Food and Drinking Water Access Perceptions in Northeast Haiti: Impact of Household, Individual, and Other Socio-economic Characteristics

by

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Abstract

Access to food and drinking water has been a significant challenge for the people of Haiti, a situation that worsened after a powerful 7.2 magnitude earthquake struck the country, pushing the majority of the population below the poverty line. To address these issues, this study introduced measures to identify individual and socio-economic factors that impact access to food and water among households in Northeast Haiti. The data used for this study is a random sample of 401 beneficiary members of a Community Based Organization in six communes in Northeast Haiti. The data was analyzed in SPSS using some descriptive and inferential analysis like mean, percentages, ANOVA, correlation and regression. The findings show that majority of the respondents were females (66.1%), in their average age of 47 years. Most of the respondents had no formal education (71.6%). There is predominance of agricultural activities, with 68.3% of households engaged in farming. Most households relied on public water sources (68.8%). Average FCS was found to be 38.71 and ANOVA result revealed that Sainte-Suzanne had the lowest mean score and showed a significant difference from other communes. Among other things, multiple regression analysis showed the surprising result that engagement in farming had a negative impact on FCS for households, and that households that owned their water sources had lower FCS. Ordinal regression analysis showed a positive relationship between household size, wealth status and water usage. However, livestock farming, using own water source and having more older people in a household all correlated with lower water usage. Overall, the finding provide valuable insights and highlight critical issues that will be useful for directing intervention efforts.

Keywords: Food security, Water security, Food consumption score, Resilience, Socio-economic factors.

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List of Abbreviations

ANOVA	Analysis of Variance
CBO	Community Based Organization
FCS	Food Consumption Score
FAO	Food and Agricultural Organization
SRS	Simple Random Sample
WFP	World Food Program

CHAPTER 1: INTRODUCTION

This chapter explores the importance of food and drinking water security in North Haiti, specifically in the context of community experiences during natural or man-made disasters. The prevalence of such disasters in the region necessitates a comprehensive understanding of the challenges faced by the local population. Access to quality food and drinking water becomes even more critical in these situations, as the risk of contamination and scarcity increases. These risks go on to affect the living conditions of households globally.

1.1 Background Statement

Access to water and food in rural communities around the world remains a crucial issue that affects the health, economic stability, and overall quality of life for millions of people (Gelting et al., 2013). In many rural areas, the lack of infrastructure and resources makes it challenging to secure a reliable supply of clean water and nutritious food. Communities often rely on natural water sources, which may be contaminated and unsafe for consumption, leading to widespread waterborne diseases. Only eight out of ten people (5.8 billion) used improved sources with water available when it is needed (W. H. Organization, 2017). The scarcity of water also impacts agricultural productivity, challenging its availability for food production and putting global food security at risk (Rosegrant et al., 2002). Without sufficient water, crop yields are low, resulting in food shortages and heightened food insecurity.

Improved productivity of agricultural resources through sustainable intensification plays a key role in increasing food availability and improving food security and nutrition (FAO, 2015), especially in rural communities. But food security in rural communities is compromised by several factors, including poor soil quality, limited access to modern farming techniques, and

inadequate storage facilities. These challenges are exacerbated by climate change, which is due to the generally predicted negative impacts on agriculture, particularly in tropical and sub-tropical countries (Parry et al., 2004) where yields are predicted to decline. Rural farmers often lack the financial resources and knowledge to implement sustainable agricultural practices that could mitigate these risks (Rodriguez et al., 2009). The inability to overcomes these barriers inhibits the adoption of recommended practices (Lindner et al., 2016). As a result, many rural households experience chronic hunger and malnutrition, particularly among vulnerable groups such as children, the elderly, and pregnant women.

To improve access to water, initiatives such as the development of clean water infrastructure, community-based water management programs, and the promotion of rainwater harvesting can help ensure a steady supply of safe drinking water. Community-scale rainwater harvesting systems have proven effective in providing reliable drinking water in rural areas, particularly in developing countries. For instance, rainwater harvesting has been successfully implemented in both Australia and Vietnam, offering a sustainable solution to water scarcity in rural communities (Ross et al., 2022). A literature review has also shown that many rural areas in both developed and developing countries with limited/no access to mains water supply adopt traditional and unsafe rainwater harvesting (RWH) practices (Chubaka et al., 2018; Özdemir et al., 2011).

Moreover, providing education and resources for sustainable agriculture, including the introduction of drought-resistant crops and efficient irrigation systems, can enhance food security. International aid, government policies, and local community involvement are crucial in addressing these issues and fostering resilience in rural populations (Batti, 2015). Addressing the

root causes of water and food scarcity is essential for ensuring that rural communities, particularly in Haiti, have the resources necessary for sustainable growth and resilience.

1.2 Haiti Disaster History

On January 12, 2010, Haiti was struck by one of the deadliest earthquakes in modern history, resulting in the deaths of over 230,000 people and leaving millions homeless (Dubois, 2012). The disaster demolished significant landmarks, including the National Palace, Port-au-Prince's historic cathedral, and the headquarters of the U.N. mission in the country. As troops and relief workers rushed to assist, familiar narratives resurfaced in the media. Almost every mention of Haiti highlighted it as "the poorest nation in the Western Hemisphere," a label repeatedly used as if it were an unyielding trademark (Dubois, 2012). The coverage often portrayed the country as an alien, primitive, and incomprehensible place, rather than recognizing Haiti's deep, three-century-long history intertwined with Europe and the United States.

Haiti being considered one of the most vulnerable countries globally when it comes to natural hazards, particularly hurricanes, floods, and earthquakes, has over 96 percent of the population exposed to these types of shocks (World Bank, 2023). On August 14, 2021, a powerful earthquake with a magnitude of 7.2 on the Richter scale hit the southern region of Haiti, affecting approximately 1.6 million people residing in that area. This caused more than 60 percent of the population to live below the poverty line, and more than four million Haitians face crisis or emergency-level-food insecurity (World Bank, 2023).

Indicators of enduring poverty and political inequality are prevalent in Haiti, with chronic malnutrition being a notable manifestation. During the last 30 years, per capita daily caloric intake has hovered between 1,900 and 2,100 calories—only 85 to 90 percent of the recommended daily allowance (USAID, 1994). Food production and distribution problems

underlie malnutrition. Although Haiti is widely considered a food deficit country, national production data are too sparse to support the claim that the deficit reflects production shortfalls. It appears that levels of food production, and access to food supplies, vary considerably among regions of rural Haiti and within them. Clearly, however, livelihood systems in much of the countryside are faltering under the burden of complex material and organizational constraints.

1.3 Resilience

Over the past two decades, the notion of resilience has become a key focus in the field of international development, particularly in countries like Haiti where communities frequently face natural disasters and socio-economic challenges. It has now become a central paradigm in many sectors, including humanitarian aid, disaster risk reduction, climate change adaptation, and social protection, indicating that resilience is well on its way to being fully integrated into the development discourse (Hoddinott, 2014; Levine et al., 2012; Osbahr, 2007).

According to Panter-Brick & Leckman, (2013), resilience is defined as a process of harnessing resources to sustain well-being. It refers to the capacity of a dynamic system to adapt successfully to disturbances that threaten the viability, the function, or the development of that system (Masten, 2014, 2015). This type of definition not only enhances our ability to think critically and collaborate effectively with individuals working towards disaster preparedness, but also enables us to cultivate the necessary skills to adapt in such situations. Moreover, this definition can be applied across various levels of systems, ranging from the molecular level to human behavior within family, community, and even societal contexts. Resilience, in the context of a social system, has been defined as ‘the ability of a system, community, or society exposed to hazards to resist, absorb, accommodate to, and recover from the effects of a hazard in a timely and efficient manner (United Nations Office for Disaster Risk Reduction, 2009).

After much elaborate conceptualization from previous studies, (Béné et al., 2012) deduced that resilience results not only from one, but from the combination of three definition, each of them leading to different short-term responses: (1) absorptive capacity leading to persistence, (2) adaptive capacity leading to incremental adjustments/changes and adaptation, and (3) transformative capacity leading to transformational responses. Absorptive capacity refers to the ability of a system to withstand and absorb the impact of shocks and stress without undergoing significant change (Béné et al., 2012).

Water supply resilience is also defined as the ability of the system to keep functioning acceptably in the wake of a disaster, and to recover a normal level of functionality after a decline experienced due to the disaster (Balaei et al., 2018; Bruneau et al., 2003; Chang & Shinozuka, 2004). Water supply systems also provide crucial services to enable, preserve, and improve living conditions (Fulmer, 2009) and any disruption in these systems will cause inconvenience and difficulties for the community.

Resilience can also be conceptualized from a food insecurity perspective by looking at the ability of individuals, households, or entire communities to withstand and recover from shock that threaten their food systems. According to Alinovi et al. (2008), resilience to food insecurity is the ability of a household to maintain a certain level of wellbeing (for example, food security) withstanding shocks and stresses, depending on the options available to the household to make a living and its ability to handle risks. An empirical study by (Alinovi et al., 2010) on livelihood strategies and household resilience to food insecurity in Kenya indicates that a unit increase in the level of resilience is associated with a statistically significant increase of 0.38% in the level of food consumption, controlling for location, gender and household size.

1.4 Food Access in Haiti

Access to food has been one of the major issues in Haiti, a country that faces challenges related to food security. In 2021, over 80% of Haitians were estimated as facing moderate-to-severe food insecurity, and almost half were experiencing acute or severe food insecurity (Rasul et al., 2022). At the time of the earthquake, Haiti was unprepared for natural disasters due to the lack of adequate infrastructure and was not successful at preparing for the subsequent cholera endemic and the state of emergency that followed (Bertuzzo et al., 2016).

Food access measurements are something seen to be crucial in food security studies as they help assess the nature and severity of food insecurity in households and monitor the effectiveness of interventions (Hoddinott & Yohannes, 2002). Poverty is a major determinant of food insecurity in Haiti and majority of the population lives below the poverty line, which limits their ability to purchase adequate and nutritious food. Income inequality further worsens the situation, with rural areas being particularly disadvantaged.

Given the shortcomings in Haiti, international aids have been crucial in addressing food insecurity in Haiti. Various organizations, including the World Food Program (WFP) and the United Nations Food and Agriculture Organization (FAO), have implemented programs aimed at improving food access and agricultural resilience. These programs include food distribution, agricultural training, and infrastructure development.

1.5 Water Access in Haiti

Water accessibility is directly associated with water availability since it implies simultaneously quantity and quality (Cassivi et al., 2019). In Haiti, one of the poorest countries in the Western Hemisphere, the challenges surrounding water access are significant and multifaceted. One of the challenges is rooted in a legacy of political instability, economic

hardship, and inadequate infrastructure. According to (Dubois, 2012), Haiti's colonial and post-colonial history has significantly shaped its current socio-economic landscape, contributing to persistent poverty and underdevelopment. This has directly impacted on the country's ability to provide reliable and safe water access to its population.

The current state of water access in Haiti is dire, with nearly 70% of households lacking direct access to potable water (Varma et al., 2008). Rural areas are particularly affected, where infrastructure is often non-existent or severely inadequate. A study by Patrick et al. (2013) highlights the disparities between urban and rural water access, noting that rural communities are more likely to rely on unsafe water sources such as rivers, streams, and unprotected wells.

Natural disasters are seen to have a profound impact on water access in Haiti. The 2010 earthquake, with a magnitude of 7.0, severely damaged the country's already fragile water infrastructure, leaving millions without reliable access to clean water (DesRoches et al., 2011). The subsequent cholera outbreak, which claimed thousands of lives, further underscored the critical need for robust water and sanitation systems (Barzilay et al., 2013). Hurricanes and recurrent droughts also exacerbate water scarcity in Haiti. These events disrupt water supplies, contaminate existing sources, and increase the burden on already strained infrastructure. Studies have shown that communities affected by natural disasters face long-term challenges in restoring and maintaining water access (Pan American Health Organization, 2011).

Several international organizations and NGOs have been actively involved in addressing Haiti's water crisis (Gelting et al., 2013). Efforts include the construction of wells, the installation of water purification systems, and the promotion of hygiene education. For instance, the work of organizations like Water.org and the International Red Cross has been pivotal in providing immediate relief and long-term solutions (Water.org, 2019). Local initiatives have also played a

major role. Community-based water management programs, supported by local governments and NGOs, have shown promise in improving water access and quality. These programs focus on empowering communities through education and participation, ensuring sustainable water management practices (Brikké et al., 2003).

1.6 Problem Statement

Haiti, the poorest country in the Western Hemisphere, has long struggled with chronic malnutrition and food insecurity (Dubois, 2012). Rural areas, in particular, face persistent challenges in securing adequate and appropriate food. Over the past 30 years, the average daily caloric intake per person in Haiti has ranged from 1,900 to 2,100 calories, which is only 85-90% of the recommended daily intake (USAID, 1994). This shortfall reflects the broader issue of insufficient food availability and access across the country. Economic constraints further hinder their ability to purchase food, leaving many individuals and localities in a state of food insecurity (Baro, 2002). The variation in food production levels and access to food is significant, both among different regions and within them. This disparity highlights the uneven distribution of resources and the localized nature of food security challenges in Haiti.

Among the ten departments in Haiti, Nord-Est (Northeast), Artibonite, Nord-Ouest, and Centre are particularly affected by high rates of poverty, malnutrition, and vulnerability to disasters. These regions experience some of the most severe levels of food insecurity in the country (Glaeser et al., 2011). The combination of economic hardship, environmental challenges, and limited infrastructure contributes to the dire food security situation in these areas. In Nord-Est, for instance, recurrent droughts and lack of agricultural support have left many households unable to produce enough food to meet their needs. Similarly, Artibonite, despite being one of the primary agricultural regions, suffers from inadequate irrigation systems and periodic

flooding, which disrupt food production and access. Nord-Ouest and Centre face similar challenges, with limited access to markets and essential services compounding the food insecurity problem.

The limited availability of improved water sources exposes the population to waterborne bacterial infections, which can cause severe health issues. Studies have shown that inadequate water infrastructure and sanitation systems contribute to the prevalence of diseases such as cholera, dysentery, and typhoid fever (Ashbolt, 2004; Tauxe et al., 1995).

The disparity in water access between rural and urban areas is stark, exacerbating existing health inequalities. In rural regions, access to clean water is even more limited, with many communities relying on contaminated rivers, streams, or shallow wells for their water needs (Gelting et al., 2013). This reliance on unsafe water sources leads to higher incidences of waterborne illnesses and contributes to the overall poor health outcomes observed in these areas (Patrick et al., 2013a). Urban areas, while somewhat better off in terms of water infrastructure, still face significant challenges, particularly in densely populated slums where access to clean water is inconsistent and often insufficient.

Further compounding the issue, the cholera outbreak that began in late 2010 underscored the critical need for improved water and sanitation infrastructure in Haiti. The outbreak, which resulted in thousands of deaths, was linked to the contamination of the Artibonite River, a primary water source for many Haitians (Barzilay et al., 2013). This public health crisis highlighted the urgent need for comprehensive interventions to improve water quality and access across the country. Efforts to address the challenges have been ongoing, with various international organizations and NGOs working to provide clean water solutions. Projects have included the construction of new wells, the installation of water purification systems, and the

promotion of hygiene education. However, these initiatives often face significant obstacles, including ineffective co-ordination, funding limitations, lack of stakeholder commitment, political instability, and logistical challenges in reaching remote areas (Batti, 2015).

1.7 Significance of Study

Access to food and drinking water safety is a critical issue that affects the health, economic stability, and overall quality of life for millions of people around the world, particularly in rural communities (Gelting et al., 2013). Numerous studies have been conducted to explore the perceptions of food and drinking water access among different households, revealing various risks and factors affecting their sustainability. For instance, research by Francis et al. (2015) identified significant factors such as a lack of knowledge about health hazards associated with unsafe water, lack of support from male members of households, and insufficient community organization support. This underscores the complexity and multifaceted nature of water and food security issues.

