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Floods and Food Security in Gatumba Zone, Burundi

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Abstract: *The food security question dominates discussions in global forums today. The growing problem of food insecurity in many nations is attributed to climate variability. This study assessed the extent that floods affect agriculture in Gatumba Zone. This study was guided by Food Availability Decline theory and anchored on case study research design. Both primary and secondary data were utilized in this study. The data collected revealed that farm productivity is affected significantly by floods. This research found that recurring floods are a major problem in Gatumba Zone as reported by a majority of the respondents. They affect the performance of the agriculture sector because they destroy crops and farms and also occasion the displacement of farmers, which interrupts their farming activities. The study recommends increased mobilization of financial resources by the government and other partners to support farmers coping mechanism aimed at addressing climate variability dynamics which affect food security.*

Key Words, *Climate Variability, Food Security, Farm Productivity, Food Availability.*

1.1 Introduction

This study aimed to examine the potential threats that climate variability poses to Burundi's food security. Therefore, a comprehensive approach was deemed essential to provide insight on the effects of floods on Burundi food security. Food security has been a prevalent concern since the turn of the century, driven by alarming statistics on global hunger. United Nations (UN estimated that 800 million people were grappling with hunger in 2021, marking a significant increase of approximately 46 million from the previous year's figures (FAO, 2022). Climate variability has exacerbated food insecurity in numerous countries, contributing to the progressive decline in agricultural production observed over the past five decades in Africa. This term encompasses fluctuations in the earth's climate patterns over short and long timescales, including variations in temperature, wind patterns, and precipitation, among other natural climate parameters. Climate variability accounts for 30% of the change in global agricultural yields,

leading households to allocate a larger share of their incomes to staple foods, thereby pushing many into poverty (Verschuur *et al.*, 2021). Insufficient food intake also has adverse effects on the health and wellbeing of individuals.

At the global level, India is one of the countries whose agricultural sector has been greatly affected by climate variability. The food system in this country has been affected by change in the production levels of its agricultural sector (Ajay & Pritee, 2013). The heat waves experienced in this country have negatively affected agriculture and food security. The damage that climate variability causes on crops, especially wheat has affected food supply, which has prompted significant rise in the price of wheat and its products. In a report that was released by the Global Food Policy Report in 2022, it warned that the variability of climate in India is likely to push more Indians towards hunger by 2030 because of the declining production levels.

Regionally, millions of people in Angola do not have access to sufficient food. The drought spells in this country have gotten worse in recent years and have forced about 3.8 million people into food insecurity (UNICEF, 2023). Because of climate variability, the agricultural harvesting seasons record losses of up to 40%, which in turn has affected households' livelihoods and incomes. The low harvests have severely affected access to food especially in rural areas. According to the International Fund for Agriculture Development (IFAD), majority of Angolans live in rural areas, and largely depend on rainfed agriculture as their source of food and income (IFAD, 2023). Therefore, many households face hunger and poverty because of the erratic rains. Food insecurity in urban areas is also high because they depend on the farm produce supplied by the farmers. So, low production in the rural areas affects the quantity of food supplied in urban areas. Because of the severe drought conditions in Angola, UNICEF has been heavily engaged in the provision of humanitarian assistance to prevent malnutrition among children and save lives of those suffering severe malnourishment.

The impact of climate variability on food security in Kenya is quite noticeable in terms of rainfall irregularity and temperature increase. Climate variations have greatly undermined agricultural production in various agricultural regions in this country. Agriculture is the mainstay of the Kenyan economy, contributing approximately 25.6% of its Gross Domestic Product (GDP), an indication that it is a major source of food security and income for the rural folk (Ochieng *et al.*, 2016). The dependency on rainfed agriculture has affected both crop and livestock yield. Downing (1992) established that in the semi-arid areas of the country, high temperatures favour production in highland but affects lowland areas negatively. Therefore, agricultural yield declines significantly in the lowlands when the temperature is high and precipitation low.

