

# The Effect of Climate Variability on Community Livelihood in Rwanda. Case of Bugesera District

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**Abstract:-** The study entitled “the effect of climate variability on community livelihood in Rwanda, a case of Bugesera district” was conducted to assess three specific objectives, such as to assess climate variability status in Bugesera District from 1990 to 2021, to analyze the community livelihood in Bugesera District from 1990 to 2021 and to find out the relationship between extreme weather events occurring in Bugesera District and community livelihood. The study is descriptive and correlative design. Population of this study are district environmentalists and staff in charge of socio-economic development from district to sector level and cell level in Bugesera district. The total is constituted by 3 staff at district level, 30 staffs at sector level and 72 staff at cell level which form a total of 105 staff in Bugesera District. Data analysis was made using SPSS (Statistical package for social scientist) for correlational analysis. The study on the effect of climate variability on community livelihood in Rwanda, a case of Bugesera district gives an insight to the community on which measures they could take to ensure that, their livelihood stay positively changing over the years even if climate is changing. The study analyzes the impacts of climate variability on community livelihoods in Rwanda, focusing on the case of Bugesera District. The study findings confirm that, climate variability reduces 23.9% of community livelihood (negative contribution). Climate variability was observed over the years, but more observation was recently marked in 21<sup>st</sup> century with the same period of rapid economic development. Economic activities were increased while environment lose its beauty and places and later this result into climate variability over the years. Due to that, we encourage district and all concerned institutions to respect all measures of climate change mitigation at all levels from agriculture production to industrial development level. Communities are encouraged to manage climate variation vis a vis the economic activities with the purpose of increasing production and keeping climate safety. This could be achieved by planting trees, water management best practices, use of non-emitting technologies in industrial and energy use as well as production.

**Keywords:** Effect; Climate Variability; Community; Livelihood.

## I. INTRODUCTION

The global surface temperature for 2021 was the sixth highest since record keeping began in 1880 (Chauhan 2018), according to National Oceanic and Atmospheric Administration (NOAA) scientists. In a separate analysis of global temperature data, also released today, NASA has 2021 tying with 2018 as the sixth-warmest year on record (Frumkin 2018). December's global surface temperature tied with 2016 as the fifth highest in the 142-year record. The 2021 Northern Hemisphere surface temperature was the sixth highest in the 142-year record at 1.96°F (1.09°C) above the 20th century average (Weaver 2019). Of note, the Northern Hemisphere land surface temperature was the third highest on record. Only the years of 2016 (second) and 2020 (warmest) were warmer (Christine 2021). Meanwhile, the 2021 Southern Hemisphere surface temperature was the ninth highest on record (Steven 2022).

The German watch institute presented the results of the Global Climate Risk Index 2020 during COP25 in Madrid. According to this analysis, based on the impacts of extreme weather events and the socio-economic losses they cause, Japan, the Philippines and Germany are the most affected places by climate change today (Steven 2022). More frequent and intense drought, storms, heat waves, rising sea levels, melting glaciers, and warming oceans can directly harm animals, destroy the places they live, and wreak havoc on people's livelihoods and communities. As climate change worsens, dangerous weather events are becoming more frequent or severe (Chauhan 2018).

The socio-economic development of most countries especially those of developing countries is influenced by the climate (Chauhan 2018). Climate variability, thermodynamic processes, small and large-scale weather patterns, and landslide and atmosphere feedbacks significantly influence temperature, precipitations, and droughts as major signs of climate variability (Weaver 2019). Invariable disruptive conditions and intrinsically unusual conditions of climate extremes are the challenges that exist in assessing changes in climate extremes.

In Rwanda, the agricultural sector which is more challenged by change in climate extremes contributes to 31% of the total gross domestic product (GDP) (RDB 2022). Further, the Rwandan labor market is predominated by

agriculture with 73% of the Rwandan population classified as farmers. Extreme temperature, very high or very low precipitations, and drought are among the effects caused by climate variability (Steven 2022). Low access to basic social services and lack of sufficient information on the characteristics of the climate extreme events, if the higher extreme poverty rate in Rwanda 16.3% (Tvaronaviciene 2021), contribute more to the vulnerabilities to impacts of climate change. It has become hard for the agricultural sector in Bugesera district to sustain production to cope with increased demand for products due to the climate variability and prolonged dry and drought in that region (Christine 2021). Indirectly or directly climate can affect livestock with its shocks leading poor to devastating effects. Furthermore, vulnerability can often be increased by land use changes, hence raising the potential for catastrophic influence from climate extremes, like drought and flood (Dimpal 2017). These could be attributable to factors such as insufficient agriculture mechanization and irrigation technique, research funding, inappropriate technology, and inefficient infrastructure. Climate variability characteristics such as extreme temperature, precipitations, and droughts have notable socio-economic impacts highly because rain-fed agriculture is the backbone of the economy of Rwanda (Steven 2022). Climate variability assessment techniques are commonly used based on water supply indices derived from rainfall data and temperature records. In our days, the effects derived from climate variability are causing serious disasters and proposed measures for adaptation and mitigation sometimes fail because they remain unpredictable. Therefore, analyzing the effects of climate variability on community livelihood in the Bugesera district in the last two decades will help the country in the decision-making as well as an early warning system for

future disaster events. The aim of this study is to analyze the effects of climate variability on community livelihood in Rwanda by focusing on the case of Bugesera district.

