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The Influences of Climate Change on Cash Crops Production in Rotterdam and Kortberaadt Villages, East Bank Berbice, Guyana

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ABSTRACT

This paper examined the influences of climate change on cash crop production in Rotterdam and Kortberaadt Villages on the East Bank Berbice, Guyana. The research used a survey method incorporating questionnaires to obtain qualitative and quantitative data on influences of climate change on cash crop production in the study communities. Majority (41%) of the respondents indictaed they cultivated vegetables.The findings showed majority of the respondents strongly agreed that constant weather and agricultural droughts (81%) and excessive rainfall (63%) were primary influences of climate change on cash crop production in their community. Majority of the respondents agreed increase in pests and diseases (51.7%), decrease in water resources and soil moisture (50%), and flooding of farmlands (32.8%) were the primary impacts of climate change on cash crop production. As such, majority (84%) of the respondents stated they experienced economic loss due to the impacts of climate change. The findings indicated majority of the respondents agreed that the creation of water reservoirs for storage (69%), bank cutting to drain excess water (53.4%), and use of disease and pest resistant seedlings (35.6%) are useful in mitigating the impacts of climate change on cash crop production within the study communities.

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INTRODUCTION

Climate change is happening more quickly than ever and carbon dioxide levels are expected to reach 550 billion tons by 2050, which will raise global temperatures by an average of 1.5 to 4.5 °C (Mekonnen et al., 2021). The main threat to agriculture in the foreseeable future is rising carbon dioxide and temperature. Numerous regions of the world are already experiencing negative effects from climate change and variability (Bahta & Myeki, 2022). Additionally, there is scientific agreement the changing global climate will have a significant impact on food security. Climate change will result in lower crop yields, which will raise food prices. Given that farmers in poor countries

mostly rely on rain-fed agriculture, the climate is a valuable resource for crop production (Pelling, 1999). The effects of climate change are especially noticeable for smallholder farmers who depend heavily on agriculture (CDEMA, 2010). Climate change impacts worsen food insecurity due to a loss in yield and decreased availability of food. Food security is at danger everywhere as a result of recently emerging climate change-induced phenomena (Ali et al., 2017). The need for adaptation strategies and approaches to reduce hazards could result from increased climatic unpredictability and global environmental changes. People who depend on agriculture will require the use of a variety of adaptation and coping mechanisms due to the increased effects of climate change and variability (Bathiany et al., 2018).

Agriculture is a main form of employment and contributor to the gross domestic product of Guyana. However, the threat of climate change is ever-present. In recent times, the country has experienced prolong dry spells and erratic rainfall that is not normally experienced (Vivid Economics Limited and Sayers and Partners LLP, 2019). As such, the agricultural sector, more specifically, cash crop farmers are at risk for crop depletion and low yields. This plays a significant role in determining the country's ability to strengthen its food security. Not only internally, agricultural produce is exported to the diaspora with many countries dependent on produce from Guyana for their own food security. Therefore, it is necessary to address the constraints of climate change on cash crop production. The employment of climate smart and resilient approaches are mandatory to tackle climate change impacts on cash crop production. This requires collective public-private partnership with local, regional and international players using a holistic approach. In turn, food security will occur with adequate food availability and accessibility.

MATERIAL and METHOD

Study Area

The East Bank Berbice is situated along the eastern bank of the Berbice River comprising of twenty-one (21) communities. Research was conducted in Rotterdam Village, East Bank Berbice (06°10'52.16" latitude N. 57°32'08.96" longitude W) and Kortberaadt Village, East Bank Berbice (06°10'23.81" latitude N. 57°34'02.72" longitude W). These communities are located in the rural areas of Guyana where agriculture is the main form of employment. Majority of the crops grown are cash crops. Rotterdam and Kortberaadt comprises of 60 households collectively with a population of approximately 180 persons combined. The fertility of the land promotes cash crop production and serves as a main source of employment. Many of the lands owned are ancestral which was inherited from previous family members that were farmers themselves. The crops grown are sold on the local market in nearby towns, transported to the capital city to be sold and also exported internationally. Many of the produce exported are sold within the Caribbean, North America, Latin America and Europe.

