

Vegetable Farmer's Perception of Climate Variability and Adaptation Strategies in Kenema City, Eastern Sierra Leone

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Abstract— This study seeks to explore the perceptions of vegetable farmers of climate variability and adaptation strategies used to increase production. The study communities was purposefully selected because vegetable farming was carried out on large scale for decades. Thirty (30) vegetable farmers were randomly selected from three vegetable producing communities in Kenema City. Two (2) respondents were also randomly selected from the Horticulture Unit of the Ministry of Agriculture and Food Security and local traditional chiefs respectively. One (1) Environmental Protection Agency staff was also selected because they deal directly with the environment and climate related issues. The study outlined vegetable crops mainly grown in the selected communities which ranges from Lettuce to cucumber. Respondent's perception of Climate variability (temperature and rainfall) was unreliable and unpredicted. Some years high temperature conditions were experienced leading to heat waves, scarcity of water etc. and for other year's scarcity or heavy downpour of rain experienced leading to flooding. Various adaptive measures were used ranging from planting of improved vegetable variety to construction of irrigation and traditional dams in the gardens. It was concluded that climate variability affected their production and livelihood. It was therefore recommended that regular training and radio education programmes be carried out by the Ministry of Agriculture and food Security and partners on vegetable farming and sustainable climate variability adaptation measures to improve production.

Keywords— Climate, Variability, Food Security, Horticulture, Buwahun, Lambayea stream.

I. INTRODUCTION

Gardening is defined by Gillard (2001) as the activity of working in a garden, growing and taking care of plants and keeping the garden attracted. According to Sunwar et al., (2006) home gardening is an area around the dwelling where different vegetables, fruits and medicinal plants are grown throughout the year, potentially with small stock present, to meet household nutritional requirements. In home gardens, various crops/plant species are planted and are accessible to households. In the United Kingdom, communal gardening activity has a long history. It traces back to a 2000 year old communally managed plots in Cornwall, in the south-west of UK to the reemergence of the idea during both World Wars where small plots were given over to the coproduction of food (Mobayed, G, 2009). Research has found that gardening increases consumption of vegetables and even if just one person in a household participates in gardening, it increases fresh vegetable

consumption for all members of the household (Alaimo et al. 2008). Vegetable gardening can also provide financial benefits. The work of Pushpakumara, et al. (2010), suggested that vegetable gardening particularly home gardening provide a number of ecosystem services such as habitats for animals and other beneficial organisms, nutrient recycling, reduced soil erosion and enhanced pollination. Climate variability is when a region's climatic parameter deviates from its long-term mean. As more people live in climate-affected metropolitan areas, climatic unpredictability and extremes are having an increasing impact on civilization. According to UN-Habitat Report (2016), climate variability and extremes are increasingly impacting society as more people live in urban areas affected by climate change. Because urban flora is sensitive to high heat and water stress, temperatures are a limiting factor for urban plants, however management can help reduce some of these stressors (Kendal. D, et al. 2012). The studies of Mendelsohn et al., (2006), postulated that most developing countries are particularly vulnerable to climate change more especially climatic variability because their economies are closely linked to climate sensitive sectors as agriculture. Adaptation strategies to climate variability various from country to country depending on its technological advancement. This is evident in the work of Ngigi (2009) who reported that the use of shallow wells and hand dug wells for dry season irrigation and soil moisture improvement techniques such as mulching are adaptive strategies in northern Ghana, Burkina Faso and Mali. In the same West African sub-regions, a new technology has been adapted such as drip irrigation, choice of high yielding, draught resistant crop varieties etc. are now practiced in Nigeria, Senegal, Burkina Faso and Ghana. With numerous empirical evidences on vegetable gardeners perception and adaptation strategies used, there has not been a quick fix solution that will improve their production. In this vein, Morton (2007) suggested that there is a need for an interdisciplinary approach to apply the rapidly growing scientific knowledge of the effects of climate change and variability on farming systems in developing countries to build adaptive capacity at all levels. The city of Kenema is growing rapidly with all categories of people residing therein such as vegetarians and non-vegetarians whose daily diet depends on various vegetables produced by gardeners of the city. The production of vegetables to feed the growing population of the city is dependent on the climate

variability over a period. Therefore the objective of the study is to examine vegetable farmer's perception on climate variability and adaptation strategies in Kenema city, Eastern Sierra Leone.