**II. MATERIALS AND METHODS**

➤ *Profile of Bugesera District:*

According to the population and housing census of 2012, the population of Bugesera district is estimated at 13.9% of the whole Eastern Province population, and at 3.4% of the total population of Rwanda (and 34.3% are poor and 20.1% are extremely poor (EICV4 report), according to Labor force survey 2017, Bugesera district labor force participation rate was ratio 57.1% while unemployment rate was 11.2%. The district level of job opportunities was at 58.6% (NISR, 2022). Bugesera district is one of the seven Districts that constitute the Eastern Province in Rwanda. It covers a total surface area of 1337 Km<sup>2</sup>. The district is composed of 15 (Administrative sectors: Nyamata, Musenyi, Ntarama, Mwogo, Mayange, Juru, Rilima, Gashora, Ruhuha, Mareba, Ngeruka, Kamabuye, Nyarugenge, Rweru and Shyara.), 72 Cells and 581 Villages. It is in the Southwest of the Province, ranged between 30o 05’ Eastern longitude, and 2o 09’ Southern Latitude, and covers the surface of 1337 km<sup>2</sup>. The district is limitrophe with Rwamagana District of Eastern Province to its North-East, Nyarugenge and Kicukiro Districts of Kigali City to its North, Kamonyi District of Southern Province to its North- West, Ngoma District of Eastern Province to its East, Ruhango and Nyanza Districts southern province to its West, and finally the Republic of Burundi to its South where they are largely bounded with the Lake Rweru and Lake Cyohoha in the South (Bugesera District, 2022).

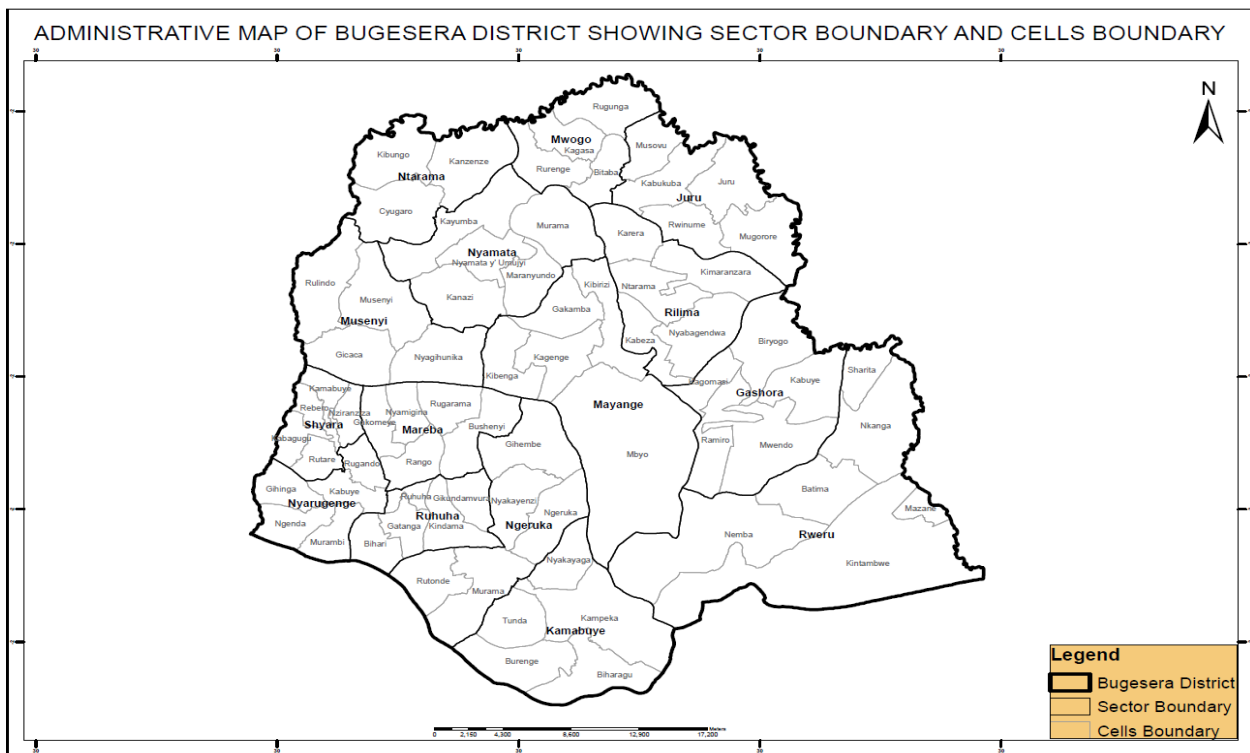


Fig 1 Bugesera District Administrative Map  
Source: Drown by the Researcher, 2022

Compared to other regions of the country, BUGESERA climate is dry with temperature varying between 20 and 30°C. The temperature average range is between 26 and 29°C. In the past the district experienced drought which resulted in hunger emigration. However, with increased government effort, the district had been afforested. Natural resources were also protected. This improved on its climatic conditions. Currently, the district has two dry seasons and two rainy seasons (Bugesera District, 2022).

Bugesera District is a rural District in the Eastern Province whose economy is principally dominated by Primary, Secondary and Tertiary sectors. These sectors are not yet modernized and hence the productions and productivity are still very low. Many challenges observed these Sectors constitute barriers to District’s Development, consequently, contribute to Poverty. Therefore, the economic activities of Bugesera District are divided into 3 main sectors depending on what are predominant in terms of production and their occupants (Bugesera District, 2022).

Primary Sector in Bugesera District is characterized by activities associated with primary economic activities including agriculture subsistence and commercial, forestry, farming & grazing, Fishing, and quarrying. The secondary sector includes those economic sectors that produce finished, usable products and construction. This sector generally takes the output of the primary sector and manufacturers finished goods or where they are suitable for use by other businesses, for export, or for sale to domestic consumers. This sector is often divided into light industry and heavy industry. Many of these industries consume large

quantities of energy and require factories and machinery to convert the raw material and waste heat that may pose environmental problems or cause pollution. The secondary sector supports both primary and tertiary sectors (Bugesera District, 2022).

➤ *Sampling and Data Collection Techniques:*

Population of this study are district environmentalists and staff in charge of socio-economic development from district to sector level and cell level in Bugesera district. The total is constituted by 3 staff at district level, 30 staffs at sector level and 72 staff at cell level which form a total of 105 staff in Bugesera District. The data were collected from NISR, Metheo Rwanda, Ministry of environment, Bugesera district reports and other institutions in charge of climate change mitigation and increasing people’s livelihood. The questionnaire was used to collect data.