Patel et al. (2020), examined drinking water quality and its relation to the characteristics of water sources and found that the majority of participants considered public water supplies to be safe for drinking and other household uses. However, this perception may not accurately reflect the actual safety of the water, as perceptions are influenced by various socio-economic factors. Similarly, Adams et al. (2016) identified income, education, household size, and region as significant predictors of improved water access in Ghana, highlighting the role of socio-economic and demographic factors in determining water security.

Further studies, such as that by Adeniyi & Dinbabo (2019), investigated household food security among smallholder irrigation farmers in Northwest Nigeria and found that about 45% of households were food insecure. They identified household income, education, training, farming

experience, and livestock management as influential factors. Oduniyi & Tekana (2020) used logistic regression analysis to explore the status and socio-economic determinants of farming households' food security, concluding that household size and the age of the household head significantly impact food security, with larger household sizes reducing the probability of achieving food security.

The Northeast Department of Haiti faces chronic issues of water and food insecurity, yet little is known about the specific predictors at the household level in this area. Understanding these predictors is crucial for developing targeted interventions that can effectively address the root causes of insecurity and improve the resilience of these communities. This study aims to fill this gap by providing insights into the perceptions of food and drinking water safety as mediated by previous disaster experiences and by assessing the level of food and water insecurities among households in Northeast Haiti.

Despite these extensive studies, there is a noticeable gap in understanding how access to food and drinking water safety is influenced by the socio-economic characteristics of individual households in Northeast Haiti. By examining the specific context of Northeast Haiti, this research will contribute to a deeper understanding of the interplay between socio-economic characteristics and the accessibility and safety of food and drinking water. It will explore how factors such as household income, education, household size, and community support impact food and water access. Additionally, it will investigate the effects of recurrent disasters on these dynamics, providing a comprehensive view of the challenges and potential solutions.

1.8 Research Objectives

- To assess the level of food insecurity among households in Northeast Haiti.
- To assess the level of drinking water access among households in Northeast Haiti.

- To determine the relationship between households selected individual and socio-economic characteristics and their access to food.
- To determine the relationship between households selected individual and socio-economic characteristics and their access to drinking water.

1.9 Research Question

- Are there relationships between households selected individual and socio-economic characteristics and their access to food & drinking water?

1.10 Definition of Terms

Communes – The English term is municipalities. It is a territorial division that corresponds to a town, a village, group of villages or a village with its hamlets. In most cases, the "commune" is the smallest administrative subdivision. It is led by a mayor or mayors. They are considered a third-level district in Haiti (i.e. the local level of government) which is roughly equivalent to an American county.

Community Based Organization - is a locality-focused association of a group of people with a common goal such as irrigation, a focal farm enterprise, etc.

Dietary diversity - This is defined as the number of different foods or food groups consumed over a specified reference period, without considering the frequency of consumption.

Food consumption score - This is defined as a frequency-weighted dietary diversity score. The FCS is calculated using the frequency with which a household consumes eight food groups—namely staples, pulses, vegetables, fruits, meat/fish/eggs, milk, sugar, and oil—within a 7-day recall period from the date of the survey (WFP, 2008).

Food frequency - In this context, food frequency refers to the number of days within the reference period that a particular food item or food group is eaten at the household level (WFP, 2008)

Food group - is a collection of food items that share similar caloric and nutrient qualities.

Food item - is an individual food that cannot be further divided into separate foods; however, general terms like fish or poultry are treated as food items for this study (WFP, 2008).

1.11 Summary

The findings of this study are expected to inform policymakers, development agencies, and local communities about the critical factors influencing food and water security in Northeast Haiti. This, in turn, will help in designing more effective and sustainable interventions to enhance the well-being and resilience of the affected populations. By addressing the broader issues of food and water security through a focused lens on Northeast Haiti, this study aims to contribute to global efforts in mitigating food and water insecurity in vulnerable regions.

CHAPTER 2: CONCEPTUAL FRAMEWORK

This chapter provide an overview of previous research and conceptualizations of food and water security with their relationships to individual and socio-economic characteristics of households based on some literatures. It provides a theoretical context for understanding food security and water access in developing countries.

2.1 Food Security

Food security is a multifaceted and adaptable concept that has been defined in numerous ways. We utilize one of the most widely accepted definitions, initially adopted by the FAO in 1996; *Food security is a situation that exists when all people, always, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life*" (Coates et al., 2007; O, 1996; U. N. F. and A. Organization, 2012). The four accompanying 'pillars' of food security were defined as availability, access, utilization and stability (Food Summit, 2009).

2.1.1 Availability

This refers to the basic supply side of food, ensuring sufficient quantities of nutritionally adequate and safe foods are consistently available (Babu et al., 2014; Food and Agriculture Organization of the United Nations., 2008). This supply can be met through domestic production or imports (Skoet & Stamoulis, 2006). However, food availability is vulnerable to environmental and climate changes, stock levels, and overall net trade (Food and Agriculture Organization of the United Nations., 2008; Food and Agriculture Organization of the United States, 2013). Despite adequate global food supplies, equal distribution and access remain significant challenges (Skoet & Stamoulis, 2006).

2.1.2 Access

Access to food involves having sufficient resources to ensure proper physical and economic access to nutritious foods (Skoet & Stamoulis, 2006; WHO, 2014). Economic food security is primarily determined by household purchasing power and food prices, while physical access is influenced by infrastructure such as roads and market outlets. Food must be acquired in a socially acceptable manner, avoiding scavenging, stealing, or relying on emergency food supplies (Babu et al., 2014). Poverty, both at the household and national levels, is a major determinant of access to nutritious food (Babu et al., 2014; Zezza & Tasciotti, 2010). Food access in turn points to the household's or individual's ability to obtain the available food (Alonso et al., 2018).

2.1.3 Utilization

Utilization pertains to how the body uses the food and nutrients consumed for nutritional and health benefits (Food and Agriculture Organization of the United States, 2013). The food's quality and quantity must provide sufficient energy and nutrients. Basic health status is crucial for good biological utilization of food; for instance, chronic diarrhea can impair nutrient absorption, increasing the risk of malnutrition. Factors such as general hygiene, sanitation, health practices, water quality, nutrient bioavailability, food preparation methods, and food safety and quality influence of how the body utilizes food (Food and Agriculture Organization of the United States, 2013; Skoet & Stamoulis, 2006). Additionally, non-food inputs, including intra-household food distribution, can impact individual food security status (Pinstrup-Andersen, 2009).

2.1.4 Stability

Stability reflects the consistency of the other three pillars over time. To achieve food security, populations, households, and individuals must have continuous access to adequate,

nutritious, and safe food (Skoet & Stamoulis, 2006). Stability can be affected by adverse weather, political instability, economic factors such as employment and food prices, and natural disasters (Food and Agriculture Organization of the United Nations., 2008). For example, the 2010 earthquake in Haiti and the subsequent cholera outbreak were significant shocks to an already food-insecure country. When stability is disrupted, food insecurity occurs and persists until all pillars are reestablished (Food and Agriculture Organization of the United Nations., 2008; Skoet & Stamoulis, 2006).

2.2 Perceptions of Food Security

In determining household access to food, three key aspects must be considered: food access indicators, food access measurements, and food security outcomes. Food access indicators provide insight into a household's food entitlement and socio-economic status, if households with sufficient means consume a variety of foods. Food access measurements are crucial in food security studies as they help assess the nature and severity of food insecurity in households and monitor the effectiveness of interventions (Hoddinott & Yohannes, 2002). These outcomes primarily measure food consumption and its various effects, such as an individual's nutritional status and influencing factors.

Several studies have measured households' perception on food access and food security (Chakona & Shackleton, 2017; Ma et al., 2016; Silva et al., 2016a). A study by Silva et al. (2016b) revealed that food secured households, on average have a significantly higher income as well as higher education level. A higher income allows economic access to a higher quantity and better quality of food. Socio-economic factors, such as income, education, and occupation, are also known to shape individuals' perceptions and behaviors regarding food security (W. H.

Organization, 2014). Additionally, food intake diversity within a household is another factor that influences food security (Hoddinott & Yohannes, 2002).

Mango et al., (2014) examined the factors influencing household food security among smallholder farmers in Mudzi District, Zimbabwe. They randomly sampled their data from 120 households using a structured questionnaire. Their study utilized descriptive statistics to analyze respondents' characteristics and linear regression analysis to identify determinants of household food security. As a result, they found that household dietary diversity was influenced by factors such as the age and education of the household head, household labor and size, livestock ownership, access to market information, and remittances. Additionally, linear regression analysis on the household food insecurity access score revealed that labor, education of the household head, household size, remittances, livestock ownership, and access to market information significantly impacted household food security.

2.3 Determinants of Food Security

A detailed understanding of the determinants of food security is essential for informing policy decisions and evaluating research-driven development projects. One of the key determinants of food security, closely related to human resource development, is livelihood assets. These include factors such as education, healthcare, clean water, population growth, urbanization, and the displacement of people, all of which significantly influence food security (Dercon & Hoddinott, 2004; Dercon & Krishnan, 2000).

Adeniyi & Dinbabo, (2019), conducted a study to investigate household food security and the socioeconomic factors influencing it among smallholders in the Middle Rima Valley Irrigation Project, Sokoto State, Nigeria. The study employed a novel approach by combining the Household Dietary Diversity Score (HDDS) and the Food Consumption Score (FCS) to measure

food security. This method, which involves regressing these variables against socioeconomic characteristics of smallholder households, is scarcely represented in existing literature, making this study particularly innovative. The HDDS and FCS were used to assess the household food security levels, while multivariate regression analysis was employed to examine the factors associated with food security. The study revealed that at least 45% of the households were food insecure, highlighting a significant prevalence of food insecurity in the study area. The relationship between HDDS and FCS was found to be moderate, positive, and statistically significant, thereby validating the food insecurity phenomenon in the Middle Rima Valley. Several factors were also identified as influencing food security, including household income, education, training, farming experience, livestock ownership, and farm size. Among these, farm size emerged as the most significant determinant of food security for smallholder households.

A study by Oduniyi & Tekana (2020) evaluates the household food security status (HFSS) among rural farming households, focusing on the drivers of food security and the impact of gender dynamics. Using a household expenditure survey (HES), their research provides valuable insights into the factors influencing food security and highlights gender differences. The findings indicate that increased farming experience and larger household size are associated with a lower probability of achieving food security. They further showed in their findings that an increase in the age of the household head similarly reduces the likelihood of being food secure. Despite these challenges, Oduniyi & Tekana (2020) revealed in their study that over half of the farming households were food secure, with female-headed households being proportionately more food secure compared to their male counterparts. These findings underscore the importance of considering gender dynamics and specific household characteristics in addressing food security in rural areas.

Babatunde et al. (2007) also used logit regression in their study, which sought to examine the socio-economic characteristics and determinants of food security among rural farming households in Kwara State, Nigeria. The researchers gathered cross-sectional data from 94 farm households in 2005 using a three-stage random sampling technique. A descriptive analysis was employed to outline the socio-economic characteristics of the households, while econometric tools were used to identify the factors influencing their food security status. Their study utilized the recommended calorie requirement approach and found that 36% of the households were food secure, whereas 64% were food insecure. The Shortfall/Surplus index indicated that food secure households exceeded the recommended calorie intake by 42%, while food insecure households fell short by 38%. For their study, a logit regression model with eight regressors revealed that household income, household size, the educational status of the household head, and the quantity of food obtained from own production were significant determinants of food security.

Other factors affecting household food security include availability of household labor, household indebtedness, performance of input and output markets, household expenditure, on-farm and off-farm income, size of arable land, agricultural inputs, and extension services that could enhance subsistence production (Mango et al., 2014). The finding of (Echebiri et al., 2017) also showed that age, years of education, credit access, farm size, monthly income and family size influences food security status of rural households.

2.4 Food Security

2.4.1 Food Consumption Score (FCS)

FCS is a survey-based composite indicator that measures food frequency, dietary diversity, and the relative nutritional importance of food groups based on a seven-day recall of food consumed at household level (WFP, 2008). According to World Food Program (WFP,

2008), FCS is defined as a frequency-weighted dietary diversity score. The FCS is calculated using the frequency with which a household consumed eight food groups—namely staples, pulses, vegetables, fruits, meat/fish/eggs, milk, sugar, and oil—within a 7-day recall period from the date of the survey. The consumption frequencies for each food group are summed to yield a food group score, which is then truncated to a maximum value of seven. Each food group score is subsequently multiplied by its assigned weight, reflecting the nutrient density of the respective food group. The weighted scores are then summed to create the overall FCS. This method provides a comprehensive measure of household dietary diversity and food access, highlighting its importance in food security assessments (WFP, 2008).

The International Dietary Data and Expansion Project also defined Food Consumption Score (FCS) as a valuable indicator for categorizing and tracking households' food security over time, specifically serving as a proxy for the quantity dimension of food security, which relates to household caloric sufficiency. This indicator has been validated for its effectiveness in capturing information about usual household diets by asking respondents to recall their food consumption over the past seven days (International Dietary Expansion Project, 2023).

2.4.2 FCS as a Measure of Food Access

Wiesmann et al., (2009) found that food frequency scores were superior to simpler measures of dietary diversity based on food group count. Their validation supported the use of the Food Consumption Score (FCS) for food security assessments, with recommendations for revising the cutoff points for food consumption groups (‘poor’, ‘borderline’, and ‘adequate’) upwards. They also suggested that further gains in validity could be achieved with small-scale technical adjustments, such as increasing the number of food groups from eight to twelve.

However, (Adeniyi & Dinbabo, 2019) argued that there are issues surrounding the cut-off points defining food insecurity based on the FCS, as there is no consensus on the thresholds. Despite this, the commonly used thresholds for FCS scores are: 0 – 21 (Poor), 21.5 – 35 (Borderline), and > 35 (Acceptable). In populations where the consumption of oil and sugar is high, it is recommended to adjust the cut-offs upwards by adding 7 to each threshold. Therefore, the revised thresholds for such populations are: 0 – 28 (Poor), 28.5 – 42 (Borderline), and > 42 (Acceptable) (WFP, 2008).

According to International Dietary Expansion Project (2023), FCS is versatile in its applications, being used for program monitoring and evaluation as well as population-level targeting. As a standardized measure, it is beneficial for comparing households across different locations and tracking cyclical changes in household diets when data is collected repeatedly across seasons or years. The World Food Program (WFP) employs the FCS as part of its Comprehensive Food Security & Vulnerability Analysis (CFSVA) tool to assess food security and vulnerability in crisis-prone populations. This comprehensive use underscores its significance in understanding and addressing food security issues globally.

There are several studies carried out in different countries that indicate a measurement of food consumption and its level among individual households. For example, (Adeniyi & Dinbabo, 2019) in their study, used FCS to measure food security level among irrigation smallholders in the Northwest of Nigeria. They found that 45.4% of smallholder households were food insecure. Likewise, study by Babatunde et al., (2007) among farming households in North Central Nigeria, found that about 62.8% of households were food insecure.

2.5 Water Security

Water security is “the availability of an acceptable quantity and quality of water for health, livelihoods, ecosystems and production, coupled with an acceptable level of water-related risks to people, environments and economies (Grey & Sadoff, 2007)”. In simple terms, water security involves harnessing the productivity of water while limiting its negative impact (Grey & Sadoff, 2007). This widely accepted definition is more comprehensive, as it highlights the importance of ensuring secure access to water not only for direct consumption but also for livelihoods and productive purposes. Water insecurity is the insufficient quantity or quality of water to support health, livelihoods, ecosystems, and production or an unacceptable level of water-related risks to people, environments, and economies (Cushing et al., 2023).

In Haiti, living conditions threaten health constantly; only 59 percent of rural people have access to safe drinking water (Baro, 2002) which is not only low but decreasing. In 2020, only 43% of Haiti’s rural population had access to basic drinking water supplies, down from 48% in 2015 and 50% in 1990 (World Bank Group, 2023). This is significantly lower than the 90% average for Latin America and the Caribbean in 2022, highlighting a concerning trend. Lack of clean water is among the most severe human rights challenge faced by the people of Haiti today. In 2002, Haiti ranked 101 of 127 countries in terms of the quantity and quality of fresh water; the existence of wastewater treatment facilities; and the presence of legal structures, such as pollutant regimes (Esty & Cornelius, 2002).

