# Analysis of Seasonal rainfall variability in Rainfed Agriculture in Homa Bay County

**J. O. Ogenga**
Masinde Muliro University of Science and Technology (MMUST), P.O. Box 190-50100, Kakamega, Kenya
School of Disaster Management and Humanitarian Assistance (SDMHA)
Department of Disaster Management and Sustainable Development (DMSD)
*Corresponding author: Email: jafogenga@gmail.com*

DOI: 10.29322/IJSRP.11.03.2021.p11132
http://dx.doi.org/10.29322/IJSRP.11.03.2021.p11132

**Abstract**

Rainfall variability exhibits spatial and temporal distribution of rainfall in the world. Extreme seasonal rainfall variability has led to lower or total failure of agricultural production in many parts of the ASALs in the world hence food insecurity and famine. The study objective was to analyze the seasonal rainfall variability in rainfed agriculture in Homa bay County. The study used descriptive research design. Secondary monthly rainfall data for the period (1950 – 2017) was sourced from the KMD Head Quarters. Time series analysis was used to analyze the monthly rainfall data. There is significant P>0.05 probability level variability of the seasonal rainfall with increase in rainfall amounts in MAM and SON while there is a decrease in rainfall amounts in JJA and DJF. There is need for sufficient employment of suitable and sustainable mitigation strategies to reduce the risk of extreme seasonal rainfall variability to enhance food security in the rainfed agriculture. The study will inform small scale farmers and other stakeholders in both agricultural and meteorological sectors in planning for sustainable food production and also a multi sectoral approach in policy formulation.

**Key words:** Rainfall variability, Rainfed Agriculture

## 1.0 Introduction

There is large variability of rainfall in different regions of the earth in both spatial - temporal distribution and magnitude. Spatial and temporal distribution of short and long rains in many parts of Kenya is defined by the general prevalence of monsoons and the corresponding agricultural practices (Stewart, 1988). Most parts of Kenya observe two rainfall seasons that alternate with dry seasons. The two rainfall seasons are the long rainfall season which is concentrated between March – May and the short season which occurs from September to Early December (Gitau, 2012). The probability of these seasons getting interrupted by dry spells is very high mostly in the ASALs and sub humid regions such as Homa Bay County as opposed to wetter regions of the country (Awange *et al*., 2007). Both short and long rainy seasons experience some degree of variability that substantially influence agriculture especially in the rangeland and sub humid lands. According to Onchiri *et al*. (2016), historical studies have shown frequent occurrence of variation in rainfall amount received in different seasons over time in the Lake Victoria Basin where Homa Bay County is situated. Variation in seasonal rainfall significantly translates to variation in agricultural production leading to failure of food production hence famine (Ogenga *et al*., 2018). Rainfall variability therefore plays a critical role in agriculture and productivity (Chhibber and Laajaj, 2008).

## 2.0 Materials and methods

### 2.1 Study area

The study was carried out in Homa Bay County which is located in the Western part of Kenya in the former Nyanza province with an area of 3,154.7 km Square. It is bounded by latitude 0° 15’ South and 0°52’ South and longitudes 34° East and 35°" East. It has an altitude of 1146 m above the mean sea level. Homa Bay County has sub humid condition with mean daily temperatures ranging between 26°C during the coldest months (April and November) and 34°C during the hottest months (December to March). There is some variation in precipitation throughout the County, with the Southern areas further from Lake Victoria receiving the highest precipitation of around 1750 mm and the northern areas closer to Lake Victoria receiving 1000 – 1250 mm precipitation per year (GoK, 2018). It has two rainy seasons; March to May and September to November representing the long rains and short rains respectively (Ogallo, 1980).

### 2.2 Research design

Descriptive research design was used to study the analysis of the seasonal rainfall variability in rainfed agriculture. Additionally, the study utilized both qualitative and quantitative approaches. The analyzed data was sourced from Kenya Meteorological Department

station in Mbita. There are other Meteorological stations in the County like for Kabunde Air strip, ICIPE meteorological station and for other institutions based stations but due to their inefficiency in terms of data and secondly given the fact that they are found in the same climatological zone, Mbita meteorological station was considered for this study. The daily rainfall data for the period under consideration (1953 – 2017) were obtained from the Kenya Meteorological department (KMD) Headquarters in Nairobi.