1.2 Overview of Climate Change and Variability

Weather variability and climate leads to the occurrence of extreme weather or climate events. Such conditions are unusual and are more severe than normal or average weather, which includes heat waves, cold waves, heavy downpours and droughts. Syed, et al., (2010) in assessing climate variability and emerging trends opines that global warming has been accelerating and intensifying the water cycle of the world, which can result in more violent storms, floods and droughts. To emphasize climate change and variability across the world, IPCC (2013) indicated that one noticeable example of changing climate is an increase in the global average temperature by $0.7^{\circ}\text{C} \pm 0.18^{\circ}\text{C}$ in only the last 100 years (1906-2005). According to IPCC (2018), the average surface temperature of the earth has increased by appropriately 1°C above the pre-industrial level in 2017 which have plethora of ecological, economic and societal impacts. According to article 1 of the UNFCCC, humans are now unequivocally implicated in contributing to global climate change. The past three decades have been the warmest in history, with each decade being warmer than the preceding period due to climate change and variability (IPCC, 2014). This has been felt all over the world. Africa particularly Sierra Leone, which contributes at a minima rates suffers the most and it affects all sectors ranging from agriculture to health. In assessing the impact of climate variability on vegetable production, Spaldon et al., (2015) stated that the influence of increased temperature and rainfall uncertainties on different growth phases of vegetable development from vegetative growth to fruiting can alter the normal development and growth of plants.

II. METHODS AND MATERIALS

2.1 Characteristics of the Study Communities

Kenema city is found in eastern part of Sierra Leone and is the third largest city of the country. The city has a population of 200,443 people according to 2015 population and housing census. Presently the population of the city is projected at 242,364 people in 2022 according to (UNFPA, Sierra Leone). With such growth in population over the years, there are vegetarians and besides the daily diet of most people is composed of vegetables. The production of this all important diet is dependent on climate variability of the producing communities within the city. The weather of Kenema City is influenced by tropical monsoonal climate which is characterized by long raining season and short dry season with extremities. There are one or more months with less than 60mm (2.4") of rain. The monthly average temperatures are greater than 64°F (18°C). Highest annual temperature occurs just before the rainy. The hottest month is March with maximum temperature about 29°C . Vegetable gardening has become a livelihood source for most people living along the Lambayea stream, and wetlands within the municipality. It is done on large scale in the dry season and due to heavy down pour of rain,

vegetable production reduces due to lack of expertise by the growers and above all extreme rainy weather conditions.

2.2 Methods

The study is a longitudinal study design, as it examines vegetable farmers' perception of climate variability in their communities (vegetable gardens) within Kenema city and the adaptation strategies used. For the purpose of this study the definition of longitudinal study design was adapted from Simkus (2021) which defines it as a study of observational and correctional study that involves monitoring a population over an extended period of time. It has an advantage in that, observed variables over extended periods can be used to study developmental shifts and understand how certain things change as years go by. Another advantage of longitudinal study design that worth it's used for this study is that it has high validation for the fact that objectives and rules for long-term studies are established before data collection, such studies are can be authentic and have high levels of validity. However, it has a disadvantage because it can take months or years to be completed, which renders it expensive and time consuming. For this reason, researchers tend to have difficulty in recruiting participants which leads to smaller sample sizes. A stratified random sampling was used to select vegetable growing communities within the city of Kenema. Three selected vegetable growing communities were Buwahun, Niawama by Methodist Secondary School and Kakajama along the Lambayea stream. The stratified random sampling criteria included vegetable gardening as the main livelihood source and a large area of vegetable plantation in the sampled communities. Purposive sampling was also used to select ten (10) vegetable growers each from three (3) selected communities which totals thirty (30) respondents who were involved in vegetable production as a main livelihood source and therefore they can provide in-depth information about climate variability and how it affects their production. Two (2) workers from Ministry of Agriculture and Food Security, Two (2) traditional rulers from the selected communities and one (1) EPA staff were also purposefully selected because they have fair knowledge on climate variability and vegetable production. Apart from the questionnaire they responded to, they also formed the discussion group. In total thirty-five (35) respondents were selected. Qualitative technique was used to analyze the result in a form of descriptive statistics.