A study by Silva et al. (2016b) suggest that households that drink water from the faucet tend to be less food secure, which at first may seem counter intuitive. In Mexico, the quality of water from the faucet is perceived as questionable. Consequently, most people drink bottled water or boil faucet water before using it. In this context, individuals who drink water directly

from the faucet likely do not have access to safe water sources. This lack of access explains the association between drinking water directly from the faucet and food insecurity.

Koskei et al. (2013) conducted an assessment on the effects of socioeconomic factors on access to improved water sources and basic sanitation in Bomet municipality, Kenya. This region is particularly afflicted by waterborne diseases such as intestinal worms, diarrhea, and bilharzia. The study aimed to elucidate the relationship between socioeconomic factors and access to improved water and sanitation. Utilizing a multi-stage random sampling method, data were collected through questionnaires and analyzed using SPSS. The Chi-Square test at a 5% level of significance revealed that household characteristics, such as the occupation and education level of the household head, significantly impacted the type of water source used, with a significance level of 0.01.

Gomez et al. (2019) analyzed how socioeconomic factors influence access to improved water sources in rural areas of developing countries. The study examined various types of water access—such as total improved, piped on premises, and other improved sources—across low-, lower-middle-, and upper-middle-income countries. Key findings indicate that factors like gross national income (GNI), female primary education completion rates, agricultural involvement, rural population growth, and governance indicators (political stability, control of corruption, regulatory quality) significantly affect water access. Wealthier countries show better access to piped water, especially in lower-middle and low-income regions. Female education correlates positively with improved and piped water access in low- and middle-low-income countries, while agricultural activity negatively impacts access in these areas, particularly in low-income countries for all water types. Governance indicators have varied effects on water access

depending on the income level. The study also noted that official development assistance generally has minimal impact on water access, except for other improved sources.

2.6 Sources of Water

Access to an improved water source refers to the proportion of the population that has reasonable access to an adequate amount of water from a reliable source. These sources include household connections, public standpipes, boreholes, protected wells or springs, and rainwater collection (World Bank Group, 2013).

In May 2012, (Patrick et al., 2013b) conducted an assessment in the rural areas of the Artibonite Department to evaluate the type and quality of water sources and to determine knowledge, access, and use of household water treatment products. This study was undertaken after emergency response was scaled back but before longer-term water, sanitation, and hygiene (WASH) activities were initiated. The household survey and source water quality analysis revealed low access to safe water, with only 42.3% of households using an improved drinking water source.

Gomez et al. (2019) conducted an analysis to determine the influence of specific socioeconomic factors on access to improved water sources in the rural areas of sub-Saharan Africa, South America and Southeast Asia. Their study was focused on various types of water access, including 'total improved,' piped on premises, and other improved sources, across low-income, lower-middle-income, and upper-middle-income countries. Their analysis indicated that wealthier countries have greater access to piped water sources. And increase in rural population has a negative impact on access to total improved water sources.

2.7 Theories of Food Security and Water Access

Food security and water access are complex global challenges that have led to the development of various theoretical frameworks to understand and address these issues effectively. One prominent theory is the **Food Availability Theory**, which emphasizes the importance of food production in preventing food insecurity. This theory argues that increasing agricultural output and improving logistics are key solutions to ensure an adequate supply of food (Maxwell, 1996). Efforts to expand food production often involve technological advancements and improved agricultural practices, with the underlying assumption that sufficient availability will translate to improved food security. However, this approach has been critiqued for overlooking issues related to distribution and access.

Amartya Sen's **Entitlement Theory** (Sen, 1982) offers a contrasting view by highlighting that food security is not solely dependent on availability but also on individuals' ability to access food through economic or social means. Sen's seminal work demonstrated that famines could occur even when food supplies are sufficient, due to factors such as unequal income distribution and lack of entitlements. This theory has significantly influenced policy approaches, shifting the focus from mere food production to ensuring equitable access and strengthening social safety nets to combat hunger and food deprivation (Sen, 1982).

The field of water access has similarly evolved through comprehensive frameworks like **Integrated Water Resources Management (IWRM)**. This approach seeks to balance the management of water, land, and resources to optimize social and economic welfare while maintaining environmental sustainability (Tortajada & Biswas, 2014). IWRM underscores the importance of inclusive governance structures that involve multiple stakeholders, such as agricultural sectors, local communities, and industries, to ensure that water distribution is both

fair and sustainable. It has gained traction as a practical method for policy-making that can adapt to the growing pressures on water resources due to population growth and climate change (Tortajada & Biswas, 2014).

Political Ecology has provided another lens through which water access can be understood, focusing on the power structures and governance that affect resource distribution (Mehta, 2005). This theory examines how political and social inequalities impact water availability, often disadvantaging marginalized communities. By framing water insecurity as a socio-political issue, scholars argue that solutions must address not only environmental or technical problems but also the embedded inequalities in power and decision-making (Mehta, 2005). This perspective stresses the need for participatory governance to ensure that all groups, particularly vulnerable populations, have equitable access to water resources.

Lastly, the **Sustainable Livelihoods Framework (SLF)** integrates the discussions of food and water security by exploring how households manage and utilize their resources to build resilient livelihoods (Chambers & Conway, 1992). This model emphasizes that food and water security are interlinked with a variety of assets, such as natural, human, and social capital. SLF argues that sustainable practices are essential for adapting to challenges like climate change and economic shocks, which can disrupt access to essential resources (Scoones, 1998a). The framework has been influential in shaping development programs that aim to strengthen community resilience and sustainability (Chambers & Conway, 1992; Scoones, 1998b).

2.8 Factors Affecting Food and Water Access

2.8.1 Age

The age distribution within a community profoundly impacts its water and food supply dynamics. Younger populations typically have higher water, and food demands due to their

growth and activity levels. Conversely, older populations may face challenges in accessing these resources, particularly in rural areas where physical exertion is often required for tasks such as water collection and farming. Communities with a significant proportion of elderly residents might experience reduced productivity in agriculture and difficulties in water management, impacting overall resilience. Moreover, older individuals often hold traditional knowledge about sustainable practices, which is crucial for resource management but may not be fully utilized if they cannot physically contribute. Oduniyi & Tekana (2020b) showed in their findings that an increase in the age of the household head similarly reduces the likelihood of being food secure.

2.8.2 Gender

Gender roles significantly influence the management and allocation of water and food resources. In many cultures, women bear the primary responsibility for fetching water and preparing food, making them central to household water and food security. However, women often encounter barriers such as limited access to land, education, and financial resources, hindering their ability to contribute effectively. Gender inequality can lead to inefficiencies and reduced resilience in managing these resources. However, (Oduniyi & Tekana, 2020a) in their findings revealed that female-headed households were proportionately more food secure compared to their male counterparts. On the contrary, Horrell & Krishnan, (2007) argued that male-headed households are better positioned to source on-farm labor than their female-headed counterparts. Empowering women through education, legal rights to land, and access to financial resources have been seen to enhance community resilience by optimizing resource use and improving overall water and food security.

2.8.3 The Role of Education

Education is a crucial determinant of how communities manage their water and food supplies. Educated individuals are more likely to adopt modern agricultural practices, understand water conservation's importance, and seek innovative solutions to resource challenges. Higher education levels correlate with better implementation of sustainable practices, such as crop rotation, rainwater harvesting, and efficient irrigation techniques.

Households with higher levels of education tend to have better food security due to improved employment opportunities and income levels. A study by Regan and Siméon (2015) found that educational attainment positively correlates with dietary diversity and food access in Haitian households. (Babatunde et al., 2007; Mango et al., 2014; Oduniyi & Tekana, 2020b) showed education to be a significant determinant of food security.

Education also raises awareness about the health implications of unsafe water and poor nutrition, leading to improved community health and resilience. Investing in education, particularly in rural areas, can transform how communities interact with their natural resources, making them more resilient to environmental and socio-economic shocks.

2.8.4 Agricultural and Livestock Practice

Agricultural and livestock practices directly influence the sustainability of food and water supplies. Traditional farming methods, while culturally significant, may not always be sustainable or efficient. Modern techniques, such as using high-yield crop varieties, chemical fertilizers, and advanced irrigation systems, can enhance productivity and water efficiency. However, adopting such practices often requires access to financial resources, education, and infrastructure, which may not be available to all communities. Livestock farming also plays a critical role in rural economies but can strain water resources. (Adeniyi & Dinbabo, 2019) in

their study showed that farming experience, and livestock ownership influences food security, and as well household access to food.

2.8.5 Wealth Status and Household Size

Wealth status significantly impacts a community's ability to access and manage water and food supplies. Wealthier households often have better access to technologies and infrastructure that can improve water and food security, such as water treatment facilities, storage systems, and transportation networks (Adeniyi & Dinbabo, 2019; Babatunde et al., 2007; Silva et al., 2016a). Economic disparities can lead to unequal access to resources, exacerbating vulnerabilities for poorer households. Household size also affects resource demands, with larger households typically requiring more water and food (Babatunde et al., 2007; Mango et al., 2014). Managing these demands efficiently is crucial for maintaining resilience, particularly in resource-scarce environments.

2.8.6 Vulnerable Populations: Pregnant, Disabled, Orphaned, and Elderly People

The presence of vulnerable populations, including pregnant women, disabled individuals, orphans, and older people, adds complexity to managing water and food resources. These groups often require additional care and resources, increasing the overall demand for community supplies. Pregnant women and young children are particularly susceptible to malnutrition and waterborne diseases, making access to clean water and adequate nutrition critical. Disabled individuals may face mobility challenges that hinder their ability to access resources. Community support systems and targeted interventions are essential to ensure these vulnerable populations' needs are met, enhancing overall resilience. Distance can also hinder older or disabled people from accessing clean and safe water, as well as food.

2.8.7 Water Sources: Public vs. Own

The source of water, whether public or privately owned, significantly impacts community resilience. Public water sources often face issues such as contamination, inadequate supply, and long distances from homes, especially in rural areas. Privately owned water sources can provide more reliable access but require significant investment and maintenance. Communities relying on public water sources may experience higher levels of water insecurity, affecting overall health and productivity. Gomez et al. (2019) suggests that wealthier countries have greater access to piped water sources. Therefore, policies and programs that improve public water infrastructure and encourage sustainable private water management can enhance resilience.

CHAPTER 3: METHODS

3.1 Description of the Study Area

The Republic of Haiti is located on the island of Hispaniola in the Caribbean region. It shares the island with the Dominican Republic, which forms its eastern border. Haiti covers a total area of 27,750 square kilometers (10,714 square miles). To the north, it is bordered by the Atlantic Ocean, to the west by the Windward Passage, and to the south by the Caribbean Sea.

The population of Haiti is entirely descended from African people who were brought to the island for slavery by France. As of 2022, the estimated population is 11,400,000 inhabitants, spread across 10 main administrative areas known as "Departments": North, West, South, Center, Northeast, Northwest, Southeast, Grand'Anse, Nippes, and Artibonite (World Population Prospects, 2022). The capital city, Port-au-Prince, is the most populous city in the country. However, this study focuses on the Northeast region of Haiti (Ferrier, Terrier Rouge, Ouanaminthe, Sainte-Suzanne, Grand-Bassin, Fort-Liberté).

Northeast (Nord-Est) is one of the ten departments of Haiti, located in northern Haiti. It has an area of 1,623 km^2 (627 sq mi) and represents about 5% of Haiti's total area, making it the smallest of all the departments. It had an estimated population of 393,967 as of 2015. Its capital is Fort-Liberté. It was a part of the North department. It is bordered to the north by the Atlantic Ocean, to the south by the Centre department, to the east by the Dominican Republic through the province of Dajabon, and to the west by North Department. About 60 percent of the population live in rural regions and farm for a living. The wide plains of the North-East which, during the second half of the 20th century were mostly known for sisal plantations, are now mostly state owned and largely deserted.

Most of the department is part of the Plain of North Cibao Valley with the southern part being the Northern Massif. The coastal plain has the Bay of Caracol, the biggest mangrove forest in Haiti and the Bay of Fort-Liberty. Tee bay harbors many islands, cays, and reefs. The biggest island in the Bay is Bayo Island. The most important rivers are the Manon River and Massacre River while the Three Bays Protected Area is the most important park in the department.

There are several large-scale investment projects in the Northeast department, such as the 1,000-hectare banana-plantain plantation known as Agritrans, and the USAID funded Feed the Future program investing approximately $88 million USD in the modernization of agriculture in the region. One of Haiti's main exports at this time is apparel and the textile industry is certainly visible in the North-East. The Caracol Industrial Park now joins the CODEVI park, together maximizing on the trade preferences extended to Haitian manufactured apparel and the abundance of casual and cheap labor in the region. The two industrial parks currently employ about 13,000 local workers in textile and garment production.

Figure 1: Map of Study Area Showing Communes in Northeast Haiti

3.2 Sample

A random sample of 401 beneficiaries (persons who receive help or advantage from the project) was taken from project rolls of Community Based Organizations (CBOs) in Northeast Haiti and were contacted in multiple ways over a 4-month period, from January to April 2023. A community-based organization (CBO) is a locality-focused association of a group of people with a common goal such as irrigation, a focal farm enterprise, etc.

Each beneficiary of the organization had an equal chance of being selected in the study (Acharya et al., 2013). Initial project works had already established a list of beneficiaries by

commune and the localities concerned, most of them with a contact telephone number. This constituted the population from which a sample of beneficiaries was randomly selected for interviewing. Following the same approach as (Omair, 2014; Rahi, 2017), the population was converted into a numbered list and using a computer program, random numbers were generated and the beneficiaries whose numbers were selected constituted the larger research sample.

Finally, the sample was then drawn from this large initial sample through the implementation of a One-stage Simple Random Sampling (SRS) method for each commune. We used a random number table to choose a random starting point, and every k_{th} name from the list in each commune (k represents the difference between successive sample points with respect to their positions on the numbered list). The formula for calculating the overall sample size, with the chosen sampling method (One-stage SRS) is explained in Appendix A.

Table 1. Sample Characteristics in Target Communes, North Haiti, 2023

Commune	Number of CBOs	Number of Beneficiaries	Population Weight ($P_i=N_i/N$)	Sample	Number of Interviewers
Sainte-Suzanne	2	29,237	49%	190	9
Grand-Bassin	2	10,500	18%	68	3
Terrier Rouge	1	10,000	17%	65	3
Ferrier	2	4,250	7%	28	1
Fort-Liberté	1	3,000	5%	19	1
Ouanaminthe	2	2,100	4%	14	1
Total	10	59,087	100%	384	18

Haitian Household Survey, 2023.

$$Population\ weight\ = \frac{Number\ of\ beneficiaries\ in\ each\ commune}{Total\ number\ of\ beneficiaries} \quad \times \quad 100$$

3.3 Data Collection

In January 2023, interviews were conducted in six communes in the Northeastern part of Haiti (Sainte-Suzanne, Terrier Rouge, Grand-Bassin, Ferrier, Forte-Liberté, and Ouanaminthe). The data collection process was conducted electronically through a digital survey platform called

mWater. The survey instrument contained both opened and closed-ended questions, structured into the following ten different sections:

(1) demographic information

(2) socio-economic information

(3) diversity of things people eat/diversity of foods

(4) food consumed by households in a week

(5) national hunger index

(6) coping (survival) strategy reduction

(7) number of meals per day

(8) what is done with food produced

(9) information for shock management

(10) drinking water.

The study also employed a semi-structured interview process through in-person and virtual meetings.

Figure 2: Interview with Participants during Data Collection

The survey was circulated with the aim of securing a minimum planned response of 384, and to guarantee that this number is achieved, additional respondents were interviewed.

Table 2. Summary of Study Sample, North Haiti, 2023

Commune	Planned	Actual	% of Planned
Sainte-Suzanne	190	200	105.26
Grand-Bassin	68	71	104.41
Terrier Rouge	65	72	110.77
Ferrier	28	30	107.14
Fort-Liberté	19	19	100.00
Ouanaminthe	14	13	92.86
Total	384	405	105.47

Haitian Household Survey, 2023.