**2.3 Analysis criteria of seasonal rainfall variability in Homa Bay County**

Annual and seasonal rainfall patterns were analyzed from daily rainfall data and the variations illustrated using of graphs and trend lines. The study divided the years into four seasons December, January and February (DJF), March April and May (MAM), June, July and August (JJA), and September, October and November (SON) for comparison between the growing seasons and the non growing seasons in relation to rainfall variability. The main growing seasons in Homa Bay County are (MAM) and (SON) that is during the long and short rains respectively.

The trend line $y = mx + c$ was used to describe changes in rainfall amounts where "y" represented rainfall amount in millimeter (mm), "m" represented slope showing the rate of change of rainfall over the period under consideration while c represented the intercepts on y – axis. $R^2$ was used to determine the significance of change at 0.05 level in both seasonal rainfall amounts over the years in consideration.

**3.0 Results and discussions**

Homa Bay County has varied seasons within the year. These are determined by the amount of rainfall received during those seasons. The County experiences two main rainy seasons namely the long rainy season from March to June and short rainy seasons from August to November (GoK, 2013). Although there are two main rainy seasons in the Lake Victoria region, some areas receive three rainfall peaks occurring between March to May, June to September and October to December (Kipkorir *et al.*, 2007).

Analysis for the daily amount of rainfall received during the March, April and May (MAM) season reveals that there is an increasing amount of rainfall received during this season in Homa Bay County. Figure 3.1 shows the trend of rainfall amounts received for the MAM season with an $R^2 = 0.134$ at 0.05 probability level. This indicated a low significance level hence there was a substantial increase in seasonal amount rainfall under the years in consideration in Homa Bay County. The MAM season receives highest amount of rainfall and agriculture is dependent on this season (KARI, 2012).

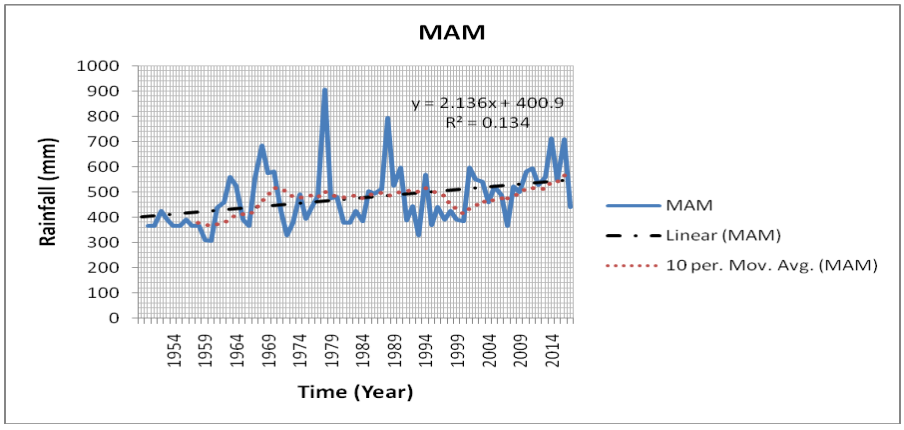


**Figure 3.1: Rainfall trend for the March, April and May Season (MAM): 1950-2017**

**Source**: Data from the Kenya Meteorological Department (2018)

In the June, July and August (JJA) Season, the analysis shows there is a decrease in rainfall amount within the years under consideration in Homa Bay County (Figure 3.2). The analysis shows a decrease in rainfall trend with $R^2$ value of 0.021 at 0.05 probability level. It therefore indicated a non substantial decrease in amount of rainfall that is highly significant in the JJA season. However, there is continuous change in the daily rainfall amount received within the season. Onchiri *et al*. (2016) observes that MAM receives the highest rainfall followed by reduced rainfall amount in JJA and an extension of the dry seasons lead to depressed or failure of long or short rains affecting food production.