**III. RESULTS AND DISCUSSION**

➤ *Background of Respondents:*

Background of Bugesera district staff selected for this study was presented based on their sex, age, education level and based on their experience as employees of Bugesera district. All these characteristics are important to ensure that, whether respondents are aware about climate variability in the area and its effect on community livelihood. Whether Bugesera district have stable climate, or it is changing over the years, in other words knowledge whether community livelihood is changing as response to the climate variability or other factors else.

Table 1 Characteristics of Respondents

Background of Respondents	Frequency	Percent
<b>Sex</b>		
Male	65	61.9
Female	40	38.1
<i>Total</i>	<i>105</i>	<i>100.0</i>
<b>Ages interval</b>		
Between 21-30 years old	25	23.8
Between of 31-40 years old	43	41.0
Between of 41-50 years old	32	30.5
Over 51 years old	5	4.8
<i>Total</i>	<i>105</i>	<i>100.0</i>
<b>Education level</b>		
Secondary A2	29	27.6
University Degree	66	62.9
Masters ‘Degree	10	9.5
<i>Total</i>	<i>105</i>	<i>100.0</i>
<b>Experience in administration of Bugesera</b>		
Between 2-4years	33	31.4
Between 5-8 years	52	49.5
9-15 years	15	14.3
16 years and above	5	4.8
<i>Total</i>	<i>105</i>	<i>100.0</i>

Among 105 Bugesera district staff assessed 65 (61.9%) were males and 40 (38.1%) were female. By ages of respondents, 43 (41%) were aged between 31 to 40 years old, 32 (30.5%) aged between 41 to 50 years old, 25 (23.8%) were aged between 21 to 30 years old and 5 (4.8%) aged 51 years old and above. By educational level, among 105 Bugesera district, 29 (27.6%) were

graduated in secondary education with A2 level, 66 (62.9%) graduated from university with A0 level and 10 (9.5%) graduated with master’s degree level. By experience as employee in Bugesera district administration (district to cell level) where 52 (49.5%) of respondents experienced between 5 to 8 years, 33 (31.4%) of respondents experienced between 2 to 4 years, 15 (14.3%) of respondents experienced between 9 to 15 years and above.

➤ *Climate Variability:*

• *Temperature:*

Assessment on the existing literature for temperature variation in Bugesera District shows that temperature varied of the years in between 11 degrees (minimum temperature) to 25 degrees in last 22 years, Table 3.2. From 1990 to 2021, the minimum temperature was 11.55 degrees to 13.43 maximum degrees. In the same period, the minimum of mean temperature was 18.49 degrees to 20.65 degrees’ maximum mean of temperature in Bugesera District since 1990 to 2021, table 2

Table 2 Temperature Variation in Bugesera District 1990 to 2021

Year	Mean-Temperature (° C)	Min-Temperature (° C)	Max-Temperature (° C)
1990	19.78	13.35	24.88
1910	18.56	11.82	23.77
1920	18.58	11.84	23.79
1930	18.49	11.55	23.94
1940	19.47	12.47	24.61
1950	19.04	12.18	24.06
1960	19.56	12.94	24.23
1970	19.59	12.75	24.50
1980	19.72	12.84	24.70
1990	19.87	12.69	25.15
2000	20.32	12.98	25.66
2010	20.65	13.33	25.94
2020	20.22	13.43	24.89
2021	20.26	13.19	25.29

Source: Meteo Rwanda, 2022

While the minimum of maximum temperature of the years in Bugesera district were 23.77 degrees to 25.94 degrees’ maximum of temperature in Bugesera district. Figure 2 shows a monthly data presentation as a summary from a monthly observation since 1990 to 2021. The max temperature is illustrated in December which shows average of 22 years of 24.69 degrees while the month with highest maximum temperature was August with 26.59 degrees. By monthly analysis since 1990 to 2021 July was marked as the month of lowest average mean temperature 18.60 degrees to August as the maximum temperature 19.70 degrees.

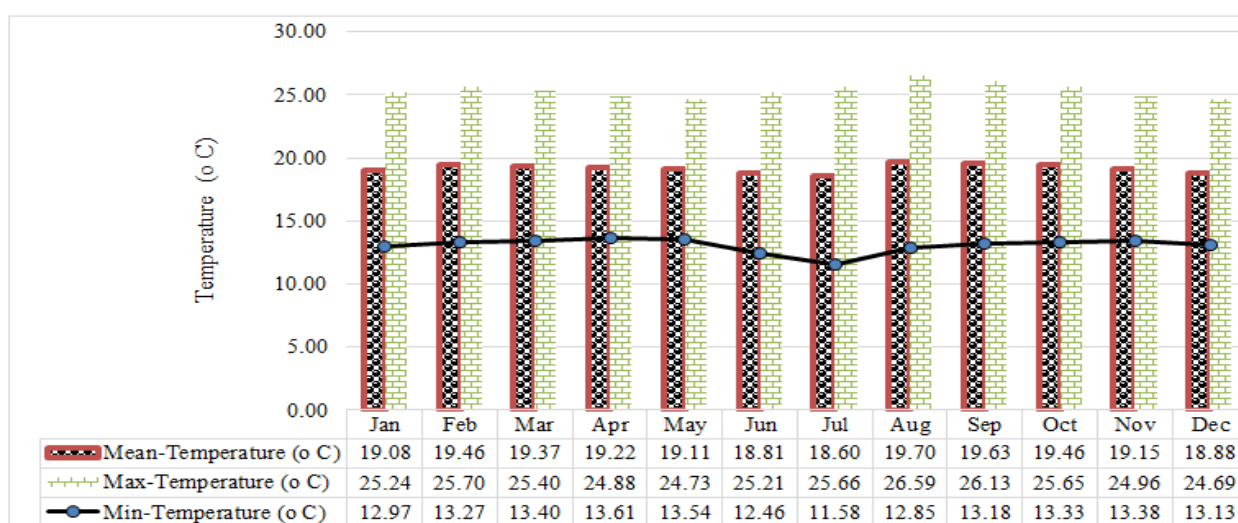


Fig 2 Monthly Climatology of Min-Temperature, Mean-Temperature and Max-Temperature 1991-2020 in Bugesera District Meteo Rwanda, 2022

By minimum temperature of the years July has shown the minimum value of 11.58 degrees to April of 13.61 degrees over 22 years (1990 to 2021).