Sampling Technique

The random sampling technique was used in this research. This type of sampling technique allows each member of the population to have an equal chance of being chosen without biasness (New Castle University, 2023). Primary data were collected through survey using questionnaires. The questionnaires obtained information on the influences, impacts and mitigating measures of climate change on cash crop production within the study communities. The population for the research were farmers in the communities; Rotterdam and Kortberaadt Village. In Rotterdam, there were 35 farmers whilst there were 26 farmers in Kortberaadt Village. The sample size for each community studied was calculated using the sample size calculator by Raosoft Inc. with a confidence level of 95%, margin of error at 5% and the response distribution at 50%. The sample size for Rotterdam was 33 farmers and 25 farmers for Kortberaadt Village, East Bank Berbice. The questionnaires were administered to 33 farmers in Rotterdam and 25 farmers in Kortberaadt Village, East Bank Berbice. These farmers were selected indiscriminately from the population in both communities. The questionnaire was administered on April 15th, 2023 and respondents were given five days (5) to complete and return. All of the questionnaires distributed were returned.

Analytical Technique

The cross-sectional research design was used with the mixed method approach to collect data for this research. The research design was selected for the capturing of temporal data. The qualitative and quantitative design was used and analyzed in this research. Both secondary and primary data were collected and reviewed in this study. Case studies were perused to assist in information gathering for the research. The questionnaire comprised of four (4) sections with a total of ten (10) questions. The sections focused on bio-data (Section A), influences of climate change on cash crop production in the study communities (Section B), impacts of climate change on cash crop production in the study communities (Section C) and possible mitigating measures to alleviate the constraints of climate change on cash crop production in the study communities (Section D). The Likert Scale was used in the questionnaire to measure the extent in which respondents strongly agree, agree, strongly disagree or disagree with an item. The data collected from the survey was analyzed using SPSS version 20.0 (Statistical Package for the Social Science). The software is capable of handling large datasets and performing complex analyses. These analyses can be conducted on both qualitative and quantitative types of data. Before inputting the data into SPSS, the dataset was cleaned for any error and irregularities to ensure accurate results are generated in the findings. The SPSS software can generate graphs and charts to further simplify the findings through pictorial aids. The researcher incorporated the use of descriptive statistics; mean, standard deviation and frequency to understand and examine the distribution of data as well as interpret the findings.

RESULTS and DISCUSSION

In Figure 1 above, majority (41%) of the farmers cultivate vegetables. Another 24% of the farmers cultivate vegetables, plantain and bananas. It is evident 14% of the farmers grow rice whilst 12% grow corn. Only 9% of the farmers cultivate plantain and bananas. The mean of 2.91 suggest the data is more aligned to farmers cultivating vegetables. The standard deviation 1.40 indicated the data was concentrated around the mean. This is indicated in the cultivation of vegetables being mostly grown. These are cash crops grown in the study communities Rotterdam and Kortberaadt Village, East Bank Berbice. Cash crops are grown to be sold in order to generate income which is used to offset household expenses.

