# Effects of Rainfall Variability on Maize production in Afgooye District lower Shebelle, Somalia.


## ABSTRACT

The research aim was effects of rainfall variability on Maize production in Afgooye District, lower Shebelle. This study adopted with a cross-sectional survey research design, and followed quantitative approach. The accessible population, the study selected 108 sample size represent the population by using Slovin formula with the maximum acceptable error of 5 %. The variables used in this study included rainfall pattern, rainfall intensity and rainfall frequency. The data were analysed analyzed with the package of statistical package for Social Science technique (SPSS 22.0). The results showed rainfall Variability effected maize production. This study showed that rainfall pattern, rainfall intensity and rainfall frequency have an effect with maize production.

**Key terms:- Rainfall variability, Maize production, Afgooye**

## 1. Introduction

Rainfall variability is one of the most important factors determining variability in agricultural production. This has serious consequences for individuals and societies, resulting in crop failures, livestock losses, income loss, and even famine. It also causes significant environmental degradation, especially when combined with inadequate management strategies.

"Globally rainfall variability is a global issue because it affects all countries of a world. Rainfall variability is an indicator of global rainfall change which has being brought about directly or in directly by human activities that alter the composition of the global atmosphere" (Bacon, 2005).

"Currently, about 60 per cent of the world and 90 per cent sub-Saharan African staple food production are under direct rain fed agriculture Intergovernmental Panel on Climate Change" (IPCC, 2013). "Over the past years the frequency of the climate variation in terms of temperature and rainfall has been increasing" (Akpalu et.al 2008). "Evidence is emerging that climate change is increasing rainfall variability and the frequency of extreme events such as drought, floods, and hurricanes Intergovernmental Panel on Climate Change" (IPCC, 2016).

Afgooye had an annual mean rainfall of 584 mm. In 1977 it received a total of 800 mm of rainfall. Chen et al. (2007) suggested that "the variability of rainfall can be more appropriately measured by the Shannon entropy and hence rainfall characteristics of 1- day resolution time series can be described. Thus, the entropy theory, comprising the Shannon entropy, seems to have much potential that remains yet to be fully exploited". The majority of studies have primarily concentrated on the spatial and temporal variability of rainfall using information theory for temperate zones, while methodologies that include rainfall in tropical climate zones have received less attention. These methodologies can improve estimates of rainfall variability at a time scale from years to days by utilizing the time series structure. The identity of the cumulative sources of rainfall uncertainty is still essentially unknown and has not been thoroughly researched. To address this issue, we used the Shannon entropy to quantify the variability of rainfall in the southern region of Somalia specially the district of Afgooye and assess long-term trends in

marginal entropy of annual and seasonal rainfall using the Mann-Kendall test. “Rainfall variability is the degree to which rainfall amounts vary across an area or through time” (Hoegh, 2017). But according to Cordis (2019) “Rainfall variability is an indicator of global rainfall change which has being brought about directly or in directly by human activities that alter the composition of the global atmosphere”. Rainfall variability refers to the rainfall parameter of a region varying from its long-term mean. (WMO, 2019) In this study rainfall variability is defined degree to which rainfall amounts vary across an area or through time. There are various characteristic of rainfall variability. According to Wilhite et.al (2006) rainfall is characterized into amount, intensity duration, frequency and pattern period. It is also characterized into regional annual rainfall totals rainfall seasonality and frequency of extreme weathers. Rainfall variability is characterized into soil moisture, plant moisture, drought, floods and rainfall patterns (Alfieri, Blanken, Yates, & Steffen, 2007).. In this study rainfall variability was be operationalized into rainfall pattern, rainfall intensity and rainfall frequency. It is characterized by rainfall seasonality and distribution. “Rainfall intensity is defined as the ratio of the total amount of rain movement of a series over an extended period of time or it is the long-term change over a period of time” (Wichelns, 2001).

“It can be duration and rainfall amount. In the context of Somalia, it is considered one the countries who are extremely susceptible to climate variations, even though the agriculture sector still remains the backbone of the Somali economy since it contributes to 3 GDP and country‟s total export earnings by approximately 75% and 93%, respectively” (Warsame, Sheik-Ali, Ali, & Sarkodie, 2021). “More precisely, changes in temperature are associated with reducing soil moisture, causing evaporation, drier conditions, and rain failures. This would ultimately decrease water availability for irrigation which further causes crop yields to decline sharply” (Warsame et al., 2021). “Specifically, the lower Shebelle region which is the country‟s principal maize production region experiences temperatures ranging from 26 to 28°C (Ryan et al., 2018). Consequently, the maize production decreases sharply in the times 85 of rainfall failures” (Warsame et al., 2021).

