

Rainfall Variability in the wet-dry seasons. An analysis in Batticaloa District, Sri Lanka

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ABSTRACT

Rainfall is of primary importance to both the physical and cultural landscape of any region. The objective of this study is to find the trends for rainfall variability on climate change in Batticaloa District of Sri Lanka, by analyzing 146 years of monthly data of rainfall received during the period 1869-2014 from the meteorological station of the Department of Meteorology. Some studies attribute extreme events to rainfall variability due to climate change induced by global warming. However, there is a dearth of climatological studies addressing the trends in rainfall over Sri Lanka in support of such attribution. In our study, statistical analysis such as linear and standard deviation for 3 year, 5 year, 11 year and 21 year periods were utilized to examine periodic rainfall changes in both annual and seasonal contexts. The study finds that the 3, 5 year moving average shows high drier seasons, but the 11, 21 years moving average show higher wet seasons during the period of study. The changes of rainfall are known to have led to disasters such as flood and drought. Annual rainfall varies from 864 mm to 3081 mm, the distribution of which has sight variation throughout the district.

Keyword: Rainfall variability, Wet-dry, Meteorology, Flood

1. INTRODUCTION

The degree to which rainfall amounts vary across an area or through time is an important characteristic of the climate of an area. This subject area in meteorology is called "rainfall variability". Changes in amount, intensity and frequency affect the environment and society.

The climate can be very different if the frequency and intensity of rainfall differ, highlight the fact to the characteristics of rainfall are just as vital as the amount, in terms of the effects on the soil moisture and stream flow (Chandrapala, 1966).

Rainfall is the primary importance to the both physical and cultural landscape of any region. Of all the standard climatic parameters, rainfall is the most variable parameter in time and space (Mendelsohn, Dinar, Sanghi, 2001; Kaleel, 2016, 2017). The rainfall intensity varies markedly across the island. Based on rainfall, several agro climatic regions (wet zone, intermediate zone, dry zone, and arid zone) can be recognized. Depending on the rainfall pattern, climatologists divide Sri Lanka's climatic year into four seasons: two Monsoon periods and two Inter-Monsoon periods.

The Southwest Monsoon (Summer Monsoon) prevails from May to September while the Northeast Monsoon (Winter Monsoon) lasts from December to February. In between these two monsoon periods, two Inter-Monsoon periods exist: March to April - first Inter-Monsoon period and October and November - second Inter-Monsoon. Westerly winds prevail during the Southwest Monsoon and Northeasterly winds prevail during the Northeast Monsoon (Yoshino, Masatoshi, Suppiah, Ramasamy, 1984). The seasonal variations of wind direction and rainfall have a marked influence on human activities.

The annual rainfall varies from 864 mm to 3081 mm (146 years data) distribution, which has sight variation throughout the district. The most of the rain is being received during the month of October to February and it is both inter-monsoon and North East monsoon types. The mean annual rainfall values on the eastern slopes are less than 3,500 mm and the lowest are in the northwest (Chandrapala, 1966).

Climate change has become a major concern to human society because of its potentially deleterious impact worldwide. It poses especially significant threats to sustainable development in developing countries, which have fewer resources and are more vulnerable (Munasinghe, 2001).

Impacts on developing countries remain poorly understood because few studies have successfully measured the effects of climate on developing country economies. Nonetheless, it is likely that a developing country will be more vulnerable because a greater fraction of its economy is in climate sensitive sectors (for example, agriculture), it is already in a hot climatic zone, and the economy relies on labor-intensive technologies with fewer adaptation opportunities (Mendelsohn, 2001).

Rainfall is a key determinant of the growing seasons and the types of agriculture practiced. Rainfall plays an important role in agriculture as any shortages or excesses of rainfall gives way to a reduction in yields. For instance, rice is the main crop in Sri Lanka and is highly susceptible to rainfall variability (Yoshino, 1984).

Therefore, it is important to investigate the factors determining the variability of rainfall. There is a dearth of studies on rainfall variability in Sri Lanka. Such studies are essential to evaluate the impact of climate change on agriculture (Chandrapala, 1966).

This study aims to assess the magnitude and significance of rainfall variability and change over time using statistical analysis techniques.