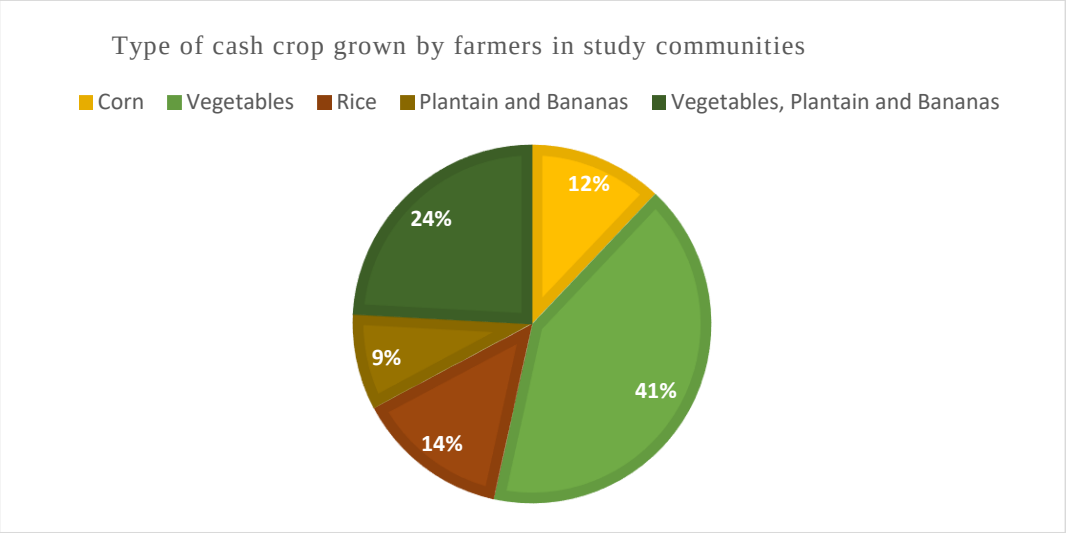

Figure 1. Types of cash crop grown, Rotterdam and Kortberaadt Village, East Bank Berbice

Table 1 above displayed the responses of the respondents, mean and standard deviation on the influences of climate change on cash crop production on the East Bank of Berbice. The mean for the items related to the influences of climate change ranged from 2.48 to 3.81 with the standard deviation between 0.39 to 0.90. This meant the respondents disagreed to strongly agreed with the items on the table above. The range of the standard deviation highlights the responses are skewed and widely dispersed.

Based on the mean calculated, majority of the respondents strongly agreed that constant weather and agricultural droughts (3.81) and excessive rainfall (3.60) were the primary influences of climate change on cash crop production in their community. The standard deviations of 0.39 and 0.49 respectively indicate the responses were concentrated around the mean.

Weather and agricultural drought has a substantial impact on water resources and food security. This means vulnerable farmers dealing with severe weather and agricultural drought are harmed by a lack of access to water resources and food instability (Bahta & Myeki, 2022). The occurrence of droughts creates a restrictive environment for cash crop cultivation (Sonnoveld et al., 2011). An excessive amount of rain harms the soil and causes nutrients to be lost through leaching. A surplus of water encourages the growth of mold and fungus, which destroys crops. Torrential rainfall can cause massive damage to cash crop cultivation (Khan et al., 2022).

Table 1. The results of influences of climate change on cash crop production in Rotterdam and Kortberaddt Village

Traits	Strongly Agree	Agree	Disagree	Strongly Disagree	Mean	Standard Deviation
Constant Weather and Agricultural Drought	47 (81%)	11 (19%)	-	-	3.81	0.39
Excessive Rainfall	35 (60.3%)	23 (39.7%)	-	-	3.60	0.49
Increased Temperature	7 (12.1%)	20 (34.5%)	26 (44.8%)	5 (8.5%)	2.49	0.82
Decreased Temperature	8 (13.8%)	20 (33.9%)	22 (37.9%)	8 (13.8%)	2.48	0.90

Scale: 0.5 to 1.4= Strongly Disagree, 1.5 to 2.4 = Disagree, 2.5 to 3.4 = Agree, 3.5 to 4 = Strongly Agree

Table 2 displayed the responses of the respondents, mean and standard deviation on the impacts of climate change on cash crop production on the East Bank of Berbice. The mean for the items related to the impacts of climate change ranged from 1.96 to 3.34 with the standard deviation between 0.63 to 0.84. This meant the respondents disagreed to strongly agreed with the items in the table above. The range of the standard deviation highlights the responses were widely dispersed.