However, the rainfall patterns has become intense and more frequently in this place. Rainfall patterns flood and other climatic events has also become constraint to the sorghum production. Therefore this study will focus on to examine the effect of rainfall variability among sorghum farmers in Afgooye District. This study will be carried out in Afgooye District which is called

the maize production in Somalia because of its crop productivity level compared to other regions in the country.

## 2.0 Materials and Methods

### 2.1 Study Area

This study was conducted in Afgooye District, Somalila among farmers. Afgooye District is located in the Lower Shabelle region and is located 30km from Mogadisho, the capital city of Somalia- in the eastern direction. The communities of the district are farmers who rely on small scale farming as a source of livelihood.

### 2.2 Research Design

This study adopted with a cross-sectional survey research design, and followed a quantitative approach. Survey research is defined as "the collection of information from a sample of individuals through their responses to questions" (Check & Schutt, 2012, p. 160). Across sectional survey is the method of choice if you want to gather the data at one point in time (Forza, 2002). The main purpose of using a cross-sectional data was used to test causal questions in a number of ways because a cross-sectional study only happens once, you were able to analyze and act on your data immediately (Miceli & Near, 1991). This were enable the researcher to present a picture of the rainfall variability on maize production in Afgooye District,Lower Shabele Somali.

### 2.3 Sample Size

Sample is a further subset of the target population which we would like to include in the study. Thus a sample is a portion, piece, or segment that is representative of a whole (Prashant & Supriya, 2010). The sample size of the study was 108 farmer. Krejcie and Morgan recommended a sample size of 108 for population of 150 at 95% level of confidence, 0.5 level of significance and 5% margin of error.

### 2. 4.Sampling Technique

This study was adapted to convenience sampling technique. This study population is undefined and infinite. Therefore, probability method could now work.

### 2.5. Data Collection Instrument

Survey research may use a variety of data collection methods with the most common being questionnaires and interviews. The data collection questionnaire was survey method. This study used questionnaires to collect data. The questionnaire is the main instrument for collecting data in survey research. Basically, Questionnaires were employed in this study because it was less expensive and took a short time.

## 2. 6.Data Analysis

Data analysis was done using SPSS 20.0 version and the results presented in charts and statistical significance was at p value of $< 0.05$.

## 3. Results

**Table 1 Demographic data**

| Variables | Frequency | Percentage |
|---|---|---|
| **Gender** | | |
| Male | 94 | 87% |
| Female | 14 | 13% |
| **Total** | **108** | **100** |
| **Age** | | |
| 25-35 | 15 | 14% |
| 35-45 | 27 | 25% |

| | | |
|---|---|---|
| 45-55 | 64 | 59% |
| Above 55 | 2 | 2% |
| **Total** | **108** | **100** |
| **Marital Status** | | |
| Single | 23 | 21% |
| Married | 71 | 66% |
| Divorced | 14 | 13% |
| **Total** | **108** | **100%** |
| **Education level** | | |
| None | 73 | 61% |
| Primary | 10 | 4% |
| Secondary | 11 | 10% |
| University | 14 | 17% |
| **Total** | **108** | **100** |

**Table 2 Rainfall Pattern on Maize Production**

| | | Level of agreement (%) | | | | | |
|---|---|---|---|---|---|---|---|
| **No** | **Statement** | **Strongly Agree** | **Agree** | **Neutral** | **Dis agree** | **Strongly Disagree** | **Total** |
| 1. | Distribution of rainfall affects maize yields in different places | 40.4 | 36.5 | 11.2 | 7.5 | 4.4 | 100 |
| 2. | Late rainfall onset affects maize production | 46.8 | 39.8 | 9.3 | 2.8 | 1.3 | 100 |
| 3. | Early rainfall onset affects maize production | 50.7 | 30.9 | 4.7 | 11.8 | 1.9 | 100 |
| 4. | Rainfall seasonality has caused retardation of | 31.3 | 43.5 | 9.4 | 10.2 | 5.6 | 100 |