Climate variability has had notable effects on Burundi. The weather patterns shift from dry spells, high winds to heavy rains, and these conditions are becoming increasingly extreme and unpredictable. Communities have been destroyed by floods and thousands of people displaced. The consequences of climate shocks on food production in this country are enormous. Majority of the people are subsistence farmers and climate variability are a serious constraint that has affected production. The climate hazards include erratic rainfall followed by floods. As a result, domestics demand for food has outpaced demand. Against this background, this research study conducted an in-depth analysis on the effects of floods on Burundi food security, with a specific focus on Gatumba zone.

1.2 Statement of the Problem

In Africa, climate extremes, such as droughts, floods, landslides, and windstorms, have become increasingly prevalent. Achieving food security and ending hunger amidst the ongoing impacts of climate variability is a key priority within the Sustainable Development Goals (SDGs). SDG 2 aimed to eradicate world hunger by 2023. However, the 2023 SDG report highlighted that food insecurity remains a pervasive threat to the lives of millions across the globe. The United Nations has established that 9.2 percent of the global population, equivalent to 735 million people, face food insecurity. United Nations World Food Program (WFP) identified Burundi among the nations facing widespread hunger. At least half of the population is suffering from chronic hunger. Another key indicator is the soaring food prices in Burundi. This has led to its classification as one of the "red zone" countries by the WFP. It has also been determined that the total food production in Burundi is capable of covering only 55 days per person per year (WFP, 2021). These repercussions are experienced despite a greater proportion of Burundi's population identifying as farmers. Exploring the climate variability effects manifestation in Burundi is key to understanding the reason that the problem of food insecurity persists in this country. Normally, the ripple effects of food shortages can also extend beyond individual households to impact entire communities and the nation's development trajectory. Reduced agricultural productivity not only undermines food availability but also diminishes income opportunities for farmers, perpetuating cycles of poverty and inequality. Furthermore, food insecurity can fuel social unrest and migration, straining the already fragile systems of governance and exacerbating humanitarian crises. This study therefore comprehensively examined floods one of the complex impacts of climate variability on food security in Burundi.

1.3 Study Objective

To analyse the extent that floods affect food security in Gatumba zone.

1.4 Justification

Climate variability, characterized by fluctuations in precipitation, temperature, and general weather patterns, poses significant disruptions to agricultural systems. Hence, this study investigating the impact of floods on food security in the Gatumba zone was justified. Without it, there would be limited research available regarding the state of food security in the selected study site, attributable to the unfavorable climatic conditions prevalent in this region. Given the vulnerability of the agricultural sector, it was imperative to explore floods in the Gatumba zone have impacted agricultural practices and crop harvests. Projections indicate that extreme weather conditions will become more severe in the future, underscoring the necessity to comprehend the impact of this condition on food systems. This research aimed to illuminate the danger posed by unpredictable weather conditions on the welfare of the people. Ignoring this area of study would deprive individuals and states of the knowledge required to mitigate the effects of floods on food security.

1.5 Theoretical Framework

Food Availability Decline (FAD) Theory

The FAD approach is credited to the scholarly works of the economist, Amartya Sen (Bowbrick, 2022). One of the core assumptions of this theory is that a sudden reduction of food supply causes famines. It describes that the major causes of this decline are wars, epidemics and natural disasters, such as floods, drought, and pest infestation to mention a few. The FAD approach explains further that, due to the constraints on food availability caused by climatic hazards, the prices of food commodities rise, posing

challenges for vulnerable households in meeting their basic needs (Atubiga and Donkor (2022). This is an approach that underscores that natural phenomenon like floods have the potential to reduce food production, which is a critical factor leading to food insecurity (Milà-Villarroel *et al.*, 2016). It is a relevant theory in this study because it predicts what the objective of this research seeks to establish, which is the extent that floods effect agriculture. As earlier explained, FAD theory emphasizes that floods can cause a decline in production, which means that farm productivity is affected and the agricultural activities are also hampered.