A total of 405 respondents agreed to take part in the survey, representing 105.47% of the minimum target study sample size. Of the 405 volunteers, we achieved a response rate of 99% (i.e., 401 returned responses), which was 104% of the needed sample size, and was thus perfect for the study. A response rate is calculated by dividing the number of completed survey responses

by the number of people who viewed or started the survey. Given the high response rate, nonresponse error was not a threat to the external validity of the study (Lindner, 2002).

$$Response\ rate\ =\ \frac{401}{405}\ \times\ 100\ =\ 99\%.$$

Figure 3 below shows the distribution of respondents to the baseline survey on water resilience in the North-East.

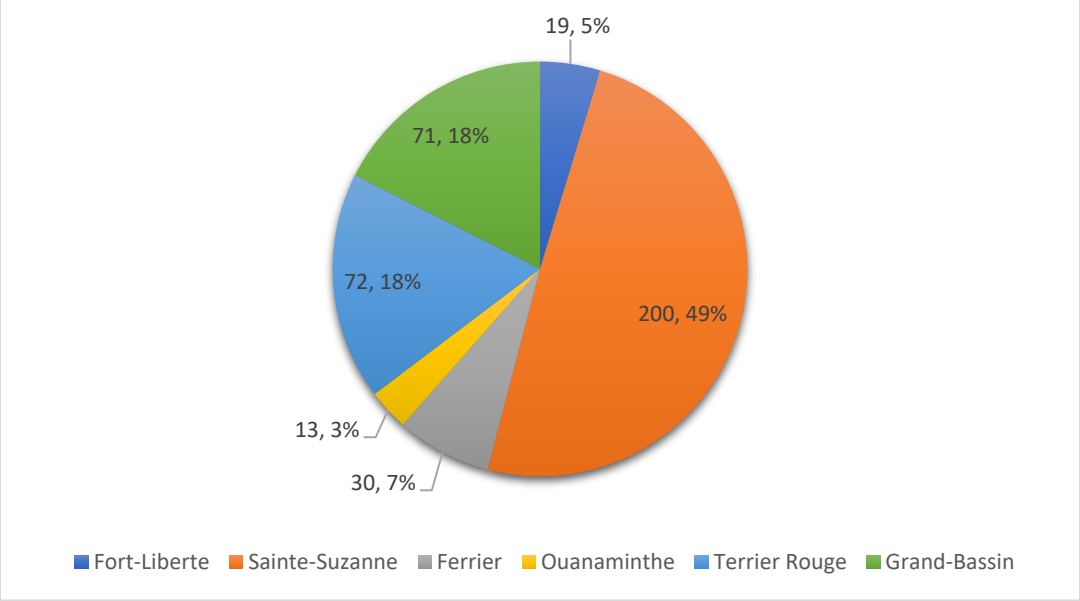

Figure 3: Number of People Interviewed as Part of the Baseline Survey on Community Organizations' Water Resilience, by Commune, 2023.

3.4 Measures

The responses from the survey were transcribed into a spreadsheet with the columns representing individual survey questions and row representing individual respondents. The dependent and independent variables are the following:

3.4.1 Dependent Variables

We considered two dependent variables, namely: “Access to food” and “Access to drinking water”.

Access to food measures food security by calculating a food consumption score for each respondent's household. These measurements are indispensable in understanding and evaluating the extent and severity of food insecurity within households, as well as assessing the impact of interventions aimed at improving food security. (Hoddinott & Yohannes, 2002). They encompass evaluating physical availability of food, economic access, and the utilization of food to ensure dietary adequacy. By analyzing food access, researchers and policymakers can identify vulnerable groups, address underlying causes of food insecurity, and develop targeted strategies to alleviate food insecurity effectively. Regular monitoring of food access trends facilitates timely intervention and contributes to achieving sustainable development goals related to poverty reduction and improved well-being.

For this study, households' access to food was measured using the household food consumption score (FCS). The Food Consumption Score (FCS), developed by the World Food Program (WFP), is a frequency-weighted measure calculated by recording the frequency with which a household consumes nine different food groups (i.e., staples, pulses, vegetables, fruits, meat/fish/egg, milk, sugar, oil, and spices) within a 7-day recall period from the date of the survey (Adeniyi & Dinbabo, 2019; Carletto et al., 2013; Marmot, 2005; WFP, 2008). Each food group is weighted on the basis of the nutrient density derived from their consumption. The food groups and standard weights for calculating FCS is presented in Appendix C. The consumption frequencies are derived from the following question: "How many times in the last 7 days have you eaten one in each of the 9 food groups?"

Household Food Consumption Score Calculation

The FCS is calculated as follows: the number of times each food group is taken in the last seven days is multiplied by their respective weights and the results are thereafter summed up to

give the overall FCS (Adeniyi & Dinbabo, 2019; Carletto et al., 2013; WFP, 2008). The formula is given by

$$\text{FCS} = \sum_{i=1}^{9} (\text{frequency of consumption}_i \times \text{weight}_i)$$

Where i represents each of the 9 food groups.

The resulting FCS value will then be used to categorize households into different food security levels (WFP, 2008), such as:

- Poor food consumption: 0 - 21
- Borderline food consumption: 21.5 – 35
- Acceptable food consumption: > 35.

Reliability

Given that FCS was calculated using 9 variables containing questions related to the quantities consumed of food from 9 food groups, we proceeded to assess the reliability of the food consumption questions as common measures of average household weekly food consumption. To do this, we employed Cronbach's Alpha to verify whether the food consumption questions in the questionnaire consistently measured the same latent variable (i.e., average household weekly food consumption). Cronbach's Alpha is the most widely used objective measure of reliability (Tavakol & Dennick, 2011). It assesses the extent to which a group of questions are related and provides an estimate of the measurement accuracy, or reliability, of the group of questions.

Table 3 below shows the Cronbach's Alpha reliability statistics for the household's weekly food consumption. The table indicates an alpha coefficient of 0.79 (alpha values greater than 0.7 are generally considered good), suggesting that the food consumption questions from

the questionnaire have relatively high internal consistency and as such are reasonably reliable for the study.

Table 3. Reliability Statistics for Food Consumption Score

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.79	0.79	9

Access to drinking water measures the availability of safe and reliable water within the respondent's household, a critical indicator of overall water security. It encompasses assessing both the physical proximity and the quality of water sources accessible to households, ensuring they meet health and sanitation standards. Monitoring access to drinking water helps identify disparities in water availability among different regions, enabling targeted interventions to improve infrastructure, promote water conservation practices, and ensure equitable access to clean water for all. Effective management of drinking water resources is essential for public health, sustainable development, and resilience to climate change impacts, emphasizing the importance of comprehensive water access assessments in policymaking and development planning. To measure access to drinking water, respondents were asked "How much water do you use per day?" and responses were recorded in gallons.

3.4.2 Independent Variables

We grouped the independent variables into two parent categories, namely, "Individual Characteristics" and "Socio-economic Characteristics". Below is a detailed breakdown.

Individual Characteristics refer to the factors that collectively contribute to the understanding of the socio-demographic profile of the respondents. The indices include the age and gender of respondents, educational level, household size, wealth status (The measured and

obtained categories are listed in Table 1.3). The following is a brief explanation of the measured indices.

- **Gender** refers to the sex of the respondent, coded 1 for women, 0 for men.
- **Age** was recorded in actual years.
- **Education level** was obtained in simplified form coded as 1 for some education and zero for no education.
- **Household size** reflects the reported number of household members.
- **Wealth status** is measured by a proxy indicator of the number of rooms reported to be in the dwelling unit.

Socio-economic Characteristics indices used in the study include, practice agricultural activities, practice breeding, pregnant women in the household, disabled persons, orphans in the household, older persons in the household, and communes (The measures and obtained categories are listed in Table 4). The variables are explained below.

- **Practice agricultural activities** refer to whether or not the respondent was engaged in farming, coded 1 for yes, 0 for no.
- **Practice breeding** refers to whether or not the respondent was engaged in animal husbandry activities, coded 1 for yes, 0 for no.
- **Pregnant women in the household** is an indicator variable that shows if at least one member of the household is pregnant. It takes the value 1 for yes and 0 for no.
- **Disabled people** is an indicator variable that shows whether or not there are presence of disabled persons in the household, coded 1 for yes and 0 for no.
- **Orphans** refers to people living in a household without a mother or father or both. It takes the value 1 for yes and 0 for no.

- **Older people in the household** refer to people who cannot help themselves, coded 1 for yes and 0 for no.
- **Public water source** was obtained in simplified form coded as 1 for use of public water and 0 for do not use public water.
- **Own water source** refers to sources of water privately owned by each household, coded 1 for have own water source and 0 for do not have own water source.
- **Communes** refers to the sub-departmental unit where the respondent resided. The six townships are listed in Table 4. Dummy variables were created for each unit, coded 1,0.

Table 4. Description of Study Variables, North Haiti, 2023

Variable	Description
Dependent variables	
Access to food	Food consumption score of the households
Access to drinking water	Mean gallons per household member
Independent variables	
Individual Characteristics	
Gender	0=Male, 1=Female
Age	Actual years
Education level	1=Some level of education, 0= No education
Household size	Number of people living in a household
Wealth status	Number of rooms in the dwelling
Socio-economic Characteristics	
Practice agricultural activities	1 = Yes, 0 = No
Practice breeding	1 = Yes, 0 = No
Pregnant women	1 = Yes, 0 = No
Disabled people	1 = Yes, 0 = No
Orphans	1 = Yes, 0 = No
Older people	1 = Yes, 0 = No
Public water source	1 = use public water, 0 = do not use public water
Own water source	1 = have own water source, 0 = do not have own water source
Communes	1=Great Basin, 2=Ferrier, 3=Fort-Liberté, 4=Ouanaminthe, 5=Red Terrier, 6=Sainte-Suzanne Dummy variables (0,1) were created for each commune.

3.5 Data Analysis

For this study, data analysis was conducted using SPSS version 29.0. During the initial phase of data processing, discrepancies stemming from data inconsistency were identified and corrected. The original transcription of the questionnaire resulted in a dataset containing 266 columns. To ensure data quality, we initiated a rigorous data cleaning process. Initially, columns with more than 80% missing values were removed, reducing the dataset to 202 columns (64 columns were eliminated due to excessive missing data). Subsequently, we further streamlined the dataset by eliminating constant columns, bringing the total down to 195 columns. Through additional analysis to identify redundant variables, another 22 columns were dropped, resulting in a final dataset of 173 columns. In total, 93 columns were removed from the original dataset during the data cleaning and dimension reduction process.

In this study, a diverse range of statistical techniques was employed to rigorously analyze and interpret the data set. The analysis commenced with the application of descriptive statistics to elucidate the characteristics of the respondents. These descriptive statistics, which included frequencies, means, and standard deviations, provided a comprehensive summary of the responses across all variables utilized in the study, as detailed in Table 5. This initial phase aimed to provide a clear and concise overview of the dataset, highlighting key trends and distributions among the study participants.

Moving beyond descriptive statistics, inferential statistical methods were then applied to delve deeper into the relationships and patterns within the data. Techniques such as One-Way ANOVA were used to explore variance across different groups, offering insights into how various factors influence the dependent variables. Multiple linear regression analysis was employed to examine the relationships between multiple independent variables and the

dependent variable FCS that was used as the metric for measuring “Access to Food”, thereby identifying significant predictors and their respective contributions. Additionally, ordinal regression was utilized to analyze the ordinal outcome variables, “Water use per day” which was used as a measure of access to water for the respondents’ households, providing a nuanced understanding of how the predictor variables influence access to water. Furthermore, a Pearson correlation matrix was constructed to assess the strength and direction of linear relationships between pairs of continuous variables, offering valuable insights into potential associations among key study variables.

By employing this comprehensive suite of statistical techniques, this study aimed not only to describe the dataset in detail but also to uncover meaningful patterns, relationships, and predictors within the data. These analytical approaches collectively contribute to a robust interpretation of findings and facilitate informed conclusions regarding the research objectives.

3.5.1 One-Way ANOVA

One-way ANOVA (analysis of variance) extends the two-sample t-test to analyze differences among three or more samples (Heiberger et al., 2009). In this study, ANOVA was used to test hypotheses concerning population means μ_j for six communes, formulated as:

$$H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5 = \mu_6$$

H_1:Not all μ_j's are equal (for $j = 1$ to 6).

This statistical test leveraged observed sample means to compare the food consumption score, and daily water use across households in Northeast Haiti's six communes. Its objective is to ascertain whether there exists compelling statistical evidence indicating significant differences in means among these communes. Subsequently, communes demonstrating statistically distinct

means was selected for regression analysis, providing deeper insights into the factors influencing food consumption and water usage patterns within the region.

3.5.2 Pearson Correlation Matrix

Pearson's correlation analysis was employed to explore the relationship between household demographics, socio-economic characteristics, and their access to food and drinking water aiming to uncover meaningful patterns or connections among these variables. Building upon the insights gained from correlation tests, the study further employed multiple linear regression and ordinal regression analyses. These statistical techniques were employed to extend and deepen understanding by examining how various predictors collectively influence food access and water availability outcomes. All statistical analyses were conducted using the conventional significance level threshold of $p < 0.05$, ensuring rigorous evaluation of relationships and statistical significance in the study findings.

3.5.3 Multiple Linear Regression

In this study, multiple linear regression analysis was utilized as a robust statistical method to investigate and quantify the relationships between multiple independent variables and a single dependent variable. This approach allows for the examination of how changes in several predictor variables are associated linearly with variations in the response variable of interest. By establishing these relationships, multiple linear regression enables the prediction of the behavior of the dependent variable based on the identified predictors.

The process involves fitting a linear equation or model that best represents the relationship between the dependent variable and the independent variables. This model provides insights into the extent to which each predictor variable influences the dependent variable, as well as the direction of that influence (positive or negative). Moreover, multiple linear regression

analysis helps to assess the overall significance of the predictors in explaining variability in the response variable and the coefficient of determination R^2 measures the proportion of the variance in the dependent variable explained by the independent variables. In regression, the lowest possible value of R^2 is 0 and the highest possible value is 1 (i.e. the better a model is at making predictions, the closer its R^2 will be to 1).

In practical terms, this statistical technique is invaluable for understanding complex relationships within datasets, identifying key factors that affect outcomes of interest, and making informed predictions or decisions based on the established model. Its application in this study aimed to deepen understanding of how various socio-economic and demographic factors impact access to food.

The model is represented as:

$$y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_p X_p + \epsilon,$$

Where;

y = dependent variable,

β_0 = coefficient of the constant term (value of y when all other parameters are set 0),

$\beta_1 - \beta_p$ = coefficients of the predictor variables,

$X_1 - X_p$ = predictor variables,

ϵ = error term (accounts for unexplained variation in the response variable, y),

3.5.4 Ordinal Regression

Ordinal regression, or ordinal logistic regression (often referred to as PLUM - Polytomous Universal Model), extends the general linear model to handle ordinal categorical data (Norusus, 2006), where the categories have a natural order but not necessarily equal spacing between them. Unlike binary logistic regression, which is suited for binary outcomes (e.g.,

yes/no, pass/fail), ordinal regression accommodates dependent variables with ordered categories that maintain a natural progression, such as levels of access to drinking water (e.g. poor, fair, good).

The model estimates cumulative logits (log-odds) that describe the relationship between the independent variables and the probability of the ordinal categories. Unlike binary logistic regression, which predicts the probability of a single event (e.g., passing an exam), ordinal logistic regression predicts the cumulative probability of an event and all events that are ordered before it.

For instance, in this study where we are interested in assessing factors influencing access to drinking water categorized as "poor," "fair," and "good," based on water availability indicators. The model would analyze predictors such as household size, wealth status, education level, etc., to understand how these variables impact the probability of households achieving higher levels of drinking water access. This approach helps identify critical factors contributing to improved drinking water access across different ordinal categories.