maize growth

The table 2 above indicated of 40.4% of the respondents were strongly agree agreed, 36.5% of the respondents were agree,11.2% of the respondents were neutral,7.5% were disagreed and 4.4% were strongly disagreed of distribution of rainfall. 31.3% of the respondents were strongly agreed, 43.5% of the respondents were agree, 9.4% of the respondents were neutral, 10.2% of the respondents were disagreed and 5.6% were strongly disagreed of rainfall seasonality has caused retardation of maize growth. 50.7% of the respondents were strongly agree agreed, 30.9% of the respondents were agree, 4.7% of the respondents were neutral, 11.8% were disagreed and 1.9% were strongly disagreed of early rainfall onset affects maize production . 46.8% of the respondents were strongly agree agreed, 39.8% of the respondents were agree, 4.7% of the respondents were neutral, 11.8% were disagreed , 1.9% were strongly disagreed of late rainfall onset affects maize production.

**Table 3 Rainfall Intensity on Maize Production**

| | | **Level of agreement (%)** | | | | | |
|---|---|---|---|---|---|---|---|
| **No** | **Statement** | **Strongly Agree** | **Agree** | **Neutral** | **Disagree** | **Strongly Disagree** | **Total** |
| 1. | Rainfall intensity increase amount of runoff causing soil erosion | 52.4 | 37.4 | 3.7 | 5.6 | .9 | 100 |
| 2. | Rainfall intensity causes post-harvest loses | 27.8 | 37.0 | 18.5 | 13.9 | 2.8 | 100 |
| 3. | Rainfall amount causes delay in the onset of planting | 32.0 | 34.8 | 10.2 | 19.4 | 3.5 | 100 |
| 4. | Rainfall variations has caused drought and flooding affecting maize production | 35.9 | 49.8 | 7.6 | 3.0 | 3.7 | 100 |

In table 3, indicates of 52.4% of the respondents were strongly agree agreed, 37.4% of the respondents were agree ,3.7% of the respondents were neutral,5.6% were disagreed and .9% were strongly disagreed of rainfall intensity increase amount of runoff causing soil erosion. 27.8% of the respondents were Strongly agree agreed, 37% of the respondents were Agree, 18.5% of the respondents were neutral, 13.9% of the respondents were dis agreed and 2.8% were strongly

disagreed of rainfall intensity causes post-harvest loses. 32.7% of the respondents were strongly agree agreed, 34.8% of the respondents were agree neutral, 10.2% of the respondents were agree neutral, 19.4% were disagreed and 3.5% of rainfall amount causes delay in the onset of planting. 35.9% of the respondents were Strongly agree agreed 49.8 %of the respondents were agree neutral 7.8 %of the respondents were agree neutral ,3% of the respondents were disagree agreed,3.7% were disagreed of rainfall variations has caused drought and flooding affecting maize production.

**Table 4 Rainfall frequency and Maize production**

| No | Statement | Level of agreement (%) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree | Total |
| 1. | Rainfall frequency affects the quality maize produced | 43.0 | 20.2 | 22.0 | 12.0 | 2.8 | 100 |
| 2. | Rainfall frequency has affected land preparation for planting | 28 | 47 | 18 | 10 | 5 | 100 |
| 3. | Rainfall frequency causes Late maturity | 42.0 | 38.7 | 6.7 | 5.9 | 6.7 | 100 |
| 4. | Rainfall frequency increases the chances of crop failure | 36.3 | 44.1 | 6.7 | 8.9 | 4.1 | 100 |

In table 4 Indicates of 43% of the respondents were Strongly agree agreed, 20.2% of the respondents were agree,22% of the respondents were neutral,12% were disagreed and .2.8% were strongly disagreed of rainfall frequency affects the quality maize produced. 28% of the respondents were Strongly agree agreed 47 %of the respondents were agree, 18% of the respondents were neutral, 10% were disagreed 5% were strongly disagreed of Rainfall frequency has affected land preparation for planting. 42.% of the respondents were Strongly agree agreed,38.7 of the respondents were Agree, 6.7% of the respondents were Agree neutral, 5.9%were disagreed 6.5%were strongly disagreed of Rainfall frequency causes Late maturity. 36.3%of the respondents were Strongly agree agreed, 44.1% of the respondents were Agree, 6.7% of the respondents were Agree neutral, 8.9% were disagreed, 4.1% were strongly disagreed of rainfall frequency increases the chances of crop failure.