1.6 Literature review

Effect of Floods on Food Security

The term food security at its earliest usage referred to global, regional, national food supply and also shortfall in food supply compared to the demand (Shetty, 2015). It was later decided that adequacy of food at the global, regional and national levels was not sufficient, and it would be more relevant to look at it from community, house hold and individual levels. Today, according to the World Bank, the term food security is defined according to the World Food Summit of 1996 as a situation whereby, "…all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (World Bank, 2023). The term has therefore broadened beyond food supply to include four other main dimensions of food access, availability, utilization, and stability.

Large and catastrophic floods have been observed in diverse areas in recent years (Haraldsen, 2023). It is claimed that these catastrophic events have grown more common now than it was observed previously. Haraldsen explains that plains are important agricultural areas with high productivity, but their vulnerability to floods is significant. Large floods cause severe damage on agricultural land through direct damage on crops, sedimentation and erosion. Floods wash away a significant amount of topsoil of agricultural lands, which is a loss for agricultural productivity. Generally, the topsoil has high levels of nutrients and organic matter. This reduces the yield in such lands, especially in the short-term.

In his study, Haraldsen (2023) explored flood damage on agricultural land by analyzing the impact of the catastrophic floods that happened in Norway in 1995, which flooded about 14,000 hectares of agricultural land. The damage occurred on these lands either through erosion or sedimentation such that about 1000 hectares could not be used for agriculture any longer until restoration measures were applied. His study found out that crops such as potatoes had almost total failure after logging even in cases where it only lasted for 1-2 days. Delayed growth was another consequence of floods on crops such as hay and grass for silage. As for cereals, the floods caused significant yield loss regardless of the period they were waterlogged. In this study, it was established that different plants have different tolerance levels for floods, which also reflects in the quantity of yield.

Wang *et al.*, (2022) concurs with Haraldsen that flooding and the waterlogging that follows are agricultural disasters that cause remarkable damage on crop production. Wang *et al.*, considers the rushing effect of water as one of the elements that destroys the crops. They also express that the submergence of crops creates abiotic stress on the crops, including oxygen depletion, reduced light availability, and alteration of the chemical characteristics of the soil. A combination of these effects reduces crop stand, growth, and yield substantially. According to Wang *et al.*, (2022), excess rainfall events have grown more common today because of climate change, and reduction in crop yields owing

to the floods has been substantial. This has in turn affected grain supply, thereby creating food insecurity. The authors express that China's agricultural sector suffers greatly the ravages of extreme floods events. The Yangtze River, which is the longest river in this country, is known for frequent floods after heavy downpour.

Wang *et al.*, (2022), the severe flooding affects agriculture along the Yangtze River Basin. The high frequency and long duration of flood disaster combined with water logging are huge challenges to agriculture in Yangtze River Basin. They are responsible for up to 40% yield reduction in this area. As one of the most agricultural areas in the world, which accounts for 28.6% of the total grain production in China and 24.5% of the total crop-harvesting area in China, the effect of flood on crop yield in this area are felt throughout China's food system. Further, the researchers developed a risk evaluation framework that investigated the most important predictor of crop damage during floods in Yangtze River Basin and they established this to be the flood duration. Ochieng *et al.*, (2017) study also found that there is a strong positive correlation between floods and economic damage in terms of crop losses. Therefore, when the duration of flood increases, the more destruction it causes on the agricultural.