• *Rainfall:*

Observation from figure 2 for Bugesera district rainfall was varied since 1990 to 2020 and this variation was not constant. From 1990 rainfall level was reduced till 1992 later increase to 1996 and after again reduces until 1999. From 1999 to 2002 it was increased again and after 2006 remain increasing 2009. By observation 2020 is the best year with high level of rainfall from 1990 to 2020 and has reached around 1800mm of rainfall.

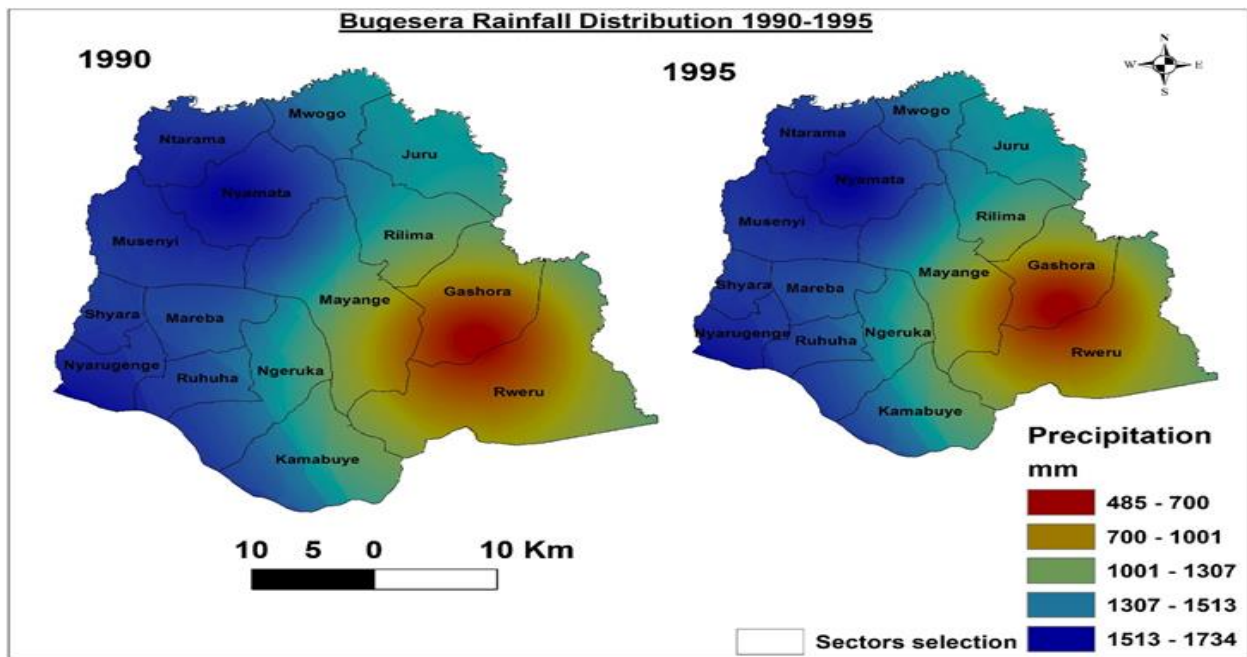


Fig 3 Bugesera Rainfall Distribution by Sectors from 1990 t 1995

Observation from figure 3 shows that there is minor change in rainfall distribution among Bugesera district sectors. Same sectors remain with same rainfall quantity in the observation of 5 years. This is because 5 years is a short period for rainfall variability measurement.