2. OBJECTIVES

- To observe the trends of annual rainfall in Batticaloa District

- To examine the trends of rainfall deviation in Batticaloa District
- To observe the seasonal changes of rainfall variability in Batticaloa District

3. MATERIALS AND METHODS

This study is entirely based on secondary data available from the Department of Meteorology. Mean monthly rainfall data from Batticaloa station between 1869 and 2014 converted to annual mean were collected from the Meteorological Department.

Rainfall data is used in this study as an indication of rainfall being a key climatic variable. The research covers one climatic period of 146 years that provides a better platform to investigate the variability and changes in the climate systems in the study area. The mean annual rainfall data were used to construct a rainfall chart of Batticaloa district for the climatic period and with the chart, the analysis of the pattern and trends of rainfall in the area was carried out.

Statistical analysis such as linear and standard deviation for 3 years, 5 years, 11 years and 21 years were utilized to examine periodic rainfall changes in both annual and seasonal contexts.

4. RESULTS AND DISCUSSIONS

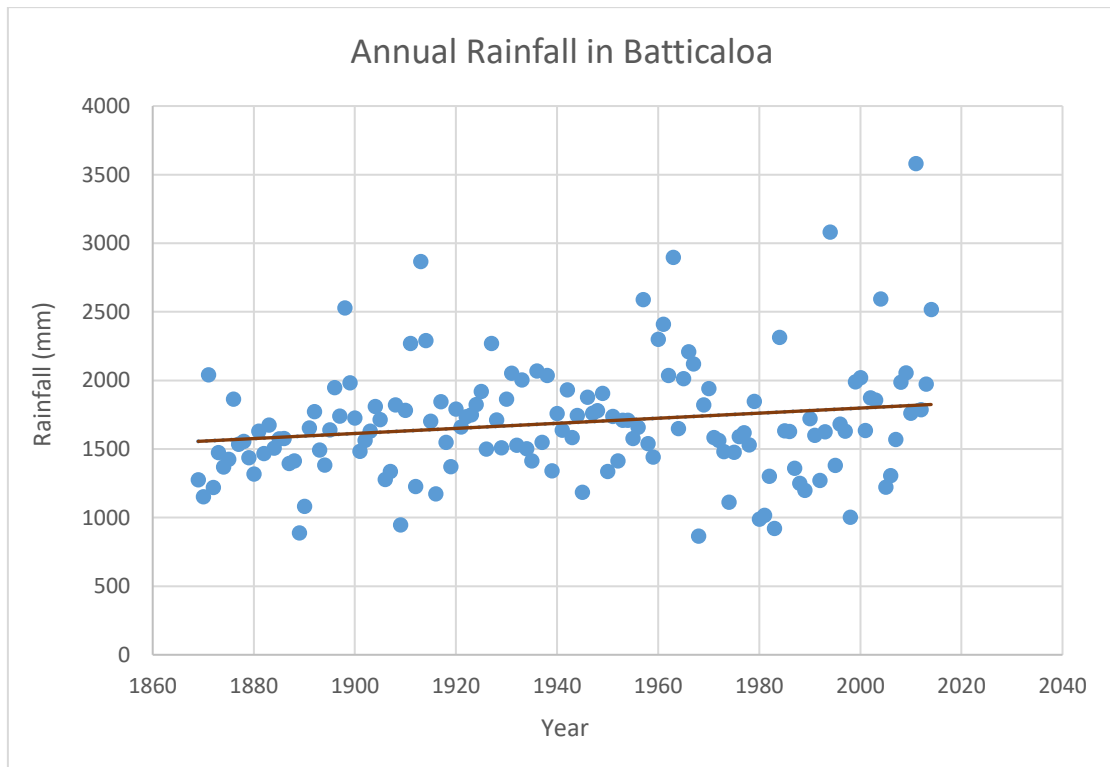


Figure 1. Annual Rainfall in Batticaloa

The trends of annual rainfall was deviated in this area, 2011 had being 3581 mm as a high rainfall of the years and 1968 had being 865 mm as a low rainfall of the years. However, the rainfall was not being below 800 mm in between these period. The rainfall was from 2000 mm to 3000 mm in the years 1871, 1898, 1911, 1913, 1914, 1927, 1931, 1933, 1936, 1957, 1965, 1966, 1984, 2000, 2004, 2009 and 2014 and above 3000 mm of rainfall was obtained in 1994 and 2011, we have faced heavy flood during this period. Some period was obtained below 1000 mm of rainfall in 1889, 1909, 1968, 1980. This was caused to the drought in the study area. In other periods, the rainfall was in between 1000 mm to 2000 mm, many years were obtained.