The model is as specified as follows:

$$\theta_1 = \frac{P(\text{daily water use} \leq 10gal)}{P(\text{daily water use} > 10gal)} \qquad \theta_2 = \frac{P(\text{daily water use} \leq 20gal)}{P(\text{daily water use} > 20gal)}$$

$$ln\,(\theta_j) = \alpha_j - (\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_{14} X_{14}), j = 1,2.$$

The terms, α_j are referred to as threshold values and are not the focus of analysis here. The coefficients $\beta_i, i = 1,2, \ldots 14$ measure the importance of individual variable (we will give more specific explanation later).

3.5.5 Hypotheses

The following hypothesis testing was performed at a 95% confidence level ($P \leq 0.05$).

$H_0: \beta_i = 0$, for all $i = 1, \ldots, 14$ vs $H_1: \beta_i \neq 0$, for some $i \in \{1,2, \ldots, 14\}$,

which other words is written as follows:

- H_0: There is no relationship between any of the personal and socio-economic characteristics of individual households and their access to food.
- H_1: There is a relationship between some households selected individual and socio-economic characteristics and their access to food during disasters. This implies that there is at least one regression coefficient that does not equal zero.

CHAPTER 4: RESULTS

This chapter presents the findings of the study, starting with descriptive statistics that provide a comprehensive overview of all variables under investigation. The descriptive statistics offer insights into the central tendencies and distributions of the variables of interest. Following this, an ANOVA table is employed to compare the food consumption score, and daily water use among households across the six communes in Northeast Haiti, assessing whether there are statistically significant differences in means.

The Pearson correlation matrix is utilized to summarize the linear relationships and strength of associations between dependent and independent variables. This analysis helps to understand the direction and magnitude of these relationships.

In the final section of the chapter, the results of multiple linear regression and ordinal regression analyses are presented. These analyses elucidate which variables emerged as statistically significant based on the hypotheses tested. Each section of the chapter focuses on presenting and interpreting the results in alignment with the specific objectives outlined in the study, providing a comprehensive understanding of the factors influencing food and drinking water access in the study area.

4.1 Descriptive Statistics

Table 5 presents the summary statistics for both dependent and independent variables derived from the sampled households. The data reveals that a significant majority of respondents (66.1%) were female, indicating their predominant representation in the study. On average, respondents were approximately 47 years old, suggesting that the sample predominantly consists of individuals in their active years. Moreover, a substantial proportion (71.6%) reported having

no formal education, which aligns with findings from (Baro, 2002) study indicating low educational attainment levels in Haiti, where only 10% complete sixth grade.

The typical household size was around 5 members, reflecting a common family structure in the study area. Wealth status, measured by the number of rooms within households (a proxy for household wealth), varied significantly (min. of 1 and max. of 8) with an average score of 3.31 rooms per household. A higher score typically indicates greater household wealth, possibly indicating larger households and availability of family labor. These statistics provide a detailed glimpse into the demographic and socio-economic characteristics of the surveyed households, shedding light on their composition and economic conditions.

Descriptive statistics on household composition reveal that 68.3% of individual households are involved in agricultural activities. Additionally, 48.9% of households engage in livestock farming, with the remaining 51.1% not participating in this practice, indicating a near-even split among respondents regarding livestock breeding. Among households surveyed for vulnerable persons, a small percentage have pregnant women (5.7%), while the majority do not report having disabled members (12%), orphans (20.7%), or elderly members (18.5%). Regarding water sources, a significant majority of households (68.8%) rely on public water sources and (31.2%) households do not, whereas a minority (9.2%) have access to their own private water sources while (90.8%) of households do not own private water sources

Descriptive statistics for the dependent variable food consumption score, which measures access to food, indicate considerable variability across households, with a wide range and a mean score of 38.71. This mean score indicates that, on average, households achieve a level of food consumption deemed acceptable by the World Food Program (WFP, 2008). Regarding access to drinking water, measured by daily household water usage, the data shows that most households

(54.4%) use between 10-20 gallons of water per day. This range illustrates typical daily water usage patterns within the surveyed households. The following boxplot and histogram give a pictorial summary of the descriptive statistics for the dependent variables Food Consumption Score and Water Usage, respectively.

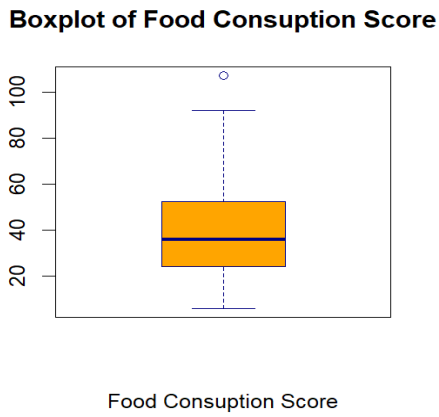

Figure 4: Boxplot of FCS

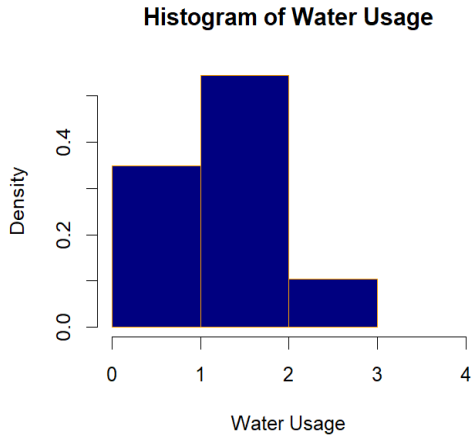

Figure 5: Histogram of Water Usage (gallons per person)

Concerning geographic distribution, the highest percentage of respondents (49.1%) reside in Sainte-Suzanne. The remaining respondents are from Great Basin (17.7%), Ferrier (7.5%), Forte-Liberté (4.5%), Ouanaminthe (3.2%), and Red Terrier (18%). This distribution provides an overview of the representation of different communes within the study, offering a geographic context to the sampled population.

Table 5. Descriptive Statistics of Study Variables, Northeast Haiti 2023.

Variables	Number		Mean	Mode	Std. Dev.	Range	Min.	Max.	Response	Percent (%)
	Valid	Missing								
Dependent										
Access to food	401	0	38.71	28.0	18.40	101	6	107		
Access to water	400	1	1.76	2	0.63	2	1	3	1=<10 gallons, 2=10-20 gallons, 3=>20 gallons	1=34.9, 2=54.4, 3=10.5
Independent										
Gender of respondent	401	0	1.66	2	0.47	1	1	2	0=Male, 1=Female	0=33.9, 1=66.1
Age of head of household	401	0	47.15	45	16.32	71	16	87		
Education level	401	0	0.28	0	0.45	1	0	1	0=No level of education, 1=Some level of education	0=71.6, 1=28.4
Household size	401	0	5.04	5	2.34	15	1	16		
Wealth status	401	0	3.31	4	1.16	7	1	8		
Practice agricultural activities	401	0	1.32	1	0.47	1	1	2	1=Yes, 0=No	1=68.3, 0=31.7
Practice breeding	401	0	1.51	2	0.50	1	1	2	1=Yes, 0=No	1=48.9, 0=51.1
Pregnant women	401	0	1.94	2	0.23	1	1	2	1=Yes, 0=No	1=5.7, 0=94.3
Disabled people	401	0	1.88	2	0.33	1	1	2	1=Yes, 0=No	1=12, 0=88
Orphans	401	0	1.79	2	0.41	1	1	2	1=Yes, 0=No	1=20.7, 0=79.3
Older people	401	0	1.82	2	0.39	1	1	2	1=Yes, 0=No	1=18.5, 0=81.5

Public water source	401	0	0.69	1	0.46	1	0	1	0=do not use public water source, 1=use public water source	0=31.2, 1=68.8
Own water source	401	0	0.09	0	0.29	1	0	1	0=do not have own source of water, 1=have own source of water	0=90.8, 1=9.2
Communes	401	0	4.44	6	1.98	5	1	6	1=Great Basin, 2=Ferrier, 3=Fort-Liberté, 4=Ouanaminthe, 5=Red Terrier, 6=Sainte-Suzanne	1=17.7, 2=7.5, 3=4.5, 4=3.2, 5=18, 6=49.1

4.2 Food and Drinking Water Insecurity

This section focuses on our first and second objective: evaluating the prevalence of food and drinking water insecurity among households in Northeast Haiti. To achieve this, we utilized One-Way ANOVA to compare the mean household food consumption scores, and water use across different communes. This statistical approach enabled us to discern significant variations among communes in terms of food consumption levels. Also, the analysis provided insights into the disparities in daily water usage among these communes. By identifying which areas had acceptable or inadequate food consumption scores and contrasting levels of daily water usage, we aimed to gain a comprehensive understanding of the food and water security landscape in Northeast Haiti.

4.2.1 ANOVA Results for the FCS and Household Daily Water Usage

Tables 6a present the ANOVA results examining differences in the means of daily water use across the six communes in Northeast Haiti. The analysis reveals a statistically significant result ($F = 4.56,\ p < 0.05$), indicating notable variations in daily water usage among the communes. This finding leads us to reject the null hypothesis, affirming that certain communes exhibit statistically distinct population means regarding daily water consumption. This reveals the variability in water access and usage patterns across different areas within Northeast Haiti.

Table 6a. ANOVA for Daily Water Use by Commune, Northeast Haiti 2023.

		Sum of Squares	df	Mean Square	F
Water use per day	Between Groups	8.65	5	1.73	4.56*
	Within Groups	149.34	394	0.38	
	Total	157.99	399		

*p<.001

Tables 6b below present the ANOVA results illustrating differences in the means of the Food Consumption Score (FCS) across the six communes in Northeast Haiti. The analysis indicates a statistically significant finding ($F = 4.20,\ p < 0.05$), suggesting meaningful variations in food consumption scores among the communes. Consequently, we reject the null hypothesis, confirming that some communes exhibit statistically distinct population means concerning food consumption score. This finding emphasizes the importance of locality-specific factors in influencing food security outcomes across Northeast Haiti.

Table 6b. ANOVA for Food Consumption Score by Commune, Northeast Haiti 2023.

		Sum of Squares	df	Mean Square	F
Food consumption score	Between Groups	6838.71	5	1367.74	4.20*
	Within Groups	128628.81	395	325.64	
	Total	135467.52	400		

*p<.001

The ANOVA results above indicate significant differences in household water use and food consumption across various communes. To pinpoint which specific groups have statistically distinct means in both daily water use and food consumption, we conducted the Tukey Honestly Significant Difference (HSD) test, as reported in Tables 7 and 8 below. This statistical method allows us to identify and compare pairwise differences between communes, providing deeper insights into the disparities in water usage and food consumption levels among different areas in the study region.

Table 7 classifies the communes into two distinct groups, labeled as subset 1 and subset 2, based on their daily water usage patterns. Membership within the same group denotes similar levels of daily water consumption, while membership in different groups indicates significant differences in daily water use, at a significance level of $\alpha = 0.05$. Subset 1 includes the

communes Ferrier and Fort Liberte, suggesting that these two communes have comparable average daily water usage. Conversely, subset 2 comprises Fort Liberte, Red Terrier, Sainte-Suzanne, Ouanaminthe, and Big pool, indicating comparable average daily water usage among these communes.

The data reveals that Ferrier stands out with an average daily water use of 1.27 <10 gallons), significantly lower than that of Red Terrier, Sainte-Suzanne, Ouanaminthe, and Big pool, where water usage is higher. These findings provide clear evidence of disparities in water accessibility across the surveyed communes, highlighting Ferrier as a particularly vulnerable area in terms of water security.

Table 7. Tukey HSD Test for Daily Water Use, Northeast Haiti 2023.

Commune	N	Subset for alpha = 0.05	
		1	2
Ferrier	30	1.27	
Fort Liberte	18	1.67	1.67
Red Terrier	72		1.75
Sainte-Suzanne	196		1.79
Ouanaminthe	13		1.85
Big pool	71		1.87
Sig.		.12	.78

Means for groups in homogeneous subsets are displayed as 1,2.

Table 8 categorizes the communes into two overlapping groups, labeled as Subset 1 and Subset 2, based on their food consumption scores. Communes within the same group exhibit similar levels of food consumption, while those in different groups show statistically significant differences in food consumption, with a significance level of $\alpha = 0.05$.

Subset 1 comprises Sainte-Suzanne, Ferrier, Big pool, and Red Terrier. Subset 2 includes Ferrier, Big pool, Red Terrier, Forte-Liberté, and Ouanaminthe. The overlap occurs at Ferrier, Big pool, and Red Terrier, indicating that these communes exhibit similar food consumption patterns to all the other communes under study.

Notably, Sainte-Suzanne stands out with the lowest mean FCS of 35.45 and falls into subset 1, indicating significantly different food consumption levels compared to Forte-Liberté (49.39) and Ouanaminthe (49.73), both of which are distinctly in subset 2. This suggests that households in Forte-Liberté and Ouanaminthe tend to have better food consumption outcomes compared to Sainte-Suzanne.

Table 8. Tukey HSD Test for Food Consumption Score, Northeast Haiti 2023

Municipality	N	Subset for alpha = 0.05	
		1	2
Sainte-Suzanne	197	35.45	
Ferrier	30	37.82	37.82
Big pool	71	39.59	39.59
Red Terrier	72	42.50	42.50
Fort Liberte	18		49.39
Ouanaminthe	13		49.73
Sig.		.65	.11

Means for groups in homogeneous subsets are displayed as 1,2.

4.3 Socio-Economic Characteristics

4.3.1 Pearson Correlation (r)

Pearson correlation analysis was employed to assess the strength and direction of the linear relationships between dependent variables (food consumption score and water use per day) and independent variables. Table 9 summarizes these correlations. Overall, the correlations between food consumption score, water use, and the independent variables were found to be low.

The analysis of access to water revealed several significant associations with demographic and contextual variables. Table 9 presents these correlations, highlighting both positive and negative relationships. Specifically, daily water use showed positive correlations with household size (0.25), and wealth status of respondents' household (0.16) measured using number of rooms. Conversely, it exhibited negative correlations with the age of respondents (-0.10). Furthermore, the number of older individuals in households also appeared to negatively

influence access to water (0.11), and this is likely due to the challenge associated with the reliance on public water sources which represents the main source of water for most households in the communities studied.

Regarding correlations among independent variables, positive correlation occurred between gender and variables like education (0.20), and household size (0.14). Negative correlations were also detected for age with the variables, education level (-0.35), and household size (-0.15). Education level also showed positive correlation with household size (0.10). Wealth status correlated positively with household size (0.27). But overall, the correlations are mild (all less than 0.5) which shows that there is no issue of multicollinearity, and all the variables can be considered in the model.

Table 9. Correlations Among Study Variables, Northeast Haiti, 2023

	Variables	1.	2.	3.	4.	5.	6.
1.	Food Consumption Score	--					
2.	Water use per day	-0.05	--				
3.	Gender	-0.05	0.03	--			
4.	Age of respondent	-0.05	-0.10*	-0.07	--		
5.	Education level	0.04	0.06	0.20**	-0.35**	--	
6.	Household size	-0.06	0.25**	0.14**	-0.15**	0.10*	--
7.	Wealth status	0.01	.16**	0.02	0.07	0.05	0.27**

**, * means Correlation is significant at 0.01 (1%) and 0.05 (5%) level respectively

Looking at the correlation scores between gender and the dependent variables, FCS (-0.05) and water use per day (0.03), it follows that there is no significant disparity in FCS and water usage across different genders. Thus, both male and female genders have relatively comparable impact on these measures.

4.3.2 Multiple Regression Analysis

Table 10 displays the standardized beta coefficients resulting from the regression analysis examining the relationships between individual characteristics, socio-economic factors, and households' access to food. Each standardized beta coefficient indicates the strength and direction of the effect of an independent variable on the dependent variable, measured in units of standard deviation. A higher absolute value of the beta coefficient signifies a stronger impact of the independent variable on the dependent variable. These coefficients are reported to identify which independent variables exert the most significant influence on access to food. Variables with larger standardized coefficients are particularly influential in explaining variations in food access among households.

The regression analysis shows that some of the variables influence the food consumption score. The important thing to understand here are the standardized beta coefficient (β). A positive standardized beta coefficient, β say, for any independent variable indicates that for every increase of one standard deviation in that independent, Food Consumption Score increases by β standard deviations. For example, wealth status with a standardized beta coefficient of 0.05 implies that for every increase of one standard deviation in Wealth status, Food Consumption Score increases by 0.05 standard deviations. The opposite holds for a negative sign on a standardized beta coefficient.