## 4. Result And Discussion

### 4.1 Demographic characteristics of respondents

Majority of the study was revealed that 87% of the respondents were male and 13 % of the respondents were female. This implies that the majority of the respondents were male. This is because these categories of people who work in maize are more men than women. The researcher was found out that 21% of the respondents were single,66% of the respondents were married whereas as the remained 13% are in divorced.About73(68%) of the respondents were none educated, 10(9%) of the respondents were primary level,11(10%) of them were secondary level and 14(13%) of the respondence were University level .In addition 15(14%) of the respondents were between 25-35 years,27(25%) of the respondents were between 35-45 years, 45-55 interval years are 64(59% ) respondents whereas the those above 55 are 2(2% )years the age of the respondents.

### 4.2 **Effect of Rainfall Pattern on Maize Production**

The researcher was found out that 40.4% of the respondents were strongly agree agreed, 36.5% of the respondents were agree,11.2% of the respondents were neutral,7.5% were disagreed and 4.4% were strongly disagreed, this implies that the majority of the respondents were strongly agreed with that statement. This is because the category of people was aware to this statement that rainfall pattern causes poor yield and the maize will failure, This findings are supporting Adamgbe and Ujoh (2013), explained “variations in the annual rain days as well as the rainfall received play a key role in the a mount of maize yields. From the research, the number of rainy days annually are decreasing as the onset of rainy seasons are delaying and the cessation period does not delay”. According to Adamgbe and Ujoh (2013), “variations in the annual rain days as well as the rainfall received play a key role in the amount of maize yields”.

### 4.3 **Rainfall Intensity on Maize Production**

The study was found that indicates of rainfall intensity increase amount of runoff causing soil erosion 52.4% of the respondents were strongly agreed, 37.4% of the respondents were agree ,3.7% of the respondents were neutral,5.6% were disagreed and .9% were strongly disagreed. This implies that the majority of the respondents were agreed with the statement. This is because the category of people was aware to this declaration.This findings are supporting Cudjoe, Antwi-Agyei, and Gyampoh, (2021) provided strong evidence about rainfall pattern and maize

production.. According to Adamgbe and Ujoh (2013), explained variations in the annual rain days as well as the rainfall received play a key role in the a mount of maize yields.

### 4.4 Rainfall frequency and Maize production

The study was indicated that rainfall frequency affects the quality maize produced, about 43% of the respondents were strongly agreed, 20.2% of the respondents were agree,22% of the respondents were neutral,12% were disagreed and .2% were strongly disagreed. These finding supported my findings of rainfall frequency and maize production Nicholson (2008) provided a support that rainfall duration and intensity of early and mid-season rain can have a dramatic effect on yield and Huho, and Kosonei, (2014) explained 27 Understanding extreme climatic events for economic development in Kenyathe frequency of occurrence and severity of floods and droughts have been increasing over time causing massive crop failure where maize yields dropped from 2.5 to 0.5tones/Ha.

## 5. Conclusion

The first objective of this study was to assess the effect of rainfall patterns on maize production among farmers in Afgooye District, Somalia. Rainfall patterns were operationalized as Rainfall Seasonality Rainfall Distribution, that the rainfall variability is a cause of poor yield potential and crop failure, so that heavy precipitation and field flooding in agricultural systems delays spring planting, increases soil compaction, and causes crop losses through anoxia and root diseases; variation in precipitation is responsible for the majority of the crop losses. It was concluded that rainfall pattern affects yield of maize The researcher also, concluded that rainfall pattern results into postharvest losses. Maize is mainly grown in rain-fed areas that receive heavy annual rainfall. That is why it is fundamentally maize is Gu season (July - August ) Deyr season (December - January) in Afgooye Somalia. The study was summarized that rainfall pattern delays the onset of the planting season. The onset of rainfall can be described as the possible start of rainfall in a year. Finally climate change will cause an intensification of rainfall variability.

The second objective of this study was to assess the effect of rainfall intensity on maize production among farmers in Afgooye District, Somalia. Rainfall intensity was operationalized as duration and amount of Rainfall. It was used to analyze the relationship between the rainfall pattern and maize production of the farmers.

The study was concluded that heavy rainfall cause damage and loss of crops. Heavy rainfall can lead to numerous hazards such as flooding, including risk to human life, damage to buildings and infrastructure, and loss of crops and livestock. The study was concluded that the rainfall amount and duration affects maize production due rainfall variability.

The final objective of this study was to determine the effect of rainfall frequency on maize production among farmers in Afgooye District, Somalia. Rainfall intensity was operationalized as number of rainy dates.

**Reference:**

Adamgbe, E. M., & Ujoh, F. (2013). Effect of variability in rainfall characteristics on maize yield in Gboko, Nigeria.