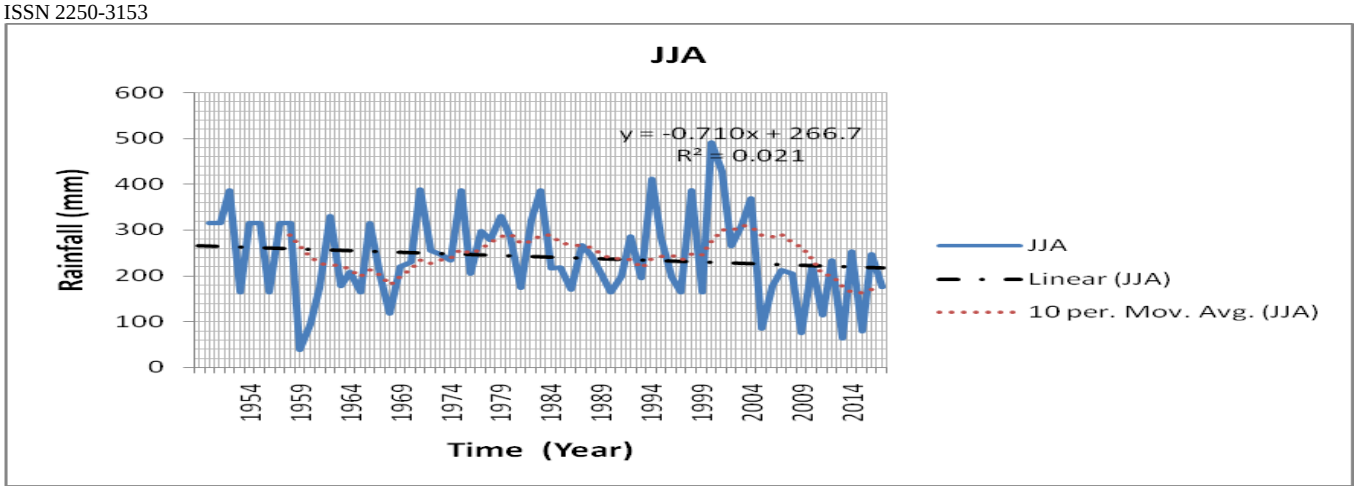


**Figure 3.2: Rainfall trend for the June, July and August Season (JJA): 1950-2017**

**Source:** Data from the Kenya Meteorological Department (2018)

In the September, October and November (SON) season (Figure 3.3) indicates an increase in the daily rainfall amount received. In reference to the $R^2$ value of 0.071 at a probability level of 0.05 that is less significant over the study period in Homa Bay County. This is despite the ever varying amount of rainfall in every year of the study period. Knowledge of these rainfall characteristics over the seasons is an important planning tool for farmers who could avoid planting during extreme climatic conditions to avoid heavy agricultural losses. Mugalavai (2013) observes that after the first rainy rainfall season MAM, the normally long dry season (June – October) receives heavy rains with a peak in August to September. These are caused by convergence of daily Lake Winds attracted by daily heating up of the land, with trade winds from the East.