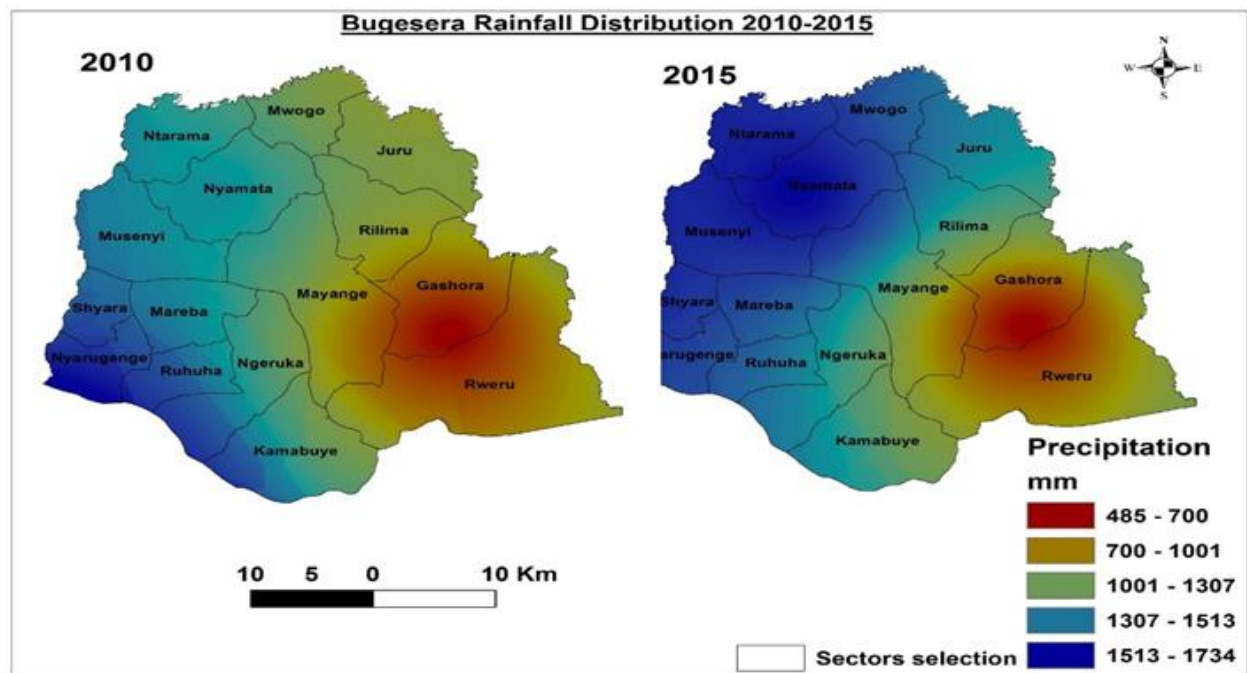


Fig 4 Bugesera Rainfall Distribution by Sectors from 2010 t 2015

Figure 4 shows a really high difference from different sectors of Bugesera district in 5 years. In 2010 Ntarama, Mwogo, Nyamata, Musenyi, Mareba, and Musenyi were characterized by rainfall ranged between 1,307mm to 1,513mm and by 2015 observation were characterized by rainfall ranged between 1,513mm to 1,734mm. This is quite high difference in only five years.

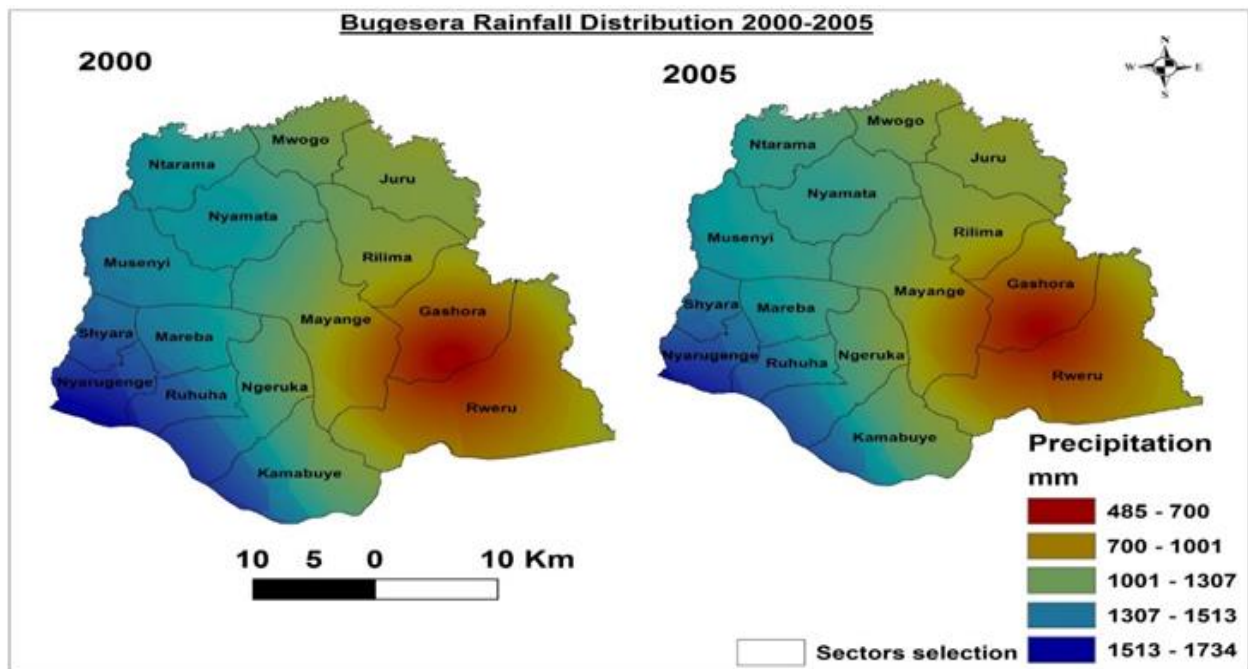


Fig 5 Bugesera Rainfall Distribution by Sectors from 2000 t 2005

Figure 5 show that from 2000 to 2005 there is minor change which could not be interpreted easy by picture observation. It seems like sectors remain in the same range of rainfall level.

- *Vegetation Cover:*

In this sub section the researcher has focused on the change of land size occupied by vegetation (all types) in Bugesera district within respective sectors and the extent to which the size was changed over the years from 1990 to 2020. Demonstration was made using maps and using numbers in tables.