Akpalu et.al 2008. Climate variability and Maize Yield in South Africa. IFPRI Research Brief 15-10. Washington, DC: The International Food Policy Research Institute.

Akpalu et.al 2008. Rainfall variability and Maize Yield in South Africa. IFPRI Research Brief 15-10. Washington, DC: The International Food Policy Research Institute.

Alfieri, J. G., Blanken, P. D., Yates, D. N., & Steffen, K. (2007). Variability in the environmental factors driving evapotranspiration from a grazed rangeland during severe drought conditions. Journal of Hydrometeorology, 8(2), 207-220.

Bacon, C. (2005). Confronting the coffee crisis: can fair trade, organic, and specialty coffees reduce small-scale farmer vulnerability in northern Nicaragua? World Development 33(3), 497-511. Murray, F. J. (2004). Potential for aquaculture in community- managed irrigation systems of the dry-zone, Sri Lanka: Impacts on livelihoods of the poor. Asal Printing Center..

Bacon, C. (2005). Confronting the coffee crisis: can fair trade, organic, and specialty coffees reduce small-scale farmer vulnerability in northern Nicaragua? World Development 33(3), 497-

Check J. K., Schutt R. K. (2012). Research methods in education. London, UK: Sage Publications

Chen YC, Wei C, Yeh HC. 2007. Rainfall network design using kriging and entropy.

Cordis T. J. (2019). Climate extremes hitting maize production could become the new norm by 2020. Journal of Climate Change, 18(1), 77-98.

Cordis T. J. (2019). Rainfall extremes hitting maize production could become the new norm by 2020. Journal of Rainfall Change, 18(1), 77-98.

Cudjoe, G. P., Antwi-Agyei, P., & Gyampoh, B. A. (2021). The effect of climate variability on maize production in the Ejura-Sekyedumase municipality, Ghana. *Climate*, *9*(10), 145.

Forza, C. (2002), "Survey research in operations management: a process□based perspective", International Journal of Operations & Production Management, Vol. 22 No. 2, pp. 152-194.

Hoegh-Guldberg O, Poloczanska ES, Skirving W and Dove S (2017) Coral Reef Ecosystems under Rainfall Change and Ocean Acidification. Front. Mar. Sci. 4:158

Huho, J.M. and Kosonei, R.C. (2014). Understanding Extreme Climatic Events for Economic Development in Kenya. IOSR Journal of Environmental Science, Toxicology and Food Technology 8 (2): 14-25.

Hydrological Process 1: 340-346.

IPCC (2013). "Climate change 2013: the physical science basis," in Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, eds T. F. Stocker, D. Qin, G.-K. Plattner, M. Tignor, S. K. Allen, J. Boschung, et al. (Cambridge; New York, NY: Cambridge University Press).

IPCC (2016) Meeting report of the intergovernmental panel on climate change expert meeting on communication [Lynn, J., M. Araya, Ø. Christophersen, I. El Gizouli, S.J. Hassol, E.M.

Miceli, M.P. , Near, J.P. & Schwenk, C.R. (1991). Who blows the whistle and why? Industrial and Lubor Relations Review, 45: 113-130.

Murray, F. J. (2004). Potential for aquaculture in community managed irrigation systems of the dry-zone, Sri Lanka: Impacts on livelihoods of the poor. Asal Printing Center..

Prashant, Supriya(2010) Sample size calculation" **International Journal of Ayurveda Research; Mumbai** Vol. 1, Iss. 1, :55-57.

Ryan, JC et al. (2018): Dark zone of the Greenland Ice Sheet controlled by distributed biologically-active impurities. Nature Communications, 9(1),

Warsame, A. A., Sheik-Ali, I. A., Ali, A. O., & Sarkodie, S. A. (2021). Rainfall change and crop production nexus in Somalia: an empirical evidence from ARDL technique. Environmental Science and Pollution Research, 28(16), 19838-19850.

Wichelns, D. (2001). The role of „virtual water" in efforts to achieve food security and other national goals, with an example from Egypt. Agricultural water management, 49(2), 131151.

Wilhite, D.A.; Svoboda, M.D.; Hayes, M.J. (2006). Understanding the complex impacts of drought: a key to enhancing drought mitigation and preparedness. Water Resources Management, 21: 763-774.

WMO 2019 Basic Documents (https://public.wmo.int/en/ resources/library/basic-documents-no1-2019-edition)