4. 1. Standard Deviation of Moving Average

Standard deviation and moving average were useful to examine the rainfall flexibility in Batticaloa District. This was clearly shown the rainfall changes of wet and dry season.

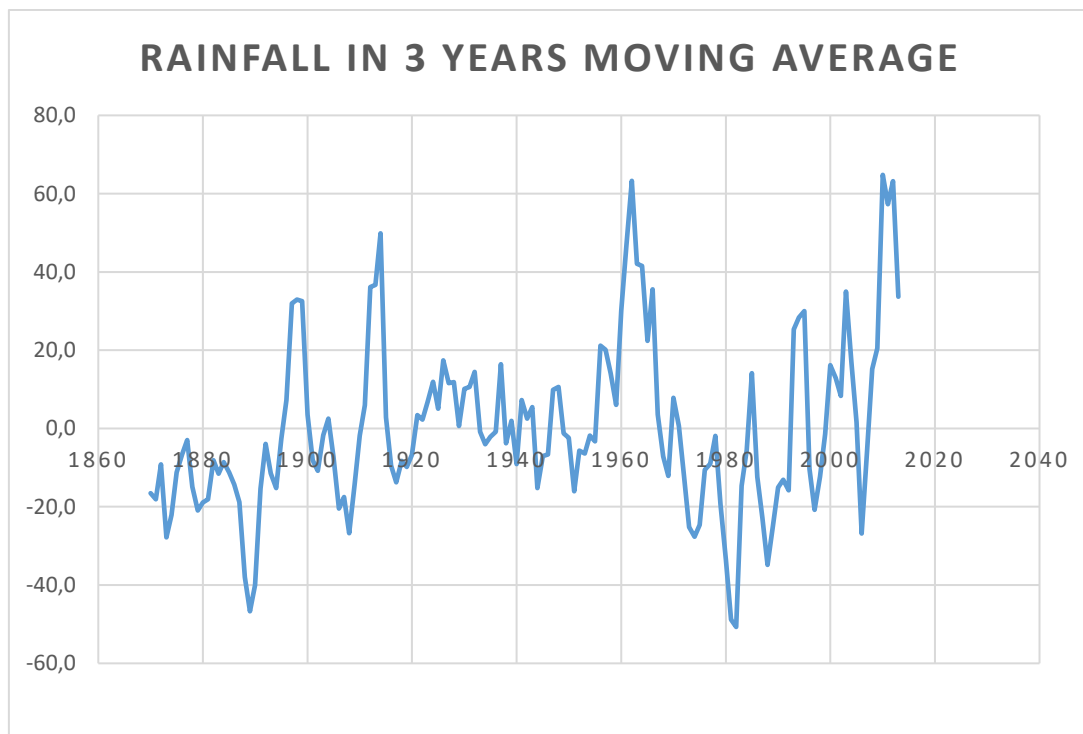


Figure 2. Rainfall in 3 years Moving Average

The Figure 2 clearly illustrates the changes of seasons. There were 14 dry season and 14 wet season. The long term of dry season were occurred from 1870 to 1895 for 16 years and the long term of wet season were occurred from 1956 to 1967 for 12 years. The first wet season was being from 1896 to 1900 for 5 years and the first dry season was being from 1870 to 1895 for 16 years. The seasons are flexible in each other. Nonetheless, the long term was experienced the dry season in between the years.