Floods also affect agriculture because they prompt farmers to abandon farming and seek jobs in other sectors. The severe damage on agricultural infrastructure can demotivate farmers to continue with the practice, which ends up affecting food security within a country. Flood- induced displacement also affects the agricultural sector. Kakinuma *et al.*, (2020) explains that, floods cause population displacement as people are forced to change their residences permanently or temporarily. In 2018, the Internal Displacement Monitoring Center (IDMC) reported that at least 16.1 million people were displaced because of weather-related events and 5.4 million of them were as a result of floods (Kakinuma *et al.*, 2020). The statistics showed that African countries were the most affected. In 2022, Nigeria was facing the worst floods in a decade causing the displacement of over 1.3 million people (UNHCR, 2022). Nigeria has a huge agricultural sector that employs about 36% of this country's total labour force, and so when farmers are displaced, they cannot continue with the practice. This creates negative effects on the supply of food in the country. Burundi is also highly vulnerable to flood, and so the effect of floods on agriculture in this zone was a subject of interest in this study.

1.7 Methodology

This study adopted a case study research design. This approach facilitated comprehensive and nuanced investigations into this complex real-world phenomenon of climate variability. Widely recognized across various disciplines, the case study design proves particularly valuable when seeking an in-depth understanding of real-life events, phenomena, or issues. Semi-structured questionnaires comprising both open-ended and closed-ended questions were employed. Another tool for collecting data that the researcher used was interview guide. Lastly, books, scholarly journals, reports, reputable websites were used in data collection. This study was conducted in Gatumba zone, Burundi. Burundi is a landlocked country located in East Africa. It is bordered by Rwanda to the north, Tanzania to the east and south, the Democratic Republic of the Congo (DRC) and Lake Tanganyika to the west. Burundi is a relatively small country in the African continent, known for its hilly terrain and beautiful landscape. Its capital city is Bujumbura. Gatumba zone is situated in the peri-urban area of the city of Bujumbura. It is bordered by Lake Tanganyika to the south, the rural commune of Gihanga to the north, Bujumbura to the south - east, and the DRC to the west. The main economic activities of the households in this Gatumba Zone are agriculture, pastoralism, and fishing.

The targeted population comprised of the heads of households in Gatumba Zone, community leaders in Gatumba Zone, along with government officials working in the Ministry of Environment, Agriculture, and Livestock in the Republic of Burundi. For the heads of households participating in the study, a simple random sampling technique was employed. Through this method, each head of household within Gatumba zone was afforded an equal opportunity for inclusion. The same approach was applied in identifying the community leaders who participated in this study. In contrast, for respondents affiliated with the Ministry of Environment, Agriculture, and Livestock in Burundi, a purposive sampling strategy was utilized. This deliberate selection process involved identifying individuals possessing the requisite expertise to contribute meaningfully to the study's objectives. Specifically, individuals knowledgeable about climate variability and its impact on food security within Gatumba zone were targeted for inclusion. The sample size was calculated using Taro Yamane's (1967) formula. The mathematical representation of this method is as follows:

$n= N/ (1+N (e)^2)$

N signifies the populations getting studied. The total population for this study is 3365 as illustrated by Table 3.1

e is the margin of error. This study used a margin of error of 0.1.

$n= 3365/ (1+3365(0.1)^2)$

$n= 3365/ (1+3365(0.01)$

$n=3365/ (1+33.65)$

$n=3365/34.65$

$n=97$

Table 1: Target Population and Sample Population

	Target Population (N)	Sample population (e)
Households in Gatumba Zone	3210	75
Community Chiefs	55	12
Representatives Ministry of Environment, Agriculture and Livestock	100	10
Total	**3365**	**97**

Source: Authors, 2024

Data collected from the field was filtered, sorted and cleaned in line with research objectives. The data was then coded before being input into the statistical package for social science (SPSS) software Version 27. Quantitative data was analysed using descriptive statistics. It involved calculation of percentages, and frequencies. Thematic analysis entailed the creation of themes related to the study variables. This was performed on the qualitative data provided from interviews and the open-ended questions in the questionnaire. The results were presented using tables, graphs and in prose.

