionnaire:

Table 1 and Figure 1 represent the Demographic characteristics of respondents (Sex and Age): Male 60%, Female 40%, 18-24 years 15%, 25-34 years 25%, 35-44 years 30%, 45-54 years 20%, 55+ years 10%. All the sexes and ages are represented, males 60% and ages from 25-34 to 35-44 years, 55% representing the highest respondents.

Table 2 and Figure 2 represent the percentage of respondents' awareness and belief of Climate Change Perceptions: Aware of climate change, 42.5%; Not aware of climate change, 7.5%; Believe climate change affects agriculture, 41.5%; Do not believe climate change affects agriculture, 6%. 42.5% of respondents are aware of climate change, and 41.5% believe climate change affects agriculture, representing the highest percentage.

Table 3 and Figure 3 enumerate the percentage of respondents testifying on the Climate change impact: Impact on rain availability, 30%; Impact on crop yields, 50%; Impact on water availability, 27.5%; Impact on food security, 17.5%. 100% of respondents attest to the impact on rain availability.

Table 4 and Figure 4 list the percentage of respondents practicing multiple agricultural production: Cassava 25%, Groundnuts 25 %, Maize 25%, Beans 16%, Potatoes 5%, Rice 2%, Soybeans 2%. 80% of respondents commonly cultivate cassava, groundnuts, and Maize.

Table 5 and Figure 5 list the percentage of rural farmers' Adaptation Strategies, information, and knowledge: not receiving climate information, 25%; not using necessary resources, 25%; Climate-smart agriculture, 5%; Crop diversification, 48%; and Irrigation management, 2%. It is showing that 100% of respondents are not receiving climate information and necessary resources.

The use of climate-smart agriculture practices, irrigation management, and crop diversification helps farmers adapt to climate change. The impacts of climate change on agriculture and food security are significant. These impacts can lead to reduced agricultural productivity, increased food insecurity, and decreased livelihood opportunities.

The study reveals that the majority of respondents (75%) cultivate multiple products (Figure 4), with cassava, groundnuts, and maize being the most common combination. Changes in rain availability affect 30% of respondents, while crop yields and water availability are impacted by 25% and 27.5%, respectively (Figure 3). This finding suggests that farmers in the study area are diversifying their crops to reduce the risks associated with climate change.

Conclusion

The study provides insight into the effects of climate change on agricultural production in rural communities and identifies effective adaptation strategies. The study concludes that the cultivation of multiple products, particularly cassava, groundnuts, and maize, is a common practice among farmers in the study area. This practice can provide several benefits, including improved food security, increased income, and enhanced resilience to climate change.

To support farmers in the study area, it is recommended to provide farmers with accurate and timely climate information to inform their decision-making.

Provide rural farmers with access to necessary resources, such as fertilizers, pesticides, and irrigation systems, to optimize their timely crop production.

Provide rural farmers with training and capacity-building programs to enhance their knowledge and skills in crop production and management.

Source of Information

Questionnaire 2025.

Ethical Approval

Informed consent was obtained from study participants, and approval was obtained from

the head office of the rural community farmers' network 0203042025.

Conflict of Interest

There is no conflict of interest tied to this article.

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