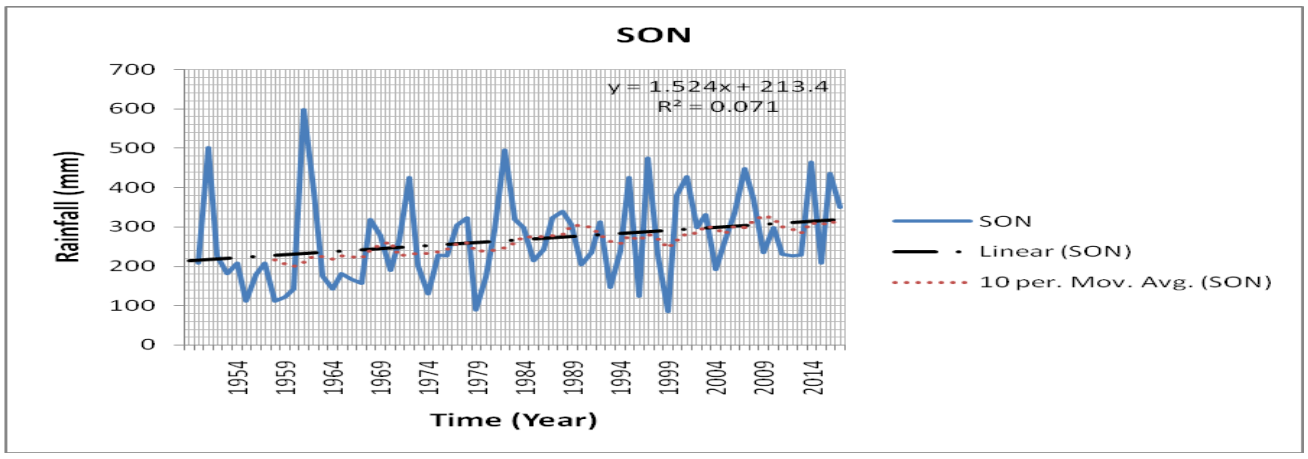


**Figure 3.3: Rainfall trend for the September, October and November (SON): 1950-2017**

**Source**: Data from the Kenya Meteorological Department (2018)

The analysis in Figure 3.4, the December, January and February (DJF) season shows a decrease of rainfall received with high significance $R^2$ value of 0.007 at 0.05 probability level that is not substantial within the years under consideration in Homa Bay County.