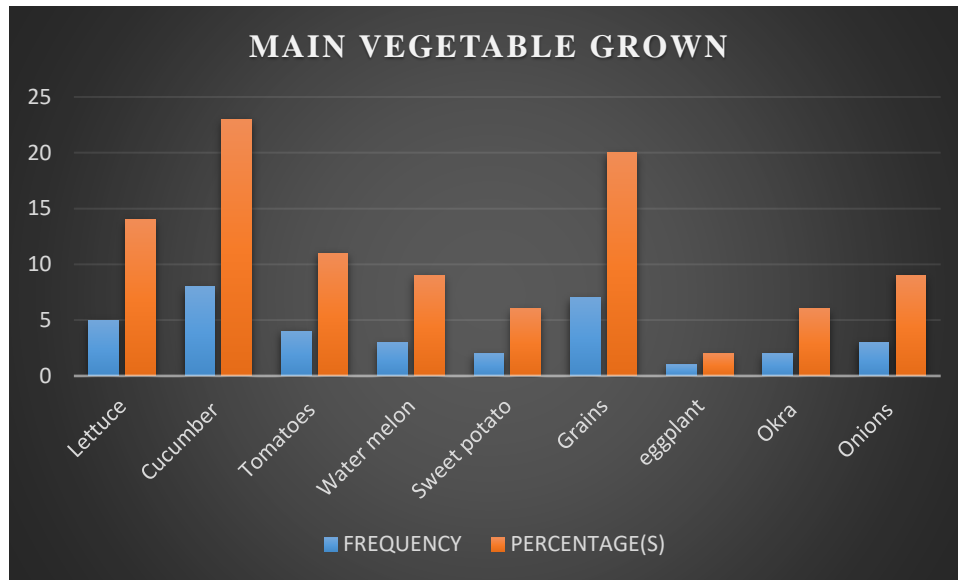
III. RESULT AND DISCUSSION

3.1.1 Main Vegetable Grown in Selected Communities in Kenema City on Large Scale

According to figure one below, 23% of the respondents stated that they grow cucumber, 20% indicated grains while 14% pin-pointed lettuce as vegetables grown in their gardens. Cucumbers (*Cucumis sativus*) are frost tender and therefore, thrives only if weather warm but unexpected frost or hot temperatures can damage cucumbers in gardens. Lettuce (*Lactuca sativa* L.) is a cool weather crop that thrives in the temperature $12-20^{\circ}\text{C}$ but when temperature increases to 30°C , it will affects the head development and quality of leaves. It should also be noted that humid, hot and rainy will also result

head rots of lettuce. However, 11% of the respondents stated tomatoes, 9% of them indicated onions and water melon and 6% stated sweet potato and okra respectively. Only 2% of the respondents claimed that, they cultivate eggplants in their gardens. According to Saeed (2007) tomatoes (*Lycopersicon esculentum* L.) requires an optimum temperature range within 18-28°C for fruit set and optimum fruit yield. During

discussions, tomato gardeners reported that, there has been variation in the day of onset, amounts and the retreat of rainfall and it has affected the production of tomatoes in their communities over the years. This was supported by Agro foresters from the Ministry of Agriculture and Food Security with evidence that on record, the production of tomatoes by farmers supported by the ministry has declined over the years due to the slated reasons.



SOURCE: Survey Data, 2022.

3.1.2 Vegetable Farmer’s Perception on Climate Variability in Kenema City.

Variable	Frequency	Percentage (S)
i) Temperature		
Increase in temperature	20	44
Decrease in temperature	4	9
No change experienced	1	2
ii) Rainfall		
Increase in rainfall	15	33
Decrease in rainfall	3	7
No change experienced	2	4

SOURCE: Survey Data, 2022.