Model Summary – Multiple Regression

Table 10. Multiple Regression Coefficient of Individual and Socio-economic Characteristics of Households on their Access to Food Based on Food Consumption Scores, Northeast Haiti 2023

	Standardized Beta Coefficients	
Predictors	β	t-value
Gender	-.06	-1.21
Age of respondent	-.04	-.65
Education level	.04	.77
Wealth status	.05	.88
Household size	-.05	-.85
Practice agricultural activities	.23***	4.56
Practice breeding	-.03	-.65
Pregnant women	.03	.59
Disabled people	-.09	-1.61
Orphans	.05	.92
Older people	.11*	1.96
Public water source	-.04	-.70
Own water source	-.11**	-1.99
Food Commune	-.17***	-3.49
R^2	.11	
Adjusted R^2	.09	
F-value	3.44***	
N	401	

*p<.05; **p<.01; ***p<.001.

- **R Square**: The coefficient of determination R^2 which measures the proportion of the variance in the dependent variable explained by the independent variables is 0.11, indicating that 11% of the variability in FCS is explained by the combined influence of households individual and socio-economic characteristics
- **Adjusted R Square**: Adjusted for the number of predictors in the model. It is .08, indicating that 8% of the variance is explained after accounting for the number of predictors.
- **F**: The F-statistic for the model tests whether at least one of the predictors is significantly related to the dependent variable. An F value of 3.44 with a p-value < .01 indicates that

the model is significant, and that the regression model provides a better fit to the data than a model with no predictors.

Interpretation of Coefficients:

In interpreting the standardized beta coefficients, the table shows that practicing agricultural activities has the strongest positive impact on FCS with a standardized beta coefficient of 0.23. This means that with more agricultural activities within a household, comes better access to food. This is in line with the findings of Adeniyi & Dinbabo (2019) which suggests that increase in the years of farming will increase FCS. The table also shows that households that own their water source have a significantly lower FCS with a standardized beta coefficient of -0.11. This could mean that reliance of a household on their own water sources might be reflective of the existence of certain limiting barriers that hinder access to alternative water sources, and thus resulting in low water quality, which can then lead to all sorts of other problems including poor farm practices, health problems, and reduced manpower.

The variable Food Commune is an indicator variable that takes the value 1, for households in the communes, Sainte-Suzanne, Ferrier, Grand-Basin, and Terrier Rouge, and 0 for households in Forte-Liberté, and Ouanaminthe. The table show a significant (p-value < 0.05) negative standardized beta coefficient of -.17, indicating that households within Sainte-Suzanne, Ferrier, Big pool, and Red Terrier have a significantly lower FC. This can also be explained by various factors like inadequate infrastructure within these communes. Limited transportation infrastructure can hinder the distribution of food, leading to shortages and higher food prices. Poor road conditions have also been shown to be a major limiting factor in the development of these communes (Haiti wiki fandom, n.d.). Additionally, it follows from the table that the households with elderly people who can help themselves have a marginally significant (0.11, p =

.05) higher Food Consumption Score. Finally, the table shows that all the other predictors do not significantly impact the Food Consumption Score, indicating that they do not play a crucial role in predicting food consumption in this context.

The resulting fitted regression equation in standardized coefficients is thus given as:

Access to food$(Y) = 0.23$(Practice agricultural activities) $+ 0.11$(Older people) $- 0.11$(Own water source) $- 0.17$(Commune).

4.3.3 Ordinal Regression Analysis

Model Summary – Ordinal Regression

This section provides the estimated coefficients (logits), standard errors, and Wald statistics for each predictor.

Table 11. Ordinal Regression for Access to Drinking Water on Selected Individual and Socio-Economic Characteristics of Households, Northeast Haiti 2023

Variables	β	SE	Wald
Household size	0.24*	0.05	22.97
Water commune	2.00*	0.46	18.72
Own water source	-1.47*	0.42	12.35
Older people	-0.77*	0.30	6.38
Public water source	-0.64*	0.26	6.26
Practice breeding	-0.52*	0.22	5.66
Wealth status	0.21*	0.10	5.01
Age of respondent	-0.01	0.01	1.46
Practice agricultural activities	0.26	0.23	1.21
Pregnant women	0.46	0.45	1.01
Orphans	-0.25	0.26	0.93
Gender	-0.13	0.23	0.32
Education level	-0.11	0.25	0.19
Disabled people	0.09	0.35	0.07
X^2 (14, 400 df)	85.06*		
Psuedo-R^2 (Nagelkerke)	0.23		

Link function: Logit., * means significant at 0.05 (5%) level

- **Chi-Square**: The difference between the "Intercept Only" and the "Final" model. A high value (85.06) with (p-value << .01) indicates that the predictors significantly improve the model fit.
- **Pseudo R-Square**: These values indicate the proportion of variance explained by the model. Nagelkerke's R-Square (.23) is interpreted as about 23% of the variance in household water use being explained by the predictor variables.

From table 11 above, household size, wealth status, the presence of older people who can help themselves in a household, practicing breeding (livestock farming), public water source, own water source, and living in Sainte-Suzanne, Ferrier, Big pool, or Red Terrier, all impact the average amount of daily water use among households. A positive β coefficient means that as values of the ordinal-or interval-independent variables increase, the likelihood of larger scores on the dependent variable increases and vice versa (Norusus, 2006).

The positive estimate (0.24) for household size indicates that for each additional person living in a house, the log-odds of the higher category of water usage increase by 0.24. This is in contrast with the findings of Adams et al. (2016), household size was negatively associated with access to improved source of water. Wealth status also has a significant positive relationship with the amount of water used daily by households. It follows that for each additional room in a household, the log-odds of the higher category of water usage increase by 0.21. This is in line with the findings of Adams et al. (2016) where richer households significantly had higher odds of higher water usage. The negative estimate (-0.77) for older people indicates that households with elderly people who can help themselves have lower log-odds of higher water usage. The practice of breeding/livestock farming with a negative estimate (-0.52) implies that households practicing breeding have lower log-odds of higher water usage compared to those not practicing breeding.

Concerning water sources, it turns out that households that do not own their water sources (-1.47) and households that do not use public water sources (-0.64) both have lower log-odds of higher water usage compared to those that do. Finally, the positive estimate (2.0) for Water Commune implies that households in other communes have significantly higher log-odds of higher water usage compared to those in Ferrier. This justifies our finding from the ANOVA table, that showed the lowest mean water usage for the commune Ferrier.

In conclusion, the analysis provides insights into which household characteristics significantly influence water usage categories. Factors like household size, number of rooms, presence of older people, and water source practices play a crucial role, while demographic factors like age, gender, and education level are not significant predictors in this model.

CHAPTER 5: SUMMARY, LIMITATIONS, IMPLICATIONS, AND CONCLUSION

This dissertation seeks to provide insight insights into the perceptions of food and drinking water access as mediated by previous disaster experiences and to assess the level of food and drinking water insecurities among households in Northeast Haiti. By examining the specific context of Northeast Haiti, this study aims to explore these dynamics to provide insights into addressing broader issues of food and water security. This study examined various socio-economic and individual characteristics of households in Northeast Haiti to understand their impact on access to food and drinking water.

5.1 Major Findings

The descriptive statistics indicated significant demographic trends, including a higher proportion of female respondents (66.1%) with an average age of 47 years. Most respondents had no formal education (71.6%), reflecting the region's low educational attainment levels. These findings align with existing literature, such as Baro, (2002), which highlights low education levels in Haiti. The average household size was around five members. Wealth status, measured by the number of rooms in a household, varied significantly, with an average of 3.31 rooms per household.

The analysis of socio-economic characteristics revealed a predominance of agricultural activities, with 68.3% of households engaged in farming. Livestock farming was less common, almost evenly split among respondents. A small percentage of households reported having pregnant women (5.7%), disabled members (12%), orphans (20.7%), and elderly members (18.5%). Most households (54.4%) use between 10-20 gallons of water per day, showing typical daily water usage patterns. Most households relied on public water sources (68.8%), with only 9.2% having their own water source. The distribution of respondents across communes varied,

with Sainte-Suzanne being the most represented (49.1%). The dependent variables, access to food and water, exhibited significant variability among households, with the average food consumption score (FCS) being 38.71. The highest percentage of respondents (49.1%) resided in Sainte-Suzanne, with other respondents from Great Basin, Ferrier, Forte-Liberté, Ouanaminthe, and Red Terrier.

The ANOVA results demonstrated significant differences in average daily water use and FCS across the six communes in Northeast Haiti, leading to the rejection of the null hypothesis that the population means are equal. This suggests that factors influencing water use and food access vary by location, and these differences should be considered when designing interventions to improve water and/or food access in the region. To pinpoint which communes had statistically distinct levels of average daily water use and food consumption within households, we conducted Tukey HSD post-hoc test with subsets for alpha = 0.05.

In the case of water use, it was found that Ferrier has the lowest average daily water use (< 10 gallons) and forms its own subset (subset 1), with significance level of 0.12 indicating that Ferrier's daily water use is significantly different from the other communes in subset 2. Fort Liberté's daily water use overlaps between both subsets (1 and 2), suggesting it is not significantly different from Ferrier in subset 1 and is also grouped with the communes in subset 2. This indicates that Fort Liberté has a transitional daily water use that is somewhat similar to both lower and higher usage communes. Red Terrier, Sainte-Suzanne, Ouanaminthe, and Big Pool form subset 2, with daily water use (about 20 gallons).

For food access, we found that Sainte-Suzanne has the lowest average FCS (35.45) and forms its own subset (subset 1). The significance level of 0.65 indicates that Sainte-Suzanne's FCS is not significantly different from Ferrier, Big Pool, and Red Terrier in subset 1. Fort Liberté

and Ouanaminthe have the highest FCS values (49.39 and 49.73, respectively) and form subset 2. Ferrier, Big Pool, and Red Terrier have FCS values that overlap between both subsets (1 and 2), indicating that their food consumption scores are not significantly different from either the lower or higher FCS communes, suggesting that their FCS levels are somewhat transitional, falling between the lower and higher ends. Overall, the results indicate that Sainte-Suzanne has significantly lower FCS compared to Fort Liberté and Ouanaminthe. However, Ferrier, Big Pool, and Red Terrier have intermediate FCS values, making them statistically similar to both the lower and higher FCS communes.

The Pearson correlation analysis revealed positive correlations between FCS and agricultural activities, as well as between water use and household size, wealth status, and older household members. Negative correlations were observed between FCS and factors like having one's own water source and residing in Sainte-Suzanne.

The multiple regression analysis reveals that practicing agricultural activities significantly improves FCS, while owning a water source and being located in certain communes negatively impact FCS. The presence of older people in households also positively affects food consumption, although marginally. Additionally, the analysis revealed the variables, Gender, Age, Education Level, Wealth Status, Household Size, Practice Breeding, Pregnant Women, Disabled People, Orphans, Public Water Source do not significantly impact FCS, indicating they are not crucial predictors in this context.

The ordinal regression analysis highlights several key factors influencing daily water use among households in Northeast Haiti. There was a direct relationship between household size and water usage, with each additional person increasing the log-odds of higher category of water usage by 0.24. Wealthier households also used more water as with each additional room in a

household, the log-odds of the higher category of water usage increase by 0.21. Additionally, It was established that households that use their own or public water sources tend to have higher water usage. Also, there are significant regional differences, with households in communes other than Ferrier having higher water usage. Conversely, the presence of older people, and livestock farming correlated with lower water usage.

5.2 Limitations

Several limitations were encountered in this study, impacting the overall reliability and comprehensiveness of the findings. Firstly, there was a physical constraint due to the inability to be present and witness data collection firsthand. This lack of direct observation may have introduced potential biases and limited the ability to verify the accuracy of the data gathered. Also, the data and questionnaires were originally written in French. During the translation process, there is likely to be a risk of information loss or misinterpretation, which could affect the study's conclusions. This language barrier posed a challenge in ensuring that the translated data accurately reflected the respondents' true responses.

Another notable limitation was the use of secondary data. We were constrained to adapt our study's objectives to align with the pre-existing questionnaire design, which may not have fully captured all relevant aspects of our study topic. Consequently, some specific areas of interest might not have been thoroughly explored due to this limitation.

One more limitation of this study was the numerous instances of missing data. This gap in information posed a challenge for data analysis, potentially skewing results and limiting the generalizability of the findings. The missing data had to be addressed through imputation or exclusion, both of which can impact the robustness of the statistical analysis.

5.3 Implications

The findings of this comprehensive study on food and water access in Northeast Haiti reveal critical socio-economic and demographic factors that significantly impact access to essential resources. The implications of these findings are far-reaching, affecting policy, community interventions, and future research in the region.

5.3.1 Theoretical Implications

Food Access

Influence of Agricultural Activities: The positive correlation between agricultural activities and Food Consumption Score (FCS) emphasizes the importance of supporting farming households. Practicing agriculture significantly enhances food security, as evidenced by higher FCS among households engaged in farming. This finding aligns with existing literature, such as the study by Adeniyi & Dinbabo (2019), which indicates that increased years of farming positively affect food consumption.

Regional Disparities: The study highlights notable regional disparities in food consumption within the region. The findings suggest that residing in Sainte-Suzanne negatively impacts FCS, aligning with the local realities of this commune. Various adverse factors, including inadequate transportation infrastructure, hinder food distribution, leading to shortages and elevated food prices. Poor road conditions significantly limit the development of Sainte-Suzanne, exacerbating its food security challenges.

Older people: The presence of older individuals in a household has a marginally positive effect on food consumption. This suggests that older individuals, who often have more resources on average, may play a significant role in managing the household. Their greater resource

availability likely allows them to allocate more towards providing food for the household's sustenance.

Own Water Source: Owning a water source is negatively associated with the Food Consumption Score (FCS). This relationship may stem from the constraints associated with water source ownership, which are more likely to be met by households in relatively urbanized areas. Since the primary activity and food source for households across the studied regions is farming, predominantly located in rural areas, the negative correlation between water source ownership and food access might reflect underlying issues related to rural location rather than a direct effect of water source ownership itself.

Access to Water

Household Size and Wealth Status: Larger and wealthier households tend to use more water daily. Each additional household member and each additional room significantly increase water usage, highlighting the direct relationship between household size, wealth, and water consumption. This is alignment with natural expectation. However, this positive relationship between household size and water usage contradicts with the findings of Adams et al. (2016) where household size was negatively associated with access to improved source of water.

Impact of Demographic Factors: A higher number of older individuals in a household and involvement in livestock farming are both associated with lower water usage. This finding is not surprising given the data, which indicates that the majority of households rely on public water sources (68.8%), with only 9.2% having private water sources. Older individuals may find it more challenging to navigate the daily demands of using public water resources. Similarly, livestock farming can negatively impact water access, as some water sources in the studied

communities are in open and unprotected sites (e.g. rivers, open wells, etc.) and are also used by livestock throughout the day.

5.3.2 Practical Implications

To effectively address all the various aspects of the food and water security problems in the communes in northeast Haiti, efforts must be simultaneously invested from multiple directions, and we highlight some ideas and practical implications from the study below.

Policy Support: In our findings, practicing agriculture significantly enhances food security, as evidenced by higher FCS among households engaged in farming. Therefore, policymakers should prioritize agricultural development programs, providing resources, training, and financial support to farming households. Such initiatives can increase productivity, improve food security, and reduce vulnerability to food shortages.

Community Programs: Local governments and NGOs should implement community-based agricultural training and support programs, focusing on sustainable farming practices and diversification of crops. Economic development programs that improve household wealth can indirectly enhance water access, as wealthier households are better positioned to secure adequate water supplies.

Targeted Interventions: Tailored interventions are necessary to address the specific needs of each commune. For instance, Sainte-Suzanne requires immediate attention to improve infrastructure, food distribution, and access to markets.

Resource Allocation: Water supply interventions should consider household size and wealth status to ensure equitable distribution of water resources. Larger and wealthier households may require more substantial water allocations to meet their needs.