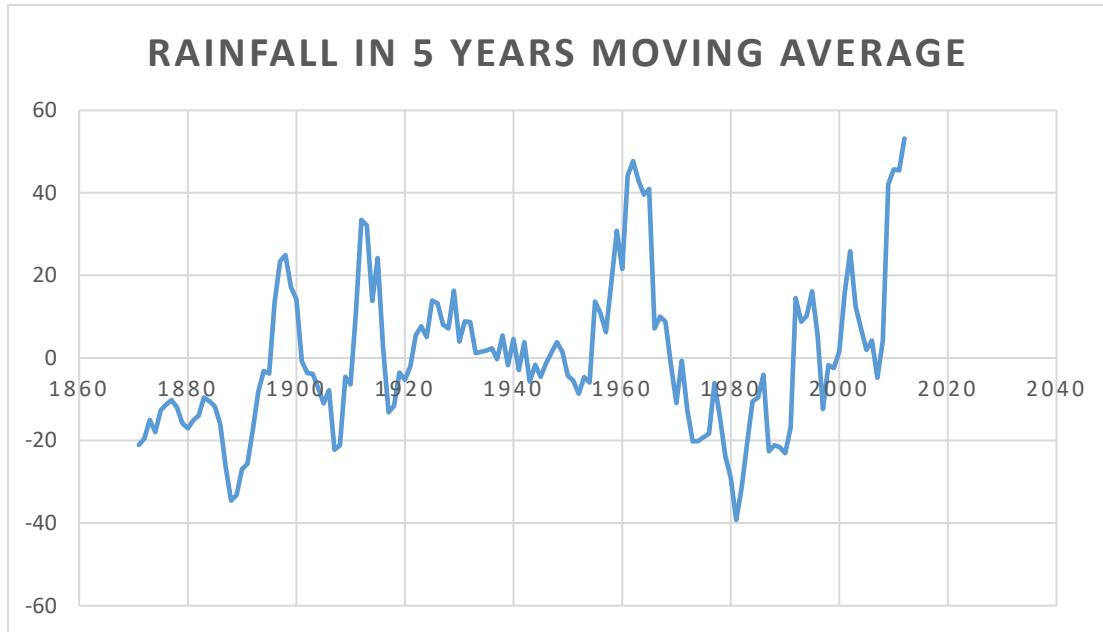


Figure 3. Rainfall in 5 years Moving Average

The Figure 3 shows that the selected 146 years rainfall, there were 11 dry season and 11 wet season. The long term of dry season were occurred from 1871 to 1895 for 25 years and the long term of wet season were occurred from 1922 to 1936 for 15 years. The first wet season was being from 1871 to 1895 for 25 years and the first dry season was being from 1922 to 1936 for 15 years. The rainfall seasons are imbalanced in each other. Nonetheless, we had experienced the long term of dry season in between the years.