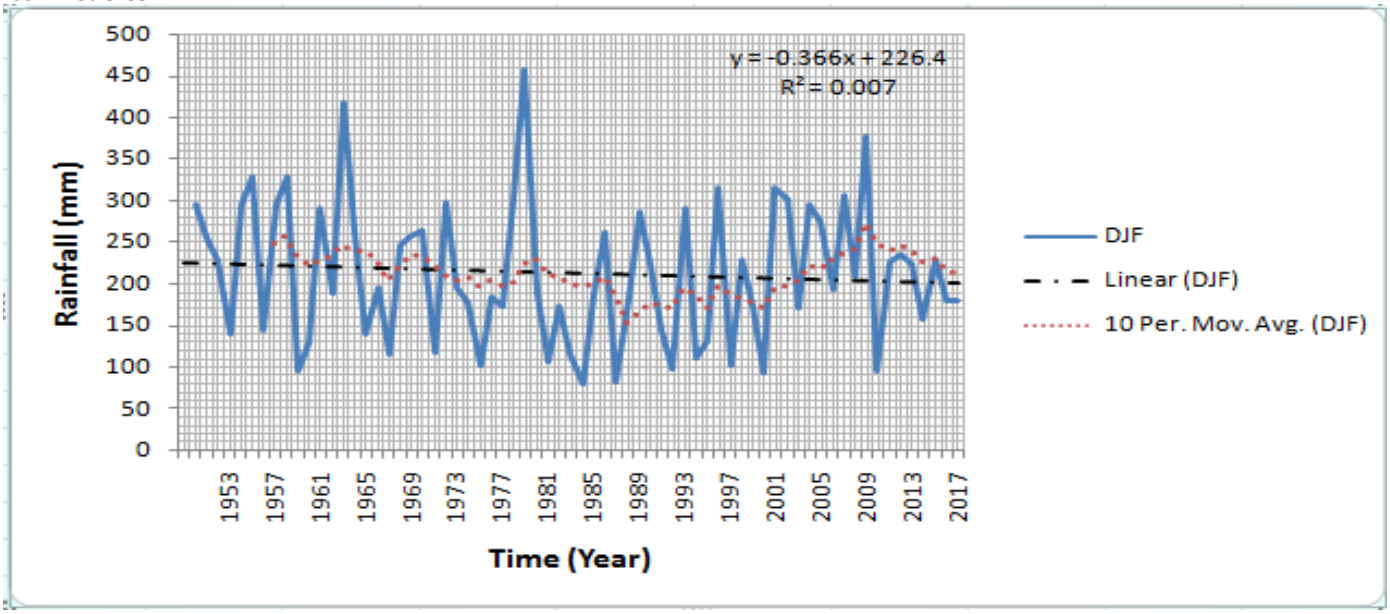


**Figure 3.4: Rainfall trend for the December, January and February (DJF): 1950-2017**

**Source:** Data from the Kenya Meteorological Department (2018)

It was confirmed from the focus group discussions that the main growing seasons "*chiri* and "*opon*" which are the long and short rainy seasons are based on the amount of rainfall received at the time. The participants reported that many farmers carry out major agricultural activities like planting crops that are regarded as staple food during the two seasons of (MAM) and (SON) while the rest of the season (JJA) in a year is meant for growing of other small scale crops that can easily be managed by supplemental irrigation like kales, onions and tomatoes.

Mugalavai (2013) observes that there is a general increase in amount of rainfall in the Western region where the Lake Victoria Basin is located but with low significance probability level at 0.05. The low increase in the amount of rainfall mostly in the crop growing seasons, suggests that the probability of crops are at risk of being affected by varying amount of rainfall received in the seasons in Homa Bay County. According to APFM (2004), most agricultural activities which are majorly subsistent in the Lake Victoria Basin region are done in the months of February to March and September to October respectively.

## 4.0 Conclusion and recommendation

There is a significant seasonal rainfall variability at $P<0.05$ with increase in amount of rainfall in MAM, decrease in JJA, increase in SON, and a decrease of rainfall received in DJF with high significance within the years under consideration (1950 – 2017) in Homa Bay County. High variability in seasonal rainfall then has a high potential of causing high variation in agricultural production within seasons. To reduce risks of any potential damage from the extremes of the rainfall variability on rainfed agriculture, there is need for piloting of suitable and sustainable mitigation strategies in different seasons for agricultural production resilience and enhance sustainable food security in Homa Bay County.

## 5.0 References

APFM (Associate Programme on Flood Management) 2004, Integrated Flood Management- Concept Paper http://www.apfm.info/pdf/concept_paper_e.pdf (2 February 2016)

Awange, J.L., Aluoch, J., Ogallo, L.A., Omulo, M., and Omondi, P. (2007). Frequency and severity of drought in Lake Victoria region (Kenya) and its effect on food security. *Climate research. (33) 135-142*

Chhibber, A.,Laaja J. (2008). Disasters, climate change and economic development in Sub Saharan Africa: Lessons and Directions' *Journal of African economy (24 ) 201-215. London, Oxford University press*

Gitau W. (2012). Spatial coherence and potential predictability assessment of intra seasonal statistics of wet and dry spells over Equatorial Eastern Africa. *Journal of Earth science. (5)272-301*

GoK, (2018). Homa Bay County First County Integrated Development Plan (CIDP) 2018- 2022. Government of Kenya, Nairobi, Kenya. Pp 270.

KARI, (2012). Food situation report. Policy response to food security in Kenya by Kenya agricultural institution Pp 72

Kipkorir, E.C Raes, D., Bargerei, R.J., Mugalavai, E.M. (2007) . Evaluation of two risk assessment methods for sowing maize in Kenya. Agriculture and Forest Meteorology (144) 190 – 200.

Mugalavai, E.M. (2013). Seasonal and Spatial Assessment of Agro-Climatic Parameters for Maize Crop Farming: Case of Lake Victoria Basin, Kenya. PhD Thesis – University of Eldoret, Kenya. Pp 168.

Ogallo, L.A. (1980). Regional classification of East African rainfall stations into homogenous groups using the method of principal component analysis. *Develop. Atmos Science (13) 213- 220*

Ogenga J. O, Mugalavai E. M and Nyandiko N.O (2018). Impact of Rainfall Variability on Food production under Rainfed Agriculture in Homa Bay County, Kenya. International Journal of Research and Scientific Publications Pg. 861.

Onchiri, M.K, Ang'awa, F., Tunoi, W.K. (2016). Effects of drought on food production in Asego Division, Homa Bay County, Kenya. *International of Geography. Vol. 3. No. 3*

Stewart, J. L. (1988). Response farming in rainfed agriculture. The WHARF foundation press USA. Pp 89