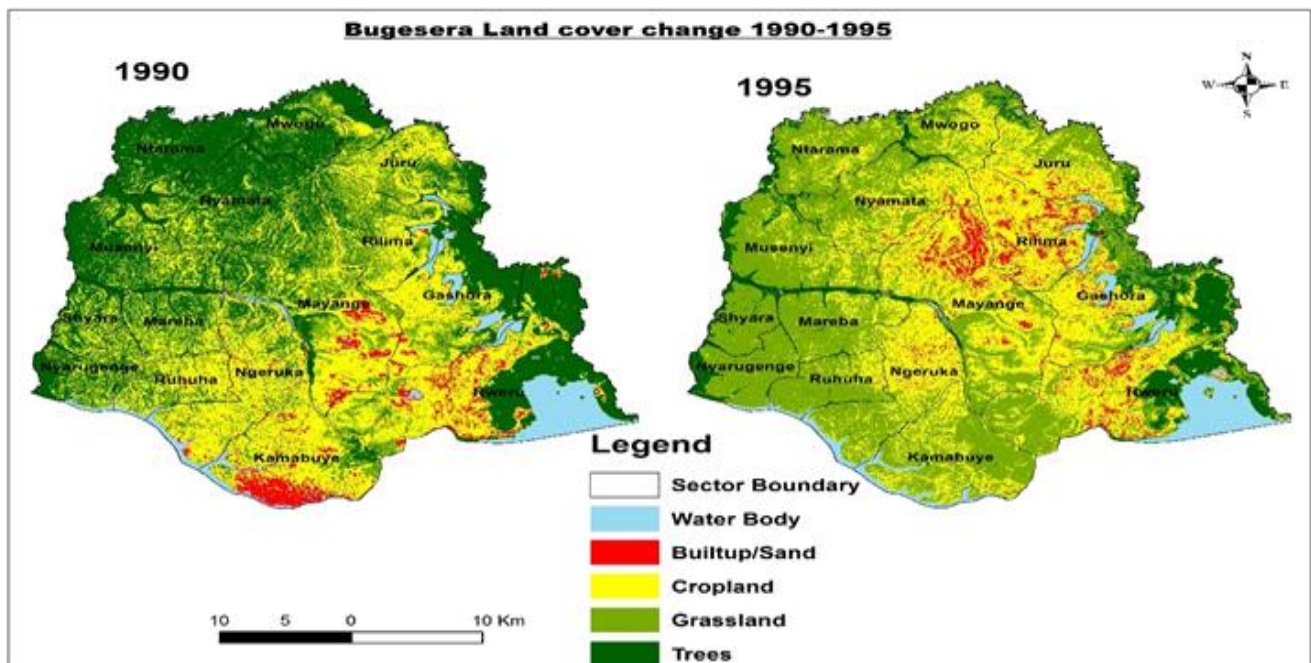


Fig 6 Bugesera Vegetation Land Cover change 1990 to 1995

Observation from figure 6 shows that size of land occupied by trees in Ntarama, and surrounding sectors were reduced from 1990 to 1995 in favor of grassland and cropland. From 1990 also built-up/ Sand land size were reduced in favour of both water, grassland, cropland covered land in Kamabuye sector.

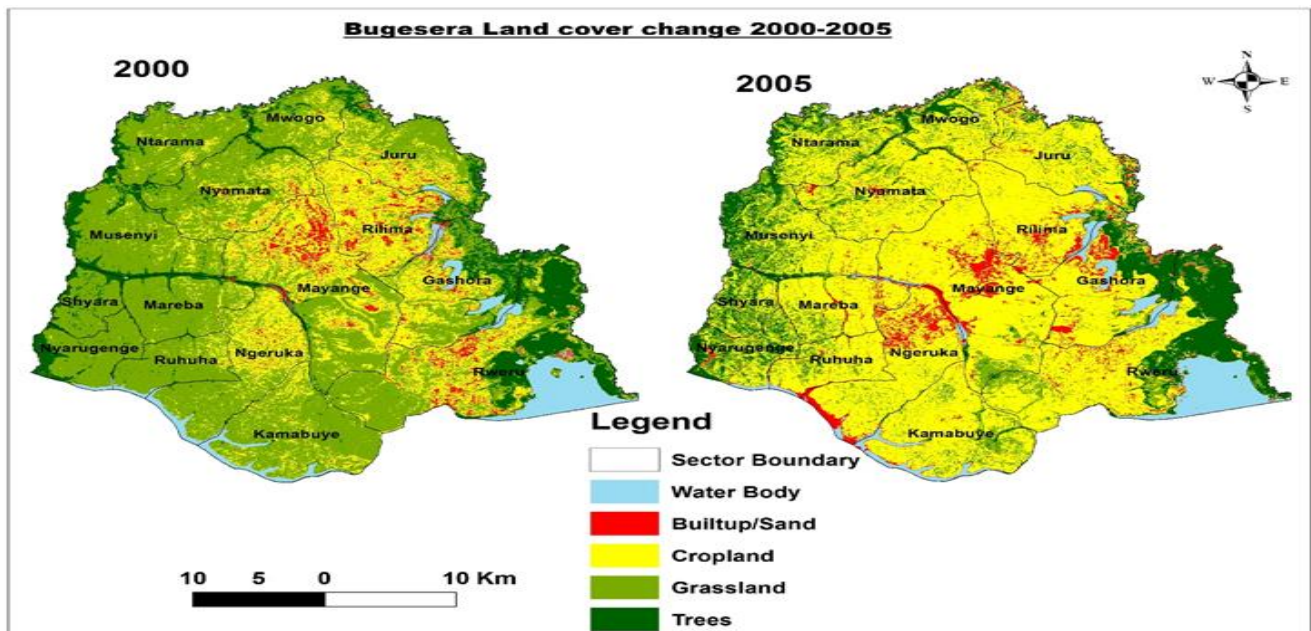


Fig 7 Bugesera Vegetation Land Cover change 2000 to 2005

Figure 7 shows a clear difference in five years where the whole district loses vegetation covered land in favor of cropland. The main observation is clear in the sector of Kamabuye, Ruhuha, Nyamata and Mareba.