1.8 Data Analysis and Interpretation

Response Rate

Table 2: Response Rate

	Frequency
Farming households	62
Community Chiefs	4
Representatives Ministry of Environment, Agriculture and Livestock	6
Total	**72**

Source: Field Data, 2024

Table 2 shows that a total of 72 respondents participated in this study. The study's sample size was 97 respondents; thus, this was 74% representation. A 74% response rate was satisfactory and gives credence to the study to provide accurate and credible information about climate variability and food security in Gatumba Zone.

The Challenge of Flooding in Gatumba Zone

The study sought to establish the extent to which floods affect agriculture and consequently food security in Gatumba Zone. To establish the prevalence of flooding in Gatumba Zone, the respondents were asked whether they had noticed an increase in the frequency of floods in Gatumba Zone in recent years. Instructively, 100% of the respondents affirmed that floods had become more frequent. This view was corroborated by the Key Informant Interviewees who also described flooding in Gatumba Zone as a serious crisis that had destroyed farmland, homes and infrastructure. KII 1 noted the following:

> *"Gatumba zone has experienced flooding annually in the last ten years or so. The flooding has had devastating effect on the agriculture sector as farmland has been destroyed; crops washed away as well as animals and peoples' homes. I believe the destruction of crops due to the flooding has contributed to the food security challenges that the country has been going through lately" (KII 1, 2024).*

The responses concur with what has been widely reported about the flooding problem in Burundi. The flooding in Gatumba Zone has been attributed to the breaking of the banks of River Rusizi which traverses the area. This phenomenon leaves many families devastated. The International Federation of Red Cross' (IFRC) statistics on the number of people that were affected by floods in the various villages in Gatumba Zone in May 2018 were as shown in Table 3.

Table 3: Villages and People Affected by Floods in May 2018

Villages	Number of affected people			Total affected people
	Men	Women	Children	
Gaharawe	355	321	1384	2060
I Mushasha	237	234	1101	1572
Mushasha II	391	377	1740	2508
I Muyange	121	124	333	578
Muyange II	276	387	936	1599
I Kinyinya	189	202	944	1335
Kinyinya II	188	184	888	1260
Warubondo	201	204	337	742
Vugizo	185	225	892	1302
TOTAL	**2143**	**2258**	**8555**	**12956**

Source: IFRC, 2018

Table 3 shows that in May 2018, floods affected 12,956 people living in the villages in Gatumba Zone (IFRC, 2018). In 2020, the International Organization of Migration (IMO) also reported startling figures about the effect of the severe floods that occurred in Gatumba Zone in May 2020. According to the reports, the most affected villages by the floods were Gaharawe, Kinyinya I, Kinyinya II, Mushasha I, Mushasha II, Muyange I, Muyange II. The report also indicated that these floods affected about 45,681 people, which is almost four times the number of those affected by the 2018 floods (IOM, 2020). This is an indication that the floods in Gatumba Zone are getting worse and so are their repercussions on the people. In April 2023, Gatumba Zone was once again hit by severe flash floods that affected thousands of households and resulting in extensive destruction (Irakoze, 2023). The displacement of the people by the floods means that they cannot meaningfully engage in agriculture and this affects food production, effectively undermining food security.

Extreme weather conditions can have destructive effects on crops. Thus, this study inquired from the study participants about effects of floods observed on the farms. Their responses were as illustrated by Figure 1.