Support for Vulnerable Groups: Special programs to support households with elderly members and those engaged in livestock farming can help address their specific water needs. This includes ensuring easy access to water sources and helping with water collection.

Sustainable Practices: Promoting sustainable livestock farming practices that optimize water usage can help balance the water needs of farming households without compromising their agricultural activities.

5.3.3 Empirical Implications

Impact of the Inability to Witness Data Collection:

The absence of firsthand observation introduces an inherent limitation to the reliability of the collected data. Without direct oversight, there is a reduced ability to confirm the accuracy or consistency of responses, which may result in biases. Therefore, future studies should prioritize in-person data collection when feasible to enhance the authenticity of data and reduce reliance on potentially biased secondary sources.

Empirically, this may mean that the findings should be interpreted with caution, as they could be influenced by unobserved factors or misreporting that the research team could not control. Researchers must acknowledge this potential bias and ensure that it is transparently reported in the study's conclusions and discussions.

Language Barrier and Translation Challenges:

The translation process can introduce nuances or shifts in meaning that affect the study's findings. Any potential misinterpretation or loss of information during translation could lead to conclusions that are less accurate or reflective of the true responses provided by participants.

Therefore, the need for thorough validation processes when translating questionnaires and data is something to be considered in future study. Also, incorporating bilingual experts to

cross-check translations or using back-translation methods would be beneficial in ensuring that the translated content aligns closely with the original responses. This suggests that results may not be entirely replicable without addressing this barrier in further studies.

Use of Secondary Data:

Due to reliance on pre-existing questionnaires, the study's scope may have been partially defined by the limitations of the survey instruments. As a result, areas that could provide deeper insight into the study may have been overlooked, impacting the comprehensiveness of the research.

Empirically, this affects the applicability of the findings, as they are limited to the data that was originally collected. It may restrict the depth of analysis and prevent a complete exploration of new or emerging variables that could influence the study topic. Therefore, future studies should consider the design and collection of primary data specifically tailored to the research objectives. This would enable a more robust and tailored exploration of the research questions.

Missing Data:

Our study encountered some challenges of missing data which is a common challenge that can introduce biases or reduce the statistical power of the study analysis. In cases where imputation methods are applied, the accuracy of these imputed values can impact the validity of the study's outcomes.

Therefore, the empirical implication could be that the study's results will be less generalizable or reliable. The methods used to handle missing data (e.g., multiple imputation or listwise deletion) should be clearly documented, and the sensitivity of the findings to these methods should be assessed. For our future study, we must acknowledge that even with

imputation, some degree of uncertainty is introduced, and it should be factored into the interpretation of the results. Sensitivity analyses can also help demonstrate how robust the findings are to the methods that would be used for handling missing data.

5.4 Conclusion

The study provides a comprehensive analysis of the socio-economic and regional factors influencing food and water security among households in Northeast Haiti. It reveals significant demographic trends, such as a higher proportion of female respondents, low educational attainment, and a predominance of agricultural activities as a primary livelihood. The ANOVA results indicate substantial disparities in daily water use and food consumption scores (FCS) across different communes, with Sainte-Suzanne showing the lowest average FCS and Ferrier having the lowest daily water use. The Pearson correlation and multiple regression analyses highlight that agricultural practices improve FCS, while factors like owning a water source and residing in certain communes negatively impact it. Additionally, household size and wealth status were significant predictors of water usage, underscoring the complex relationship between socio-economic characteristics and resource access.

Therefore, interventions must be tailored to address location-specific challenges to effectively improve food security and water access. First, targeted community-based interventions should be implemented, focusing on promoting sustainable agricultural practices to improve food consumption scores. Second, infrastructure development should prioritize improving access to safe and reliable water sources, especially in communes like Ferrier and Sainte-Suzanne, which have lower usage and FCS. Third, policy measures should include support for wealth-building initiatives and educational programs to empower households and enhance their resource management capabilities. Fourth, specific assistance should be provided

for vulnerable groups, including households with elderly members or those engaged in livestock farming, to ensure equitable resource distribution. Finally, future research should continue to explore additional socio-economic and environmental factors affecting food and water security and update intervention strategies to reflect new data and emerging trends.

Future research should consider examining the effectiveness of different interventions aimed at improving food and water security. This could include the role of government policies, community-based initiatives, and international aid programs in enhancing the availability and quality of essential resources. Additionally, understanding the social dynamics and conflicts that arise due to limited access to food and water can provide valuable insights into developing more effective and inclusive solutions.

Another critical area for future research is the irrigation needs of Northeast Haitians. Investigating their current perceptions and attitudes towards irrigation as a coping strategy for water resilience can shed light on the potential for irrigation to improve food security and economic stability. This research could involve assessing the availability and condition of irrigation infrastructure, the willingness of households to adopt irrigation practices, and the barriers they face in doing so.

By expanding the scope of research to include these additional aspects, we can develop a more comprehensive understanding of the challenges and opportunities related to food and water security in Northeast Haiti. This, in turn, can inform the design of more effective policies and interventions to support the resilience and well-being of these communities.

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Appendix A

Sampling Calculator

The formula for calculating the sample size, with the chosen sampling method (One-stage Simple Random Sample (SRS)) is as follows:

$$n_{initial} = \boldsymbol{D_{est}} \left[\frac{Z_{1-\alpha}\sqrt{2\underline{P}(1-\underline{P})} + Z_{1-\beta}\sqrt{P_{1,est}(1-P_{1,est}) + P_{2,est}(1-P_{2,est})}}{\delta} \right]^2$$

Where:

$\mathbf{n_{initial}}$ **:** is the initial sample size required for the baseline study.

$\boldsymbol{P_{1,est}}$: represents a survey estimate of the true proportion P_1 of the population at baseline [but 0.5 will be used since such estimate is not available]

$\boldsymbol{P_{2,est}}$: represents a survey estimate of the true proportion P_2 of the population at baseline for the final study.

Since we are at the baseline, the value $P_{2,est}$ is no longer applicable in the previous formula. For this reason, we use this equivalent formula in our situation (UN, Designing Household Survey Samples: Practical Guidelines, 2005a) (Nations, 2005).

$$n = \boldsymbol{D_{est}} \frac{\boldsymbol{Z^2}\left(P_{1,est} * (1-P_{1,est})\right) * \boldsymbol{r}}{\boldsymbol{\varepsilon^2}}$$

Where D is: This is the design effect that is equal to 1 in a One-stage Simple Random Sample (SRS) design.

Z: z-score of the confidence level (1.96 corresponding to 95% confidence)

r: nonresponse rate (usually set at 1.1 corresponding to 5% but may change depending on the context)

ε: margin of error fixed in this work at 0.05

Therefore, $n = 1\frac{\mathbf{1.96^2}(0.5*(1-0.5))*\mathbf{1}}{\mathbf{0.05^2}}$

$$n = 384$$

Appendix B

CBO Water Resilience Baseline: Household Questionnaire

Consent Form

Hello. My name is___. I work with the Henri Christophe Campus of the State University of Lemonade (UEHL). We are conducting a survey to shape the services of the USAID-funded Water Resilience Unit on Responses to Extreme Weather Events and Conditions. We survey households in communities where UEHL works. These include some communities where UEHL has worked and other communities where UEHL has never worked.

Each community has been purposely selected so that we can gather information on the conditions and needs to ensure the effectiveness of UEHL's support.

Your community is among those who have been chosen to represent this part of Haiti. We'd like to ask you a few questions about your venue as an important member of the community. In total, the questions should take about 15 minutes of your time. Your information will help UEHL know how best to provide support and understand how the university's Centre for Water Resilience can help households and children. We ask for open and honest information.

The results will be summarized for the selected communities and made available in a few months. I hope you will help the UEHL project so that it can work more effectively to support the poor and vulnerable.

We can come back later today if you don't have time to finish all the questions now. All responses you give will be confidential and will not be shared with anyone other than members of our survey team.

You do not need to participate in the survey, but we hope you will agree to answer the questions, as your views are important. If I ask you a question you don't want to answer, let me know and I'll move on

to the next question or you can stop the interview at any time. If you need more information about the survey, you can contact the person listed on this card.

Do you have any questions about the study or your participation?

◯ Yes

◯ No

If you have any questions about the study or your participation? Yes:

Ask the question:

Do you agree to participate in the survey?

◯ THE RESPONDENT AGREED
◯ THE RESPONDENT DISAGREED

My signature confirms that I have read the verbal statement of informed consent to respondents and have answered all questions asked about the study. The respondent consented to

INTERVIEWER CODE

INTERVIEWER'S FIRST AND LAST NAME

SECTION A.- DEMOGRAPHIC INFORMATION

Department

◯ Northeast

Commune

◯ Ferrier

◯ Red Terrier
◯ Ouanaminthe
◯ Sainte-Suzanne
◯ Great Basin
◯ Fort-Liberté

Communal Section

Locality

GPS coordinates of the house

Date of Investigation

Name of Supervisor

Name of Investigator

SECTION B.- SOCIO-ECONOMIC INFORMATION

Respondent's Name

Respondent's telephone number

Respondent's gender

◯ Male

◯ Women's

Age of respondent

Respondent's relationship with the head of household:

◯ 1=Head of Household
◯ 2=Husband
◯ 3=Female
◯ 4=Daughter/Son
◯ 5=Brother/Sister
◯ 6=Parent/Grandparent
◯ 7=Nephew/Niece
◯ 8=Cousin
◯ 9=Grandson
◯ 10= Other ties that bind us (uncle, tent, etc.)
◯ 11= Adopted children
◯ 12= People working from home
◯ 13= Other (specify)

If Respondent's relationship with the head of household isn't 1=Head of household:

Name of Head of Household:

If Respondent's relationship with the head of household isn't 1=Head of household:

Gender of the head of household:

◯ Male
◯ Women's

If Respondent's relationship with the head of household isn't 1=Head of household:

Age of the head of household:

If Respondent's relationship with the head of household isn't 1=Head of household:

Marital status of the head of household:

- ◯ 1=Single
- ◯ 2=Married
- ◯ 3=Employment
- ◯ 4=Separated/Divorced
- ◯ 5=Widower
- ◯ 6=Other (Specify)

If Respondent's relationship with the head of household isn't 1=Head of household:

Educational level of the head of household:

- ◯ 1=none
- ◯ 2=incomplete primary
- ◯ 3=complete primary
- ◯ 4=incomplete secondary
- ◯ 5=full secondary
- ◯ 6=full university
- ◯ 7=incomplete university
- ◯ 8=professional
- ◯ 9=technical school
- ◯ 10=vocational school
- ◯ 11=Other (Specify)

Current Occupancy Status of Head of Household:

- ◯ Busy
- ◯ Unemployed with previous work
- ◯ Unemployed who has never worked
- ◯ Pupil/student
- ◯ Housewife
- ◯ Retiree/Annuitant
- ◯ Military/PSP
- ◯ Other inactive - inactive should be understood in the sense of employment.

What is the main occupation in the last 6 months?

- ◯ Farmer with at least one export crop (coffee, tea, cotton)
- ◯ Farmer without export crop
- ◯ Ageing

- ◯ Public Sector Employee
- ◯ Broader Public Sector Employee
- ◯ Agricultural Private Sector Employee
- ◯ Non-agricultural private sector employee
- ◯ Crafting
- ◯ Merchant or seller
- ◯ Caregiver
- ◯ Apprentice
- ◯ Other (specify)

How many people live in this house?

How many people live in this house? was answered:

Branch of activity of persons in the household

Industry:	Number of persons per household in this branch	Salary Average per month (gourdes)
Subsistence agriculture / Export agriculture / Livestock / Traditional fishing (customary and artisanal) / Industrial fishing / Forestry / Primary processing of agricultural products / Food crafts / Food industry / Textile crafts / Textile industry / Mining, Water and electricity / Wood and paper / Mechanical industries and garages / Chemical industries / Miscellaneous handicrafts / Traditional housing / Construction & Public Works / Transport & Communication / Traditional Trade / Modern Trade / Traditional Services / Modern Services / Banking & Insurance / Public Administration / Private Administration / No Economic Activity		
Subsistence agriculture / Export agriculture / Livestock / Traditional fishing (customary and artisanal) / Industrial fishing / Forestry / Primary processing of agricultural products / Food crafts / Food industry / Textile crafts / Textile industry / Mining, Water and electricity / Wood and paper / Mechanical industries and garages / Chemical industries / Miscellaneous handicrafts / Traditional housing / Construction & Public Works / Transport & Communication / Traditional Trade / Modern Trade / Traditional Services / Modern Services / Banking & Insurance / Public Administration / Private Administration / No Economic Activity		
Subsistence agriculture / Export agriculture / Livestock / Traditional fishing (customary and artisanal) / Industrial fishing / Forestry / Primary processing of agricultural products / Food crafts / Food industry / Textile crafts / Textile industry / Mining, Water and electricity / Wood and paper / Mechanical industries and garages / Chemical industries / Miscellaneous handicrafts / Traditional housing / Construction & Public Works / Transport & Communication / Traditional Trade / Modern Trade / Traditional Services / Modern Services / Banking & Insurance / Public Administration / Private Administration / No Economic Activity		

Industry:	Number of persons per household in this branch	Salary Average per month (gourdes)
Subsistence agriculture / Export agriculture / Livestock / Traditional fishing (customary and artisanal) / Industrial fishing / Forestry / Primary processing of agricultural products / Food crafts / Food industry / Textile crafts / Textile industry / Mining, Water and electricity / Wood and paper / Mechanical industries and garages / Chemical industries / Miscellaneous handicrafts / Traditional housing / Construction & Public Works / Transport & Communication / Traditional Trade / Modern Trade / Traditional Services / Modern Services / Banking & Insurance / Public Administration / Private Administration / No Economic Activity		
Subsistence agriculture / Export agriculture / Livestock / Traditional fishing (customary and artisanal) / Industrial fishing / Forestry / Primary processing of agricultural products / Food crafts / Food industry / Textile crafts / Textile industry / Mining, Water and electricity / Wood and paper / Mechanical industries and garages / Chemical industries / Miscellaneous handicrafts / Traditional housing / Construction & Public Works / Transport & Communication / Traditional Trade / Modern Trade / Traditional Services / Modern Services / Banking & Insurance / Public Administration / Private Administration / No Economic Activity		

Are there any pregnant women?

◯ 1= Yes

◯ 2= No

Are there people with disabilities?

◯ 1= Yes

◯ 2= No

Are there any orphans?

Hint: This means that without a mother or father/ or both

◯ 1= Yes

◯ 2= No

Are there older people who can't help themselves?

◯ 1= Yes

◯ 2= No

What type of house does the respondent live in?

◯ 1=Ground house
◯ 2=Todit/Plank
◯ 3=Ajoupa
◯ 4=Tin house
◯ 5=Low but simple house
◯ 6=Two-storey house
◯ 7=Other (specify)

How many rooms does the house have?

Are agricultural activities practiced?

◯ 1= Yes

◯ 2= No

Is animal husbandry practiced?

◯ 1= Yes

◯ 2= No

Do you know of a grassroots community association that works in your community?

◯ Yes

◯ No

If Do you know of a grassroots community association that works in your community? Yes:

What is the name of the association?

What radio station do most people listen to in this community?

Which resort do young people like?

Which resort do adults prefer?

How far is it from your community to

	Distance to travel
(a) Nearest canton	
(b) Health Centre	
(c) Primary School (Public)	
(d) Secondary school (public)	
(e) High School	
(f) Banking	
(g) Public procurement	

What best describes road access to the community:

◯ NO ROADS to the community (e.g. access only on foot)
◯ Rough track Suitable for trolleys but not for cars/trucks
◯ Accessible by car/truck in dry weather only
◯ Accessible by car/truck in all weather conditions
◯ On the main highway

What best describes the availability of electricity in your community?

◯ ELECTRICITY NOT AVAILABLE HERE
◯ Electricity (government line)
◯ Electricity organized by community
◯ Electricity (Private/Commercial Producer)

What are the main buildings in the community?