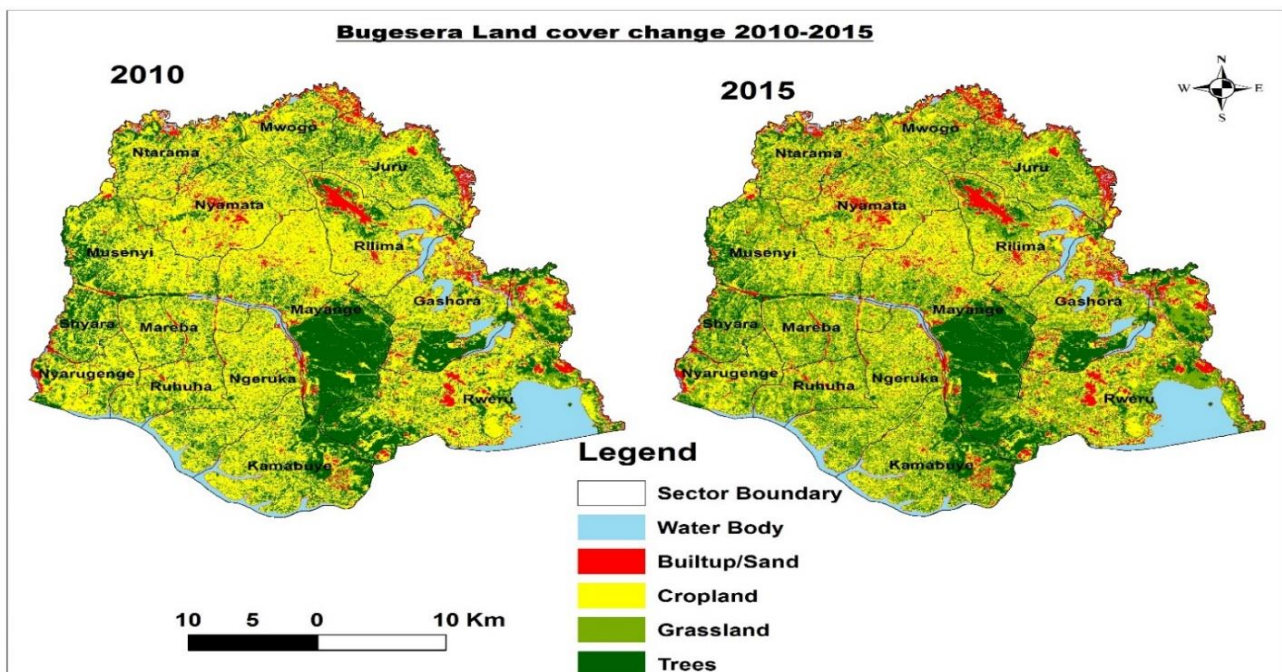


Fig 8 Bugesera Vegetation Land Cover change 2010 to 2015

Land covered by vegetation in the years of 2010 to the years of 2015 was not changed a lot. Figure 8 tells that crop land is that with large size in Bugesera since 2010 to 2015. Water and trees covered land were small in this period and these are best for climate consistency of the years.

• *Community views on Climate variability status in Bugesera District:*

In this section, the researcher has assessed the views of respondents on the indicators which illustrate the climate variability status in Bugesera district since 1990 to 2021.

As seen from the table 3, among 105 assessed Bugesera district staff, the statement which illustrates that the temperature of Bugesera District was normal over the seasons, 25.7% of respondents were strongly disagreed, 61% were disagreed, however, the 8.6% of respondents were Neutral, 4.8% were agreed with 1.92 mean and 0.730 standard deviation).

According to the history and observation, temperature in Bugesera district changed over the years, 22.9% of respondents were agreed and 77.1% strongly agreed with 4.77 mean and 0.422 standard deviation. About the statement illustrates that the people in Bugesera area are happy with the temperature of the area, 9.5% of respondents strongly disagreed, 54.3% were disagreed, however, 9.5% were Neutral, 15.2% were agreed, 11.4% were strongly agreed with 2.65 mean and 1.193 standard deviation.

Table 3 Views of Respondents on the Indicators of Climate Variability Since 1990 to 2021

Climate Variability indicators since 1990-2021	SA (%)	A (%)	N (%)	D (%)	SD (%)	Total	Count	Sample	Mean	Stdv.
<b>Temperature</b>										
Temperature of Bugesera District is normal over the seasons.	0.0	4.8	8.6	61.0	25.7	100	105		1.92	0.730
According to the history and observation, temperature in Bugesera district was changed over the years.	77.1	22.9	0.0	0.0	0.0	100	105		4.77	0.422
People in Bugesera area are happy with the temperature of the area.	11.4	15.2	9.5	54.3	9.5	100	105		2.65	1.193
<b>Rainfall</b>										
From last more than 30 years, the rainfall period was changed in Bugesera District.	14.3	61.9	15.2	8.6	0.0	100	105		3.82	0.782
There is not incidents or disaster taken place in Bugesera district for 5 years as an outcome of heavy rainfall.	5.7	14.3	9.5	45.7	24.8	100	105		2.3	1.161
<b>Drought</b>										
Bugesera District has a normal drought period over the years.	9.5	26.7	9.5	41.9	12.4	100	105		2.79	1.238
Bugesera District drought period is different to that of other districts in Rwanda.	13.3	45.7	4.8	25.7	10.5	100	105		3.26	1.271

Source: Primary data, November 2022

The status of rainfall variability, the study findings confirm that, from last more than 30 years, the rainfall period changed in Bugesera District with 8.6% of respondents which were disagreed, 15.2% were Neutral, 61.9% were Agreed and 14.3% were Strongly agreed with 3.82 mean and 0.782 standard deviation. There is not incidents or disaster taken place in Bugesera district for 5 years as an outcome of heavy rainfall which 24.8% of respondents were strongly disagreed, 45.7% were disagreed, 9.5% of respondents were Neutral, 14.3% were agreed, 5.7% Strongly agreed with 2.3 mean and 1.161 standard deviation.

Assessment on drought variability in Bugesera district since 1990 to 2021, on the statement which indicates that Bugesera District has a normal drought period over the years, only 12.4% of respondents were strongly disagreed, 41.9% were disagreed, 9.5% were Neutral, 26.7% were Agreed, 9.5% were strongly agreed with mean of 2.79 and 1.238 standard deviation. Bugesera District drought period is different to that of other districts in Rwanda, the 10.5% were Strongly Disagreed, 25.7% were disagreed, 4.8% were Neutral, 45.7% were agreed, 13.3% were strongly agreed with mean of 3.26 and 1.271 standard deviation.

➤ *Community Livelihood change in Bugesera District from 1990 to 2021:*

As seen from the table 4, community livelihood change was not favored by climate variability, more specifically agriculture production. The assessment of 105 staff in Bugesera district confirm that because of climate change in Rwanda, Bugesera district is known as the first district which face famine frequently over the years, 5.7% of respondents were strongly disagreed, 4.8% were disagreed, however, the 3.8% were Neutral, 76.2% were Agreed, 9.5% were Strongly agreed with mean of 3.79 and 0.895 standard deviation.

Due to the changes of rainfall and long period of sun, agriculture and animal production were reduced over the years in Bugesera district, 20% of respondents were disagreed, 69.5% were agreed, 10.5% were strongly agreed with a mean of 3.70 and 0.909 standard deviation.