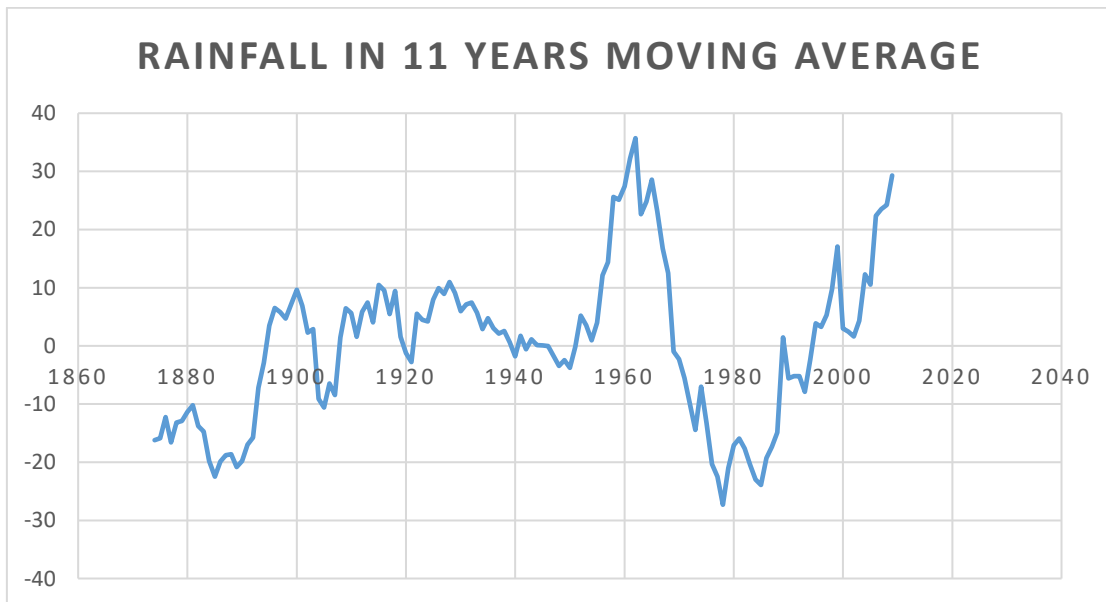


Figure 4. Rainfall in 11 years Moving Average

According to the Figure 4, the selected 146 years, there were 8 dry season and 8 wet season. The first wet season was being from 1895 to 1903 for 9 years, in between 1908 to 1939 of 30 years wet season, in 1920 to 1921 was dry season and again 1940, 1942 were dry season, 1941, 1943, 1944, 1945 were wet season. Thereafter, experienced 17 years wet season, in between 25 years dry season from 1969 to 1994, there was a wet season in 1989 and then, 15 years wet season were being from 1995 to 2009. The seasons are more flexible in each other. However, the long term was experienced the wet season in between the years.

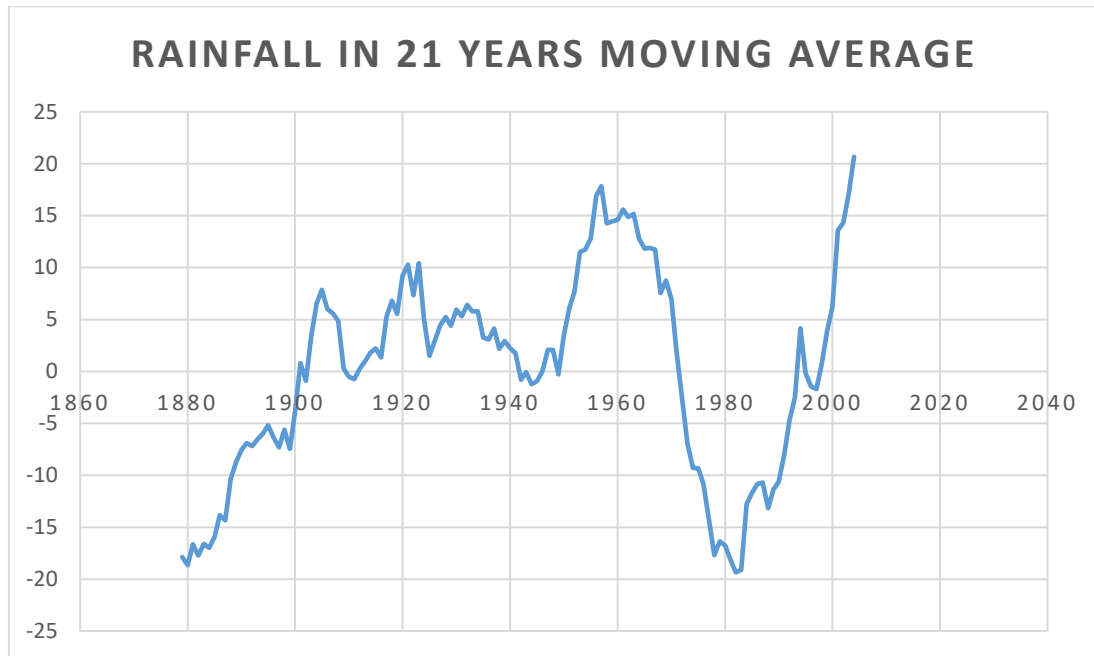


Figure 5. Rainfall in 21 years Moving Average

The Figure 5 shows, the selected 146 years, there were 8 dry season and 8 wet season. The dry season was being from 1879 to 1900. 1901 was the first wet season after 22 years of dry season and 1902 was dry season. 1903 to 1909 were wet season and 1910 to 1911 were dry season. The long term of wet season was occurred from 1912 to 1941 for 30 years, 1942 to 1946 were dry season, again 1947 to 1948 were wet season, 1949 was dry season and 1950 to 1971 were another long wet season. Thereafter, experienced 22 years another long dry season from 1972 to 1993, there was a wet season in 1994 and then, 3 years dry season were being from 1995 to 1997 and 7 years wet season were being from 1998 to 2004. The seasons are imbalanced in each other. Nevertheless, the long term was experienced the wet season in between the years.