Table 2. The results of impacts of climate change on cash crop production in Rotterdam and Kortberaddt Village

Traits	Strongly Agree	Agree	Disagree	Strongly Disagree	Mean	Standard Deviation
Decrease in Water Resources and Soil Moisture	24 (41.4%)	29 (50%)	5 (8.6%)	-	3.32	0.63
Increases in Pest and Diseases	10 (17.2%	30 (51.7%)	-	18 (31%)	2.86	0.68
Flooding of Farmlands	31 (53.4%)	19 (32.8%)	5 (8.6%)	3 (5.2%)	3.34	0.84
Creation of Barren Farmlands	-	19 (32.8%)	18 (31%)	21 (36.2%)	1.96	0.83

Scale: 0.5 to 1.4= Strongly Disagree, 1.5 to 2.4 = Disagree, 2.5 to 3.4 = Agree, 3.5 to 4= Strongly Agree

Based on the mean calculated, majority of the respondents agreed that decrease in water resources and soil moisture (3.32), increase in pests and diseases (2.86) and flooding of farmlands (3.34) were the primary impacts of climate change on cash crop production. The standard deviations 0.63, 0.68 and 0.84 respectively indicates the responses were dispersed from the mean. The decrease in water resources and soil moisture creates water stress. In the study communities, an absence of water catchment results in water shortage especially during weather and agricultural droughts. Pests, and crop diseases can be transferred to plants by rain which result in a widespread of unhealthy crops. The occurrence of intense and irregular rainfall patterns has prompted an increase in pests and crop diseases (Shrestha et al., 2022). Agricultural production and food security may be affected by variations in rainfall's intensity, length, and frequency (Shrestha et al., 2022). The absence of adequate drainage during intense and prolong rainfall cause farmlands to flood. Excess rainfall causes soil logging creating a deficiency of oxygen for crops causing them to die.

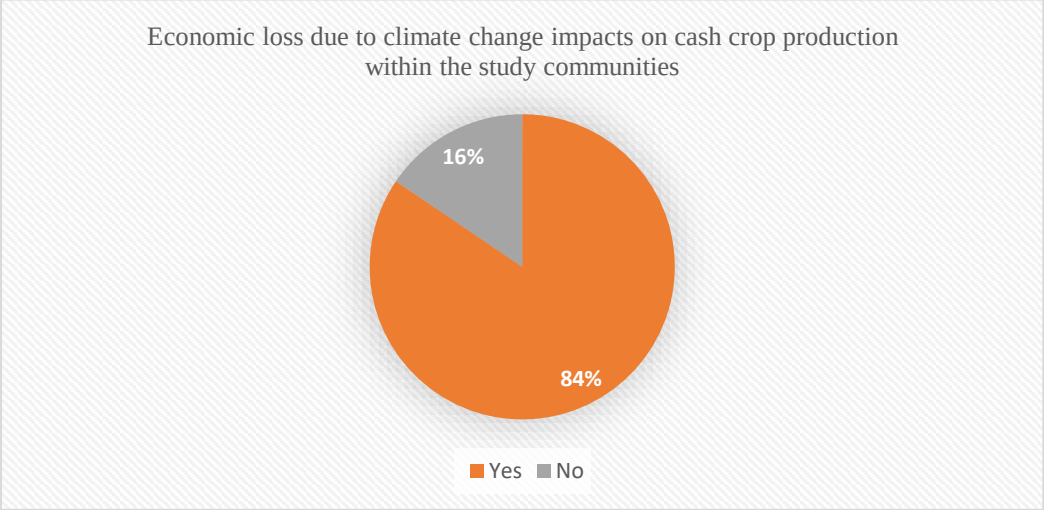

Figure 2. Quantification of farmers registering economic loss due to climate change impacts in Rotterdam and Kortberaddt Village

In Figure 2 above, majority (84%) of the farmers experienced economic loss due to the impacts of climate change whilst 16% of the farmers stated they did not experience economic loss. The mean 1.15 indicates majority of the respondents agreed to experiencing economic loss. The standard deviation of 0.36 indicated the responses were concentrated around the mean. Extreme weather has a significant impact on farmers' life and lower output of important cash crops is the result (Khan et al., 2022). These hazards frequently have an effect on cash crop output, which lowers household income and exacerbates the economic effects on cash crop farmers (Shrestha et al., 2022). Many cash crops are exposed to the influences of climate change and suffers

from their impacts. Generally, these crops die resulting in loss for farmers. This has implications on the spending power in the household disrupting the purchasing power of the community. The local businesses reliant on cash crop farmers economic support also suffers due to the loss farmers experience as a result of climate change. The need for additional investment and increase in production cost has resulted in farmers breaking even and not being able to make a profit or suffer a loss.