Climate change has brought conflicts among family and community originated from land degradation and pressure on food due to competition with animal's food with 8.6% Disagreed, 3.8% Neutral, 62.9% Agreed and 24.8% strongly agreed, with a mean of 4.04 and 0.796 standard deviation. Due to the heavy rainfall (irregular) and heavy sunshine as well as poverty in families of Bugesera District, school drop-out was observed with 4.8% Strongly Disagreed, 15.2% Disagreed, 8.6% Neutral, 54.3% agreed, 17.1% Strongly agreed with a mean of 3.64 and 1.084 standard deviation.



Table 4 Perception of Respondents on Community Livelihood Change Indicators in Bugesera District Since 1990 to 2021

Change of community livelihood indicators since 1990-2021 in Bugesera	SA (%)	A (%)	N (%)	D (%)	SD (%)	Total	Count	Sam	Mean	Stdv.
Because of climate change in Rwanda, Bugesera district is known as the first district facing famine frequently over the years.	9.5	76.2	3.8	4.8	5.7	100	105		3.79	0.895
Due to the changes of rainfall and long period of sun, agriculture and animal production were reduced over the years in Bugesera district.	10.5	69.5	0.0	20.0	0.0	100	105		3.70	0.909
Climate change has brought conflicts among family and community originated from land degradation and pressure on food due to competition with animal's food.	20.0	72.4	3.8	3.8	0.0	100	105		4.09	0.622
Due to the heavy rainfall (irregular) and heavy sunshine as well as poverty in families of Bugesera District school drop-out was observed.	24.8	62.9	3.8	8.6	0.0	100	105		4.04	0.796
Bugesera is one among districts mostly affected by the climate change effects and people born in the place use to move to the other districts for searching living conditions.	17.1	54.3	8.6	15.2	4.8	100	105		3.64	1.084
Climate change effects has resulted into increased community poverty, as it discouraged agriculture sectors and different business and functions.	30.5	45.7	8.6	15.2	0.0	100	105		3.91	1.001

Source: Primary data, November 2022

Bugesera is one among districts mostly affected by the climate change effects and people born in the areas moved to the other districts for searching living conditions during the drought with 4.8% Strongly Disagreed, 15.2% Disagreed, 8.6% Neutral, 54.3% Agreed, 17.1% Strongly agreed with a mean of 3.64 and 1.084 standard deviation. And climate change effects has resulted into increased community poverty, as it discouraged agriculture sectors and different business and functions with 15.2% Disagreed, 8.6% Neutral, 45.7% Agreed, 30.5% Strongly agreed with a mean of 3.91 and 1.001 standard deviation.

Table 5 Change of Livelihood Indicators for Bugesera District 1990 to 2020

Year	Life expectancy at birth	GNI per capita (2017 PPP\$)	Poverty Rate (%)
1990	33.4	933	67.0
1995	31	749	62.5
2000	48.6	860	58.0
2005	55.3	1,137	53.4
2010	63.4	1,497	48.0
2015	67.5	1,846	44.5
2020	69	2,155	40.3

Source: NISR, 2022

Livelihood change of the community could not be measures only by people's perception or any single indicator, but more indicators(Christine 2021). With this study, in addition to the views of respondents, the researcher also has examined the change of life expectancy at birth, Gross National Income (GNI) per capita and poverty rate level for community households in Bugesera district vis a vis the climate variability constraints. From 1990 life expectancy at Birth of Bugesera District community population was changed from 33.4 years to 69 years by 2021. In the same orientation, GNI (Gross National Income) per capita was increased from 933 to 2,155 USD per person and poverty were reduced from 67% of poor people to 40.3% of people in Bugesera District(RDB 2022).

➤ Relationship between Climate Variability on Community Livelihood:

Analysis of correlation between variables (climate variability and community livelihood) was made by summarizing the views of each respondent on overall variable assessed and later both means were compared using bivariate analysis parameters. All item's assessed on independent variable were grouped and all items assessed on dependent variable were grouped.

As seen from the table 6, the analysis shows that, the Pearson Correlation (r) is – 0.239 which means a negative weak correlation between climate variability and community livelihood and this correlation is statistically significant which means that, once climate variability increases its intensity, community livelihood changes. In other words, climate variability reduces 23.9% of community livelihood (negative contribution).

Table 6 Correlation Analysis

		Climate Variability	Community Livelihood
Climate Variability	Pearson Correlation	1	-0.239*
	Sig. (2-tailed)		0.014
	N	105	105
Community Livelihood	Pearson Correlation	-0.239*	1
	Sig. (2-tailed)	0.014	
	N	105	105

\*. Correlation is significant at the 0.05 level (2-tailed).

Source: Primary Data, November 2022

#### IV. CONCLUSION AND RECOMMENDATION

This study is important to the community and policy makers in field of environmental protection and community, livelihood development. Here both sides' community and policy makers should learn about climate variability mitigation and community livelihood development. Community could ensure respect of change in temperature and precipitation and apply adaptation methods like irrigation, crops mixture, construction of strong houses and terracing and planting of trees. Policy makers should provide both skills, technical and financial support to the communities.

All in all, it was found that, climate variability was observed in Bugesera district and in Rwanda in general. This has affected change in people's livelihood where precipitations affect water bodies and lowland regions and destroy plants. Livelihood has affected by climate variability because Rwandans more than 50% rely on agriculture as main income source for living, thus, as climate variability affect or down agriculture production, this affect negatively or reduce livelihood capacity of the community in Bugesera district.

Considering the findings from the study, recommendations were made to Bugesera District staff, the community, and all institutions responsible for environmental protection and socio-economic development. We call on the district and all concerned institutions to respect all measures to mitigate climate change at all levels from agricultural production to the level of industrial development. Communities are encouraged to manage climate change concerning economic activities to increase production and keep the climate safe. This could be achieved through tree planting, best water management practices, and the use of zero-emission technologies in industrial and energy use as well as manufacturing.

The study is scope gap limited, due to that the researcher encourages to evaluate the effect of climate variability to the country as whole not a single district like Bugesera or to the whole world community with maximum respect of climate variability attributed by location or region and with consideration of regional economic development differentiation.

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