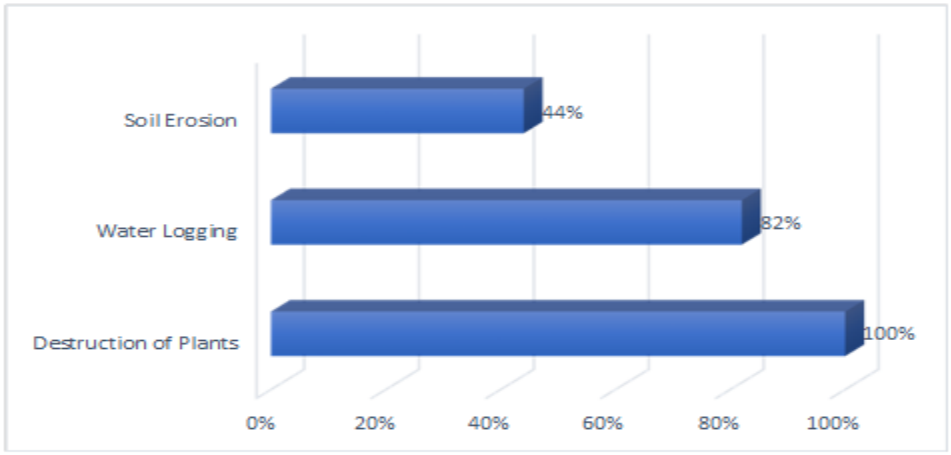

Figure 1: Effects of Floods on Farms in Gatumba Zone
Source: Field Data, 2024

Figure 1 shows that all respondents agreed that floods destroy plants. 82% agreed that the other destructive effect of floods on farms in Gatumba Zone is water logging. 44% confirmed soil erosion as the other effect on the farms in Gatumba Zone following floods. Water logging is a serious threat to crop productivity. Floods also cause soil erosion because the sheer velocity of the water dislodges soil particles and carry them downstream. Soil erosion has detrimental effects on crops because it often results in the loss of the fertile topsoil layer, which is rich in organic matter and nutrients essential for plant growth. The study determined that crops such as maize, beans, Amaranth, sweet potatoes, tomatoes are the most affected when floods occur in Gatumba Zone.

Asked whether flooding had occasioned displacement of farmers, 100% of the respondents responded in the affirmative. These findings are corroborated by Kakinuma *et al.*, (2020) who carried out a similar study where they established that floods cause displacement of populations. A case example is the flooding that occurred in Gatumba Zone in May 2018. It destroyed several houses and many others were flooded as showed by Table 4.

Table 4: House Destroyed by Floods in Gatumba Zone in May 2018

City	Houses totally destroyed	Houses partially destroyed	Houses flooded	Total
Gaharawe	40	51	256	347
Mushasha I	87	105	27	219
Mushasha II	116	177	129	422
Muyange I	81	38	10	129
Muyange II	19	16	259	294
Kinyinya I	65	109	24	198
Kinyinya II	79	57	49	185
Warubondo	10	19	120	149
Vugizo	7	16	167	190
TOTAL	504	588	1041	2133

Source: IFRC, 2018

Table 4 illustrates that a total of 504 houses were totally destroyed in 9 villages in Gatumba Zone, 588 were partially destroyed and 1,041 were flooded. The level of destruction varied, but the most affected were Mushasha II and Gaharawe. Majority of the families whose houses were destroyed were forced to relocate to safer areas. One of the interviewees expressed the devastation of having to leave their home because of floods. She said: *"Because of the flooding, I have been forced to move. All our houses were destroyed and our families forced to live as internally displaced people" (KII 2, 2024).*

The displacement of households as a result of floods has become a persistent problem in Gatumba Zone. IOM reported that the floods that hit this region in May 2020 resulted in the displacement of 17,792 people. The demographics of the persons displaced is in that year was as shown in Figure 2.