Table 3 above displayed the responses of the respondents, mean and standard deviation on the mitigating measures of climate change on cash crop production on the East Bank of Berbice. The data was gathered from the study communities; Rotterdam and Kortberaadt Village. The mean for the items related to the mitigating measures of climate change ranged between 2.14 to 3.13 with the standard deviation between 0.54 to 0.92. This meant the respondents disagreed to strongly agreed with the items in the table above. The range of the standard deviation highlights the responses were skewed and widely dispersed.

Table 3. The results of mitigating measures against climate change impacts in Rotterdam and Kortberaddt Village

Traits	Strongly Agree	Agree	Disagree	Strongly Disagree	Mean	Standard Deviation
Creation of Water Reservoirs for Storage	13 (22.4%	40 (69%)	5 (8.6%)	-	3.13	0.54
Use of Diseases and Pest Resistant Seedlings	19 (32.8%)	21 (35.6%)	18 (31%)	-	3.01	0.80
Bank Cutting to drain Excess Water	17 (209.3%)	31 (53.4%)	10 (17.2%)	-	3.12	0.67
Crop Rotation and Crop Diversification	8 (13.8%)	9 (15.5%)	30 (51.7%)	11 (19%)	2.24	0.92

Scale: 0.5 to 1.4= Strongly Disagree, 1.5 to 2.4 = Disagree, 2.5 to 3.4 = Agree, 3.5 to 4 = Strongly Agree

Based on the mean calculated, majority of the respondents agreed creation of water reservoirs for storage (3.13), use of disease and pest resistant seedlings (3.01) and bank cutting to drain excess water (3.12) are useful in mitigating the impacts of climate change on cash crop production on the East Bank Berbice. The standard deviations of 0.54, 0.80 and 0.67 respectively showed the responses were dispersed from the mean. The creation of water reservoirs will assist during water stress as a result of weather and agricultural drought. Farmers can use water stored in canals to irrigate farmlands prompting high yields during prolong dry periods (Habib-ur-Rahman et al., 2022). The use of disease and pest resistant seedlings will mitigate the impacts of pest and disease infestation on crops. These seedlings can survive during harsh climatic conditions

providing high yields (Shrestha et al., 2022). Bank cutting to drain excess water will provide adequate drainage to remove surplus reducing the impacts on farmlands (Shrestha et al., 2022). Crop rotation and crop diversification is useful in combatting the impacts of climate change on cash crop production. The cycle and cultivation of various crops adds absent nutrients to the soil that was lost due to the impacts of climate change (Habib-ur-Rahman et al., 2022). Therefore, the results show there is a need for edification to ensure farmers are knowledgeable about the usefulness of crop rotation and diversification to mitigate the impacts of climate change on cash crop production.

CONCLUSION and RECOMMENDATIONS

It is evident from the data collected, majority of the farmers cultivate vegetables. The primary influences of climate change on cash crop production in the study communities were constant weather and agricultural drought and excessive rainfall. The main impacts of climate change on cash crop production in the study communities were decrease in water resources and soil moisture, increase in pests and crop diseases and flooding of farmlands. As such, the recommendations based on the findings of the study to mitigate the impacts of climate change on cash crop production were the creation water reservoirs for storage, use of diseases and pest resistant seedlings and bank cutting. The incorporation of these recommendations are tailored to address current challenges farmers are experiencing. In addition, more research along this line of study is required to ascertain the influences of climate change on cash crop production in other rural communities across the country.

Conflict of Interest

The authors have declared that that there are no competing interests.

Authors' Contribution

NA: Conceptualisation, Data Curation, Formal Analyses, Writing of the Manuscript, Review and Editing. AFW: Data curation, Formal analysis, Reviewing and Editing.

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