4. 2. Seasonal Changes of Rainfall

The Figure 6 illustrates, the rainfall of 1st Inter monsoon period were below 250 mm in many times except the years 2007, 2009, and 2011. The rainfall was high as above 250 mm in 1996, 1997, 2003, 2004 and 2010 during the Southwest monsoon. The high rainfall in 1994 was 1317mm and in other periods, it was below 900 mm in the 2nd Inter monsoon period. The

rainfall in 1994, 1999, 2000, 2002, 2004, 2009 were in between 1000 mm to 1500 mm and it was very high as 2403 mm in 2011. According to this, we can experience the instability of rainfall in between the ten years of 1992 to 2011.

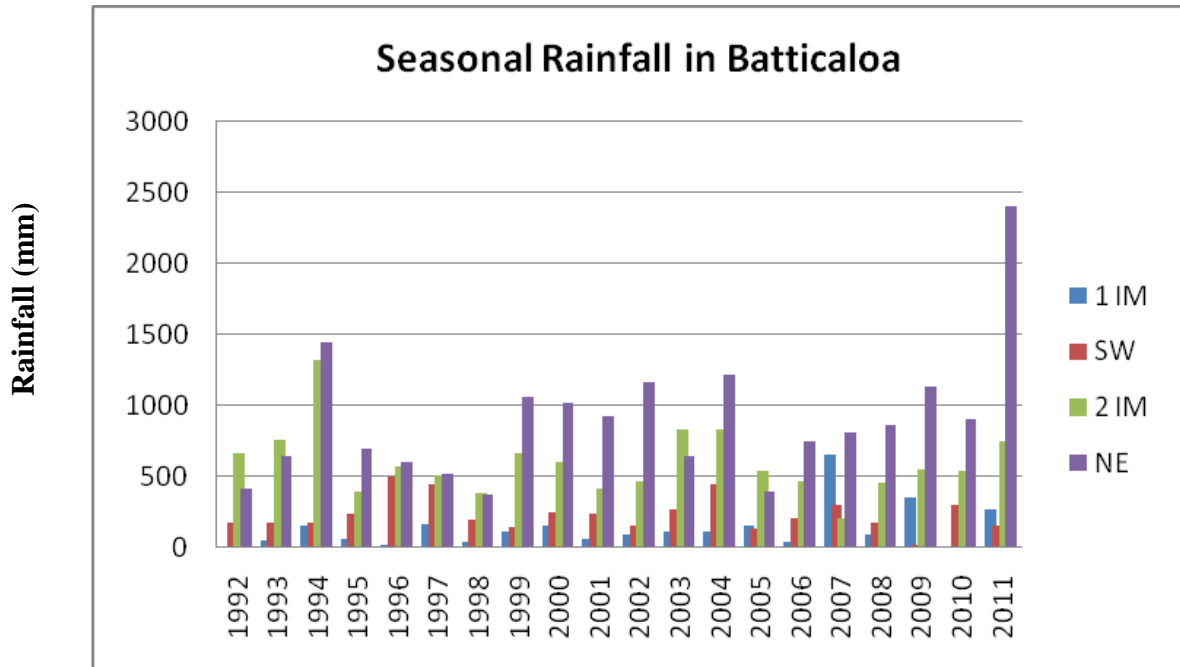


Figure 6. Seasonal Rainfall in Batticaloa

This study established that there is variability in rainfall of Batticaloa District due to the observed shifts in rainfall within the 146years climatic period. Based on the 3, 5 years moving average, we had experienced high drier season, by the 11, 21 years moving average showed the high wet seasons of the years. However, the rainfall differed in every year that caused to the disasters as flood and drought. For instance, the high rainfall of 1994 and 2011 were caused to heavy flood and more damages including agriculture.

5. CONCLUSIONS

The Earth has experienced cycles of temperature and precipitation changes on a geological scale. The overlying mechanism for the various changes in weather and climate system is related to restless atmospheric processes, which are always in a delicate state of equilibrium. However, this study indicates that there is variation in the climate of Batticaloa District following rainfall variability and many negative impacts have been created by this climatic phenomenon in the area. This could indicate that the intensity of rainfall events may have increased together with increased durations of dry spells. The apparent increased incidence of flooding and droughts in the recent past could probably be attributed to such changes in the temporal pattern of rainfall distribution. Such studies could provide invaluable guidance to decision making in agriculture and water resources management.

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