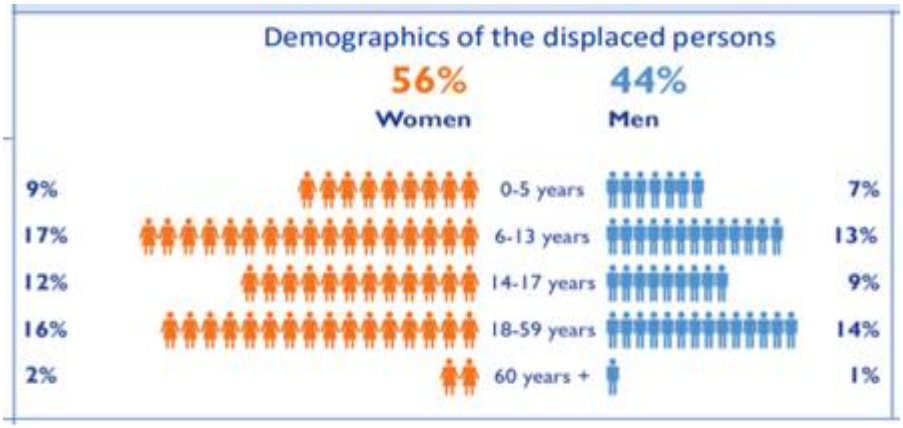

Figure 2. The Demographic of Displaced Persons in Gatumba Zone During 2020 Floods
Source: IOM, 2020

Figure 2 shows that majority of the men who were displaced were between the ages of 18-59 years and this age category was among the highest group of the internally displaced women as a result of floods. The people in this age category are among the most productive in a society, and since majorities are farmers, displacement forces them to abandon their farming activities to the detriment of food security. Sana (2023) conducted a study on the displaced persons following the April 2013 floods in Gatumba Zone. One of the internally displaced persons who were interviewed during this study expressed that he was forced to flee his home together with his family for the third time since 2019. Among the displaced persons, those unable to construct new houses or restore their old houses are forced to live in emergency shelters. When people are displaced, it means reduction in food production, which has cascading effects on sustainability of food systems. According to Food and Agricultural Organization (FOA), when people are forced to flee their homes, they lack access to land and so they are less able to cultivate food (FAO, 2024).

Displacement also forces some farmers to find alternative sources of earning a livelihood other than farming. During the interviewees, one of the respondents noted that: *"As a result of floods, the entire community of Gatumba is languishing in immeasurable poverty…Our group has decided to put more effort into a small business" (KII 6, 2024).* Another interviewee expressed their concern as follows: *"We are looking for several benefactors to increase our capital to set up a large business (KII 3, 2024)".*

This is a clear indication that floods discourage farmers from farming and they start venturing in other businesses. This adversely affects the food supply in the communities. To confirm that this was happening in Gatumba Zone, the participants were asked to describe the extent to which floods had affected the availability of food in Gatumba Zone. Their responses were as shown in Figure 3.