Table one present vegetable farmer’s perception of variations in temperature and rainfall. The results from the above table indicated that twenty of the respondents representing 44% perceived increase in the average temperature while fifteen of them representing 33% perceived an increase in the average rainfall. During discussions, the Environmental Protection Agency Staff pointed out that, increase in temperature in particular has been a challenge to agricultural communities and even human health in Sierra Leone and it is attributed to climate variability. Similar sentiment was raised by vegetable farmers adding that unpredicted rainfall patterns coupled with temperature variation has affected the production system greatly in the study communities. This has connection with the work of Hoffmann (2013) who stated that crop yields show strong correlation with temperature change and with the duration of heat or cold waves and differ based on plants

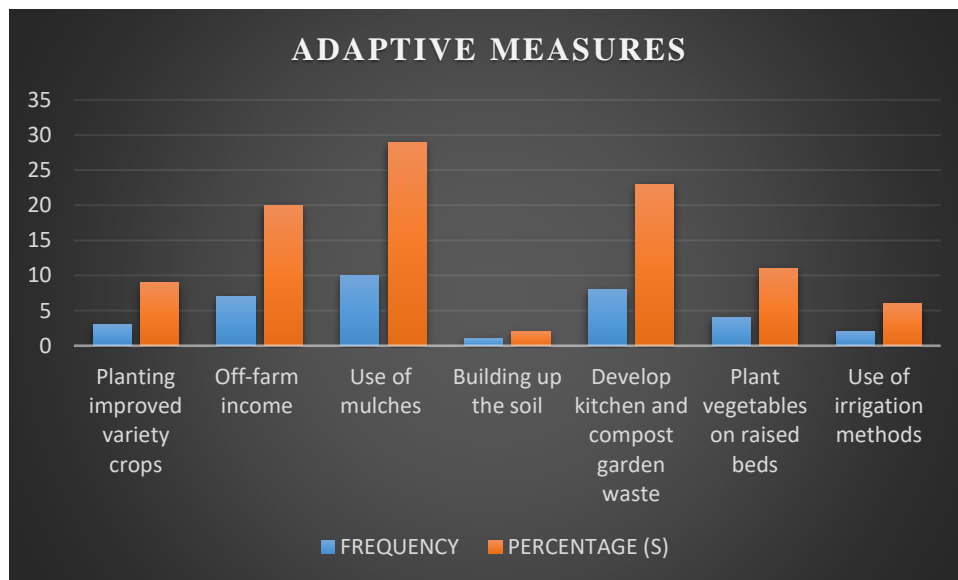
maturity stages during extreme weather events. The small number of vegetable farmers who indicated that they have not perceived any change in temperature and rainfall as a result of climate variability had small portion of vegetable gardens and they had other livelihood sources. Had it not been that, they should have detected climatic vagary and its impact on their crops. This situation is better explained by Afroza, et al. (2010), who found that vegetable crops are very sensitive to climate variability and sudden temperature increases, as well as irregular precipitation, at any stage of crop growth, and that this can affect normal growth, flowering, pollination, fruit development, and, as a result, crop yield. However, 9% of the respondents’ perceived decrease in the average temperature and 7% perceived decreased in rainfall while 2% and 4% of the respondents claimed that they observed no change in average temperature and rainfall throughout their cultivation years. During discussions the farmers reported that the change experienced in the rainfall patterns over the years in their communities was the later onset of the rains which led to a short rainfall season for some years but for other years they experienced earlier and prolonged rainfall season. These conditions affected their vegetable production. This is in line with the work of Jiri et al. (2015) whose work postulated that as high as 8.7% and 87% of smallholder farmers perceived precipitation as decreasing and average temperature as increasing respectively. Similar supporting statement was proffer by NAPA (2007), which sated that raining season in Sierra Leone has been marked with periods of delays and water

shortages; but there are periods of heavy rains which results in extensive flooding throughout the country. Abnormal temperatures and rainfall in Sierra Leone affect the obvious agriculture, water supply and sanitation in Sierra Leone. The perceptions of the vegetable farmers in the study communities is worth to go by as it was predicted by IPCC (2007) that most countries will experience an increase in average temperature, more frequent heat waves, more stressed water resources, desertification, and periods of heavy precipitation.