☐ NO FACILITIES

☐ Primary School (Government)

☐ College (Government)

☐ High School (Government)

☐ Non-Governmental School

☐ Sub-Rural Health Centre

☐ Grain Bank/Seed Bank

☐ Storm shelter

☐ Other (Specify)

Les groupes d'entraide (SHG) sont des personnes qui se réunissent pour résoudre leurs problèmes communs dans la communauté. Ces groupes essaient de prendre des décisions et de partager les avantages sur une base équitable. Exemples : coopératives, sociétés de crédit,

Are there self-help groups operating in the community?

◯ Yes

◯ No

SECTION C: DIVERSITY OF THINGS PEOPLE EAT/DIVERSITY OF FOODS

Which of the following foods have you eaten in the past 4 weeks?

	Answer:	Dietary Diversity Score
1. Staple Foods:		
2. Legumes:		
3. Vegetables/Leaves:		
4. Fruits:		
5. Meat, poultry and offal, Seafood		
6. Milk and milk products:		
7. Sugar and Honey:		
8. Oil & Grease Products:		
9. Spices/Beverages:		

SECTION D: FOOD CONSUMED BY PEOPLE IN A WEEK / FOOD CONSUMPTION

How many times in the last 7 days have you eaten these things?

	Frequency:	Frenquence	Weighting
1. Staple Foods:			
2. Legumes:			
3. Vegetables/Leaves:			
4. Fruits:			
5. Meat, poultry and offal, Seafood			
6. Milk and milk products:			
7. Sugar and Honey:			
8. Oil & Grease Products:			
9. Spices/Beverages:			

SECTION E: HUNGER AT HOME/NATIONAL HUNGER INDEX

In the last 4 weeks, has there ever been no food at all in the house because there were no means?

◯ 1=yes

◯ 0=No

In the last 4 weeks, has there ever been no food at all in the house because there were no means? is 1=yes:

How many times has this happened in the last 4 weeks?

◯ 0= never

◯ 1=Rarely or a few times - (at least 10 times)

◯ 2=Often - (more than 10 times in the last 4 weeks)

In the last 4 weeks, has there ever been a time when you or anyone else in the house has had to go to bed hungry (at night) because there wasn't enough food?

◯ 1=yes

◯ 0=No

If in the last 4 weeks, has there ever been a time when you or anyone else in the house has had to go to bed hungry (at night) because there wasn't enough food? is 1=yes:

How many times has this happened in the last 4 weeks?

◯ 0= never

◯ 1=Rarely or a few times - (at least 10 times)

◯ 2=Often - (more than 10 times in the last 4 weeks)

SECTION F: HOW PEOPLE RESIST / COPING (SURVIVAL) STRATEGIES REDUCTION

In the last 7 days, if there wasn't enough food and enough money to buy food at home, how many days did you have to make those decisions?

	Frequency:	Frequency	Weighting
Eat what you don't like too much and it's not expensive			
Go borrow food and get food from family and friends			
Give each person a small amount of ready-made food			
Reducing what is given to adults so that children can eat well			
Reducing the number of meals we eat per day			

SECTION G: NUMBER OF TIMES TO EAT EACH DAY/NUMBER OF TWO MEALS PER DAY

How many times a day do people eat at home?

	Frequency:
Children: Children aged 6 to 23 months	
Children: Children aged 24 to 59 months	
Children: Children between 5 and 18 years old	
Adults: Between 19 and 59 years old	
Adults: 60 years and older	

SECTION H: WHAT IS DONE WITH THE FOOD PRODUCED/USE OF PRODUCTION

What is the main food that comes from the garden and that you use (crops)

	Usage
1=But;	
2=Sorghum;	
3=Rice;	
4=Bean;	
5=Congo peas;	
6=Banana;	
7=Potato;	
8=Yam;	
9=Potato;	
10=Cabbage;	
11=Carrot;	
12=Onion;	
13=Shallot;	
14=Chili pepper;	
15=Tomato;	
16=Coffee;	
17=Mango;	
18=Lawyer;	
19=Sugarcane;	
20=Other	

POST-HARVEST TECHNICAL TRAINING

Is there anyone in the field who has taken the training on the techniques they need to use when harvesting on:

	Answer

1. Drying	
2. Well-conditioned cultivation	
3. Retention	

Do you apply these techniques?

◯ Yes

◯ No

Are you getting good results?

◯ Yes

◯ No

SECTION J: INFORMATION FOR SHOCK MANAGEMENT/INFORMATION FOR SHOCK MANAGEMENT AND THE AGRICULTURAL SITUATION

Do you have this preparedness measure for natural or man-made disasters (for each type of disaster)?

◯ Yes

◯ No

If Do you have this preparedness measure for natural or man-made disasters (for each type of disaster)? Yes:

If yes, please describe

How did you react to your last recent disaster?

Hint: CHECK ALL THAT APPLY

- ☐ Don't suffer disasters
- ☐ Construct dams/roads/walking trails
- ☐ Flooding: use of sandbags
- ☐ Have a disaster preparedness plan (for the family or local area/community)
- ☐ Join a local/community/community disaster management committee
- ☐ Learn a skill, e.g. how to swim, first aid, how to build a shelter.
- ☐ Listen to the weather forecast
- ☐ Making permanent adjustments to my house, e.g. Flooding: using stilts to elevate the house, Earthquake: following building codes
- ☐ Making Temporary Adjustments to My Home, Earthquake: Fix Them furniture on the walls,
- ☐ Planting Trees
- ☐ Save money
- ☐ Sign up for early warning alerts
- ☐ Stockpiling food
- ☐ Take steps to ensure people can easily get to a place of safety (e.g., repair routes to shelters, make shelters safer)
- ☐ Take out insurance in the event of a claim
- ☐ Don't know
- ☐ Not applicable
- ☐ Other (specify)

What is the main shock that makes you have hunger problems in the area:

- ◯ 1. Floods/droughts
- ◯ 2. Plant Diseases
- ◯ 3. Erosion
- ◯ 4. Hurricane
- ◯ 5. Landslides
- ◯ 6. Insecurity
- ◯ 7. Other. Specify

Since the beginning of the shock, has there been any information found to deal with the problem of hunger?

- ◯ Yes
- ◯ No

Since the beginning of the shock, has any information been found to deal with the problem of hunger? Yes: Who gave you this information?

- ◯ 1. Emergency Preparedness
- ◯ 2. Church
- ◯ 3. Radio
- ◯ 4. Community Leaders
- ◯ 5. KASEK/ASEK
- ◯ 6. The Town Hall
- ◯ 7. On the phone
- ◯ 8. Other/Specify

Since the beginning of the shock, has any information been found to deal with the problem of hunger? Yes: Have you used this information?

- ◯ Yes
- ◯ No

Since the beginning of the shock, has any information been found to deal with the problem of hunger? Yes: Do they allow us to live better?

- ◯ 1. No

◯ More or less
◯ A lot

Since the beginning of the shock, has any information been found to deal with the problem of hunger? Yes:

Do they protect family property?

◯ No

◯ More or less
◯ A lot

How did you react to your last recent disaster?

Hint: CHECK ALL THAT APPLY

☐ Trigger an alarm

☐ Keep up to date with weather reports

☐ Follow the contingency plan

☐ Evacuate to a safe place

☐ Have emergency supplies, e.g., torches, medicines, food, fuel.

☐ Pray to God

☐ Other (Specify)

SECTION K: WATER FOR HUMAN DRINKING/DRINKING WATER

What is the main source of water to use at home?

◯ 1. Private Pipes
◯ 2. Public Pipeline/ DINEPA
◯ 3. Public Pump
◯ 4. Water sources without catchment
◯ 5. Rainwater
◯ 6. Unprotected wells
◯ 7. Truck/Tanker (treated water)
◯ 8. Truck/Tanker (Raw Water)
◯ 9. Private Sellers
◯ 10. Price protection
◯ 11. Other (specify)

Are we used to treating water for drinking?

◯ Yes

◯ No

If Are we in the habit of treating water for drinking? Yes:

And what is used to treat drinking water?

☐ 1. Guardian of the Water

☐ 2. Lemon

☐ 3. Clorox

☐ 4. Place in the sun

☐ 5. Boil water

☐ 6. Aquatab

☐ 7. Filter

☐ 8. Let the snowshoes rest and put on them

☐ 9. Other (specify)

How much water can we use per day?

◯ 1. <10 gallons
◯ 2. <10-20 gallons
◯ 3. > 20 gallons

Where do you store drinking water?

◯ 1. In the drum that has blankets
◯ 2. In the drum without a lid
◯ 3. In jars containing the lid
◯ 4. In boxes without lids
◯ 5. In gallons
◯ 6. In the pool
◯ 7. Other (specify)

Select the right choice for each statement:

	hoice
Safe drinking water is easy to find in my community	
Drinking water in my community generally tastes good	
The drinking water in my community smells good	
The quality of the water we drink in this community has improved	
Your community needs to do more to improve water quality	
Your community doesn't know how to improve water quality	
Flooding has been a big problem for our community over the past few years	
Your community doesn't know how to prevent flooding.	
You don't have good choices in your community when you have a drought	
Your community wants to participate in drought prevention training	
Your community needs instructions to improve water quality	
Your community needs help knowing what to do in the event of a severe drought	
You don't have good choices when there is flooding	
Your community wants to participate in training on what to do in the event of a severe flood.	
Clean drinking water is a serious problem in our community.	
Your farmers want to know more about irrigation system management	

What are the sources of domestic water in the community?

Hint: CHECK ALL THAT APPLY

- ☐ River
- ☐ Creek
- ☐ Pond
- ☐ Irrigation canal
- ☐ Brick Well
- ☐ Well dug by hand
- ☐ Shallow tube well (< 200 feet)
- ☐ Deep tube well (>200 feet)
- ☐ Tube Well (motor pump; powered by electric or diesel motors)
- ☐ Tubular Well (Hand Pump)
- ☐ Spring water (natural}
- ☐ Spring water (stored)
- ☐ Public water supply system
- ☐ Government Dam
- ☐ Private Dam
- ☐ Rainwater storage tank
- ☐ Purchased water
- ☐ Other (specify)

Is there an irrigation system in this community?

- ◯ Yes
- ◯ No

If Is there an irrigation system in this community? Yes:

If yes, please describe

In what months is drinking water scarce?

Hint: CHECK ALL THAT APPLY

☐ EVERY MONTH

☐ January

☐ February

☐ March

☐ April

☐ May

☐ June

☐ July

☐ August

☐ September

☐ October

☐ November

☐ December

In what months is irrigation water scarce?

Hint: CHECK ALL THAT APPLY

☐ EVERY MONTH

☐ January

☐ February

☐ March

☐ April

☐ May

☐ June

☐ July

☐ August

☐ September

☐ October

☐ November

☐ December

☐ DOES NOT APPLY TO ME

In what months is drinking water for livestock and animals scarce?

Hint: CHECK ALL THAT APPLY

☐ EVERY MONTH

☐ January

☐ February

☐ March

☐ April

☐ May

☐ June

☐ July

☐ August

☐ September

☐ October

☐ November

☐ December

☐ [a.] DOES NOT APPLY TO ME

Les groupes d’entraide (SHG) sont des personnes qui se réunissent pour résoudre leurs problèmes communs dans la communauté. Ces groupes essaient de prendre des décisions et de partager les avantages sur une base équitable. Exemples : coopératives, sociétés de crédit,

Are there self-help groups operating in the community?

◯ Yes

◯ No

If Are there self-help groups operating in the community? Yes:

What are they?

If Are there self-help groups operating in the community? Yes:

What do they do?

If Are there self-help groups operating in the community? Yes:

Self-help group information

Self-Help Group Name:

Main activities

Number of members:

Number of Male Members:

Number of women members:

When was the last time the group met?

Hint: Indicate Month/Year

Have any NGOs been working in the community in the last 24 months?

◯ Yes

◯ No

If Have any NGOs worked in the community in the last 24 months? Yes:

If so, what were their main activities in the community?

Has a government or non-government organization conducted training for community members in the past 12 months?

◯ Yes

◯ No

If Has a government or non-government organization conducted training for community members in the past 12 months? Yes:

If so, please describe which organization and what type of training?

What are the main sources of credit in this community?

Hint: Choose more than one if possible

☐ Community Savings and Loan Association

☐ Family/Friend

☐ Farmers' Association/Cooperative

☐ Government

☐ Microcredit provider (low interest rate, 2.5% per month or less

☐ Money Lender

☐ Pre-sale of the product to the merchant

☐ Private bank

☐ Private company

☐ Merchant

☐ Other (Specify)

What are the main crops produced in the community?

Season	Period	Name of the crop
a. Dry / b. Wet / c. Cool	MARCH-MAY / JUNE-OCT / LAST HARVEST	
a. Dry / b. Wet / c. Cool	MARCH-MAY / JUNE-OCT / LAST HARVEST	
a. Dry / b. Wet / c. Cool	MARCH-MAY / JUNE-OCT / LAST HARVEST	
a. Dry / b. Wet / c. Cool	MARCH-MAY / JUNE-OCT / LAST HARVEST	
a. Dry / b. Wet / c. Cool	MARCH-MAY / JUNE-OCT / LAST HARVEST	

What are the main agricultural activities in this community?

Season	Period	Activities
a. Dry / b. Wet / c. Cool	MARCH-MAY / JUNE-OCT / LAST HARVEST	
a. Dry / b. Wet / c. Cool	MARCH-MAY / JUNE-OCT / LAST HARVEST	
a. Dry / b. Wet / c. Cool	MARCH-MAY / JUNE-OCT / LAST HARVEST	
a. Dry / b. Wet / c. Cool	MARCH-MAY / JUNE-OCT / LAST HARVEST	
a. Dry / b. Wet / c. Cool	MARCH-MAY / JUNE-OCT / LAST HARVEST	

In the past three years, has your community experienced a natural or man-made disaster?

◯ Yes

◯ No

If In the past three years, has your community experienced a natural or man-made disaster? Yes:

If yes, please describe

What types of natural or man-made disasters has your community experienced?

☐ Failure of the bank or bank of the watercourse

☐ Cyclone

☐ Drought

☐ Earthquake

☐ Fire

☐ Flood

☐ Terrain Slide

☐ Water scarcity

☐ Other (specify)

When was the last time your community faced this natural or man-made disaster?

◯ In the last 6 months
◯ Within the last 1 year
◯ In the last 2-3 years
◯ In the last 4-5 years
◯ In the last 5 years

How often has your community experienced these natural or man-made disasters?

◯ More than 1 time in a year
◯ Annual

◯ Once within 2-3 years
◯ Once within 4-5 years
◯ Rarely

Merci pour votre participation à cette interview

Appendix C

Food Consumption Score Weight

No of group	Group of foods	Weighing
1	**Basic foods:** corn, rice, millet, other cereals, roots and tubers (potatoes, cassava, yams, sweet potatoes, plantains, plantains) and bananas	2
2	**Legumes:** white beans, black beans, kidney beans, butter beans, kidney beans, almonds, peanuts (and all other similar foods)	3
3	**Vegetables/Leaves:** spinach, spinach, watercress, cabbage, pumpkin, tomato, onion, broccoli, cabbage, radish (and all other similar vegetables)	1
4	**Fruit:** Mango, papaya, guava, apricot, cantaloupe, pineapple, orange, watermelon, watermelon, hemp, cherry, lemon, grapefruit, avocado, fig, apple, plum, tamarind, strawberry, pear (and all other fruits)	1
5	**Meat, poultry, and offal:** Goat, pig, mutton, cow, horse, chicken, turkey, pentad, pigeon, liver, kidney, heart, intestine, fall of goat, fall of cow, brain, (and all other types of meat) **Seafood:** Fresh fish, salted fish, langoustines, crabs, shrimps, shrimps, (and all other types of seafood)	4
6	**Milk and milk-based products:** Cow's milk, powdered milk, canned and bulk milk, yogurt (and all other similar products)	4
7	**Sugar and honey:** White sugar, red sugar, honey (and all other similar products)	0.5
8	**Oil and fat-based products:** vegetable oil, olive oil, butter, shortening, fat (and all other similar products)	0.5
9	**Spices/drinks:** coffee, tea, spices (parsley, cinnamon, garlic, cloves), salt, fish powder, small amount of milk for tea	0