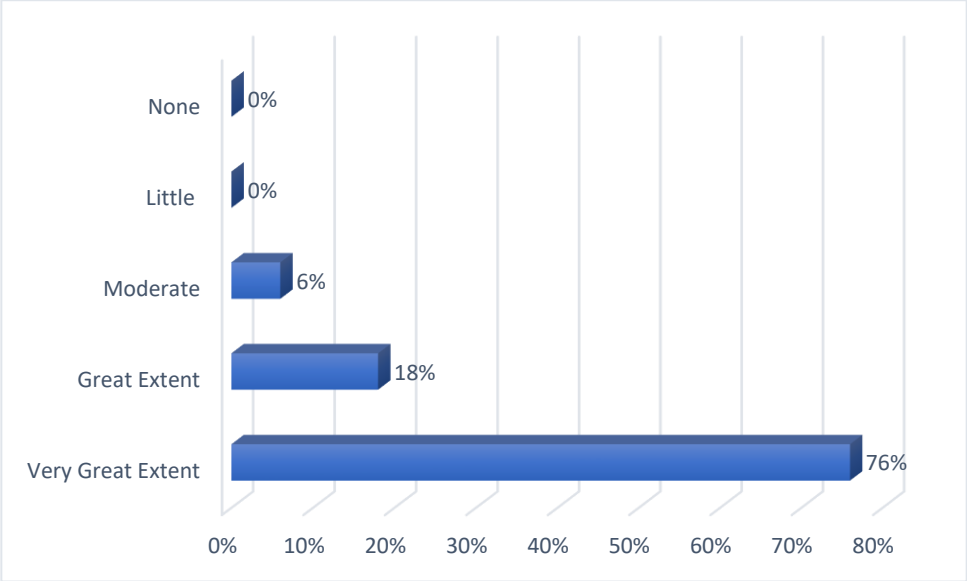

Figure 3: Floods and Food Availability in Gatumba Zone
Source: Field Data, 2024

Figure 3 illustrates the responses provided by the study participants about the effects of flood on food availability in Gatumba. Majority (76%) expressed that floods have affected food availability to a very great extent, 18% responded that the food availability has been affected to a great extent, and 6% expressed that the effect is moderate. From these findings, it is evident that floods have had adverse effects in Gatumba Zone including, destroying crops, soil erosion, displacement of the agricultural workforce, thus affecting the overall performance of the agricultural sector which manifests through low food supply and the increased prices of food commodities, thus undermining food security.

1.9 Conclusion

The investigation determined that various crop vulnerabilities are linked to flooding including crop damage, pest and diseases. In studying the extent that floods affect agriculture in Gatumba Zone, it was established that flooding is the most significant climatic hazard being experienced in Gatumba Zone. The floods have been getting more severe with each passing year and have become cause of devastation for many households. It was determined that Rusizi River increases during torrential rains, breaks it banks thereby flooding the villages in Gatumba Zone. In order to find out the extent that agriculture in Gatumba Zone is affected by floods, two perspectives were explored. Firstly, the effect of the floods on the farms were explored. It was determined that floods destroy crops, and cause water logging and soil erosion. The floods wash aways the crops. In the farms where there is water logging, the prolonged exposure to waterlogged conditions decreases the plants metabolic activities, causes root damage and consequently, crops decay. The water-logged soils also create favorable conditions for pathogens and diseases that attack surviving crops. Floods also result in soil erosion which is also detrimental to crops

growth because the land is stripped off of the nutrients essential for crop growth. The destruction of crops, the waterlogged farms and soil erosion adversely affect agriculture performance in Gatumba Zone. The second way by which the effect of floods on agriculture was explored in this study was by exploring the role it plays in the displacement of farmers from their lands. The study established that thousands of people in Gatumba Zone are displaced every year from their homes because their houses are either totally destroyed by the floods, partially destroyed or because they are flooded. It was determined that some villages are affected more than others, and families are forced to relocate to other areas where they live in temporary shelters. The displacement of the people is detrimental to agriculture, because majority are farmers, and because of the floods, they are forced to abandon their homes and their farmings, which further affects Gatumba Zone's food security. Some of the displaced farmers even resort to other income generating activities, including opening small businesses.

1.10 Recommendations

Based on the findings, the following was recommended:

Academic Recommendation

There ought to be exhaustive investigation on the overflow of River Rusizi as the major cause of flooding in Gatumba Zone. An exhaustive analysis of the destruction it has caused on homes and farmlands is needed in order to inform the mitigation measures that can be proposed to combat the phenomenon.

Policy Recommendations

The government through the Ministry of Agriculture should reinvigorate the agricultural extension services to educate farmers on methods of floods tolerance. This information will help them better prepare and adjust to the attendant climate shocks.

Secondly, the Ministry of Water, Environment and Land Management should ensure timely allocation of land to displaced persons who are unable to restore their homes after floods to allow them continue with farming. This will help maintain continues production of food and curb food insecurity.

The study also proposes the establishment of an agricultural insurance mechanism that can compensate the farmers the losses that they incur in the course of food production, and especially vagaries relating to climate variability. This will make farming attractive and farmers will no longer have to count their losses whenever there are floods. It could also be an incentive to encourage more people into farming, thus boosting food security.

Finally, the Ministry of Agriculture should collaborate with the media houses to ensure regular dissemination of weather forecasts, and agronomic and climate information that can enhance the farmers' levels of preparedness.

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