3.1.3 Climate Variability Strategies Adapted by Vegetable Farmers in Kenema City

Figure three presents adaptation strategies used by vegetables farmers in the selected communities. When asked as

to what type of adaptation strategies in in their various, 29% of the respondents indicated that they use mulching, 23% stated development of kitchen and compost garden waste while 20% claimed using off farm income. Traditional mulching practices was seen carried out in all the selected vegetable farm communities. Discussions with the respondents reveals that it was done mainly in the dries. Mulching is a good adaptation strategy used and has been effective for decades in vegetable farms. The paper states that many local farmers are practicing mulching techniques, including trees (perennials such as fruit trees and zero forage trees), as a component of a well-maintained vegetable garden with a mix of crops. It is supported by the research of Ishaya & Abaje (2008) that I discovered. Especially vegetables, integrations and herbs.



SOURCE: Survey Data, 2022.

In the study communities, respondents revealed during discussions that mulching beds has helped retain soil moisture and therefore it was widely used as adaptation measure in their gardens. However, 11% of the respondents stated that they plant their vegetables on raised beds, 9% of them indicated planting of improved variety of crops while 6% claimed the use of irrigation methods and traditional dams to harvest and store water. Raised beds were common along the Lambayea stream in Buwahun communities and along the canals supplying water in the swamps Niawama section. This is in line with the study of Mubiru (2010) carried out in Uganda states that in the dry areas, adaptation options include irrigation, migration, settling along wet corridors and cultivation along the river banks, agroforestry and seeking alternative livelihoods. As weather patterns in the selected communities becomes less predictable, gardeners embarked on planting vegetables that can survive warmer temperatures, withstand irregular or heavy rain and those that support local pollinators. The same situation was supported by Pereira & Chaves (2007) whose work stated that plants native to climates with marked seasonality are able to acclimatize more easily to variable environmental conditions and provide opportunities to identify genes or gene combinations that confer such resilience. In Buwahun vegetable

garden sampled, raised beds were constructed on which vegetables were planted. This was used as an adaptation strategy and helped in reducing too much water and moist in the soil. This is a good adaptation strategy as it was supported by La Pena & Hughes (2007) who opine that excessive soil moisture due to heavy rain becomes a major problem and it could be overcome by growing crops on raised beds. Local irrigation methods were used coupled with traditional dams which was filled with water especially the dry season. Irrigation method has been recommended as one of the best adaptation method used. This is in line with the work of Malhotra (2016) which stated that providing irrigation during critical stages of vegetable crop growth and conservation of the soil moisture reserves are the most important interventions. With all these adaptive measures, respondent’s complaint of low yield due to climate variability experienced in the selected communities in Kenema City.

IV. CONCLUSION AND RECOMMENDATIONS

With the current wave of weather variability in both rural and urban communities across the world, vegetable production or gardening has faced and will continue to face challenges in its production to meets the need of the deserving growing

population. Even where adaptive measures are used by vegetable farmers in the selected communities, the adverse effects of climate variability affects their production greatly. The Ministry of Agriculture and Food Security is aware of the climate variability and its impact on vegetable farmers but can do little or nothing to help farmers with new climate variability measures other than the traditional methods used by vegetable farmers. It was recommended that training of vegetable farmers be carried out by Ministry of Agriculture and Food Security, Environmental Protection Agency of Sierra Leone and partners bordering around climate variability and adaptive measures that improve production in the study communities. This should be done having in mind that succulent vegetable crops are highly sensitive to adverse climatic conditions of heat, drought, flooding etc. It was also recommended that agronomic practices that conserve water and equally protect vegetable crops from adverse climatic and environmental conditions be made accessible to vegetable farmers in the study communities. Regular capacity building programmes and radio education programmes be aired on key sustainable climate variability adaptation strategies for vegetable farming was also recommended.

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