 doi:10.20944/preprints201807.0102.v1

Analysis of Start, End and Length of the Rainfall Seasons in Mbeya, Southwestern Highland in Tanzania

Offoro Neema Kimambo[1], Emmanuel Lubango Ndeto[2]

[1 &2] Department of Physical Sciences, Faculty of Science, Sokoine University of Agriculture, P.O. Box 3038, SMC-Mazimbu Morogoro - Tanzania

Corresponding Email: offoro@sua.ac.tz

Abstract

Tanzania like any other developing countries is depending on uncertain rainfall for their subsistence and commercial agriculture. In this paper the start and end of rains for Mbeya Meteorological Station in Tanzania Mainland was analyzed and critically examined. Data were kindly given by Tanzania Meteorological Agency (TMA) during face to face Statistics in Applied Climatology (fSIAC) workshop which was held at Sokoine University of Agriculture (SUA) the year 2013 prior to online Course on Statistics in Applied climatology (eSIAC). In this study data were analyzed using Instat (for windows version 3.3.7) package developed by the Statistical Services Centre of the University of Reading. The analysis showed that much of rains start early December all the way to May. There is also 50 percent chance of having below and above the mean for both total annual rainfall and number of rains, in other word one in two years the total rains are below means likewise the number of rain days.

Keywords: Start, End, Length, Season, Rains, Agriculture

Introduction

More than 80 percent of Tanzanians are gambling their time and money they have in subsistence agriculture. However, rainfed agriculture is clearly the most dominant practice and finally it has an implication to the Tanzanian economy. It has been reported that regional predictions indicate Tanzania may suffer a loss of over 10 percent of its grain production by the year 2080 (Parry et al., 1999). The cultivation of maize is going to be particularly hard hit. Estimates from crop environment resource synthesis model (CERES) came up with the following; average yield decrease over the entire country would be 33 percent, but simulations produced decreases as high

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 5 July 2018 doi:10.20944/preprints201807.0102.v1

as 84 percent in the central regions of Dodoma and Tabora yields in the north-eastern highlands showed decreases of 22 percent while in the Lake Victoria region decreases of 17 percent were indicated. The southern highland areas of Mbeya and Songea were estimated to have decreases of 10 to 15 percent (Jones and Kiniry, 1986). With the changing climate start of rains, end of rains and length of seasons are important parameters to be investigated for betterment of agriculture sector. Therefore, there is a need to investigate the start of rains and end of rains and length of season; their variability so that farmers are up-to-date on any communication, as well as decision on when and what to plant to avoid risks of replanting or loss of their agricultural inputs.

Start of Rain

Start of rainfall is complex in agronomical aspects, since rain does not start in a time. He also went far arguing that the first precipitation is not the start of it (Mazandarani, Ahmadi, & Ramazani, 2013). According to Edoga, (2007) start of rains is as a traditional to semi empirical monthly rainfall minimum of 60mm and 30mm respectively. Edoga, (2007 cited in Stern at al., 2003) defines it as 20 mm of rain in one or more date(s) within the next thirty days and as at least 20 mm and not followed by a period of more than 10 consecutive dry days in the following 30 days defines respectively. Another definition according to report work in Sub Saharan Africa defines start of rains as 25 mm of accumulated rainfall in 10 days and 45 mm of accumulated rain fall in 4 days (Tadross et al., 2011). Many findings also (Mugalavai, Kipkorir, Raes, & Rao, 2008 cited in Mupangwa, Walker, & Twomlow, 2011) suggest that there is a significant relationship between start of rains and length of the seasons.

End of Rain

The end of rainfall is also the parameter that its definition is difficult in arid region of the word. This definition should be in complete relationship with the definition of the start of rainfall. Mazandarani et al., (2013) defines the end of precipitation as the last date of precipitation after March 21(depending the area of study), and after that the dry spell is over 20 days while according to Edoga, (2007) defines it as minimum daily rainfall threshold of 25mm. In some other finding (Edoga, 2007 cited in Benoit, 1977; Stern et al., 1982) soil is assumed to be field at a capacity of 100mm on the last day of rain that is >0.5 Potential Evapotranspiration (PET) provided that the date is not proceeded by a dry spell (<1mm average daily rainfall) while

 doi:10.20944/preprints201807.0102.v1

(Mupangwa et al., 2011; Tadross et al., 2011) suggests that for 3 consecutive decades each <20mm and also when water balance drop to zero can be termed as end of rains.

Material and Methods

Sixty years (60) (1952-2011) daily rainfall data for Mbeya meteorological weather station were kindly supplied by TMA during fSIAC workshop which was held at SUA the year 2013. The study location was chosen for the facts that the station has somewhat a true representation of the south western highlands in terms of rainfall distribution. The second reason was availability of data since in the south western highlands it was only data for Mbeya which were available. In this study data were analyzed, summarized and presented in graphs using Instat (for windows version 1.3.1) package developed by the Statistical Services Centre of the University of Reading, UK. In this study the definitions of 20 mm of rains in one or two consecutive days without a dry spell (no more than 10 dry days in the next 30 days for the start of rains) were adopted from Edoga (2007, cited in Stern, 2003; Stern et al, 1981). On the Other hand the end of rain was adopted from (Mupangwa et al., 2011) and the length of season was obtained by subtraction the start date from end date.

Results and Discussions

All the figures in this discussion, daily data were sorted and shifted from January to July for easier viewing of rain seasons and trends. In this study the start of rain (accumulation of 20 mm of rains in one or two consecutive days after December 1st) end of rains (from May 1st where water balances drop to zero) were used. This agrees well with Mbeya regional report on census on agriculture (URT, 2007) which describes the region climatic conditions as the region receives abundant and reliable rainfall. The report depicted that, normally the dry season begins in June and ends in December whilst the Wet season runs from January to May which corroborate well with the figure 1 below.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 5 July 2018 doi:10.20944/preprints201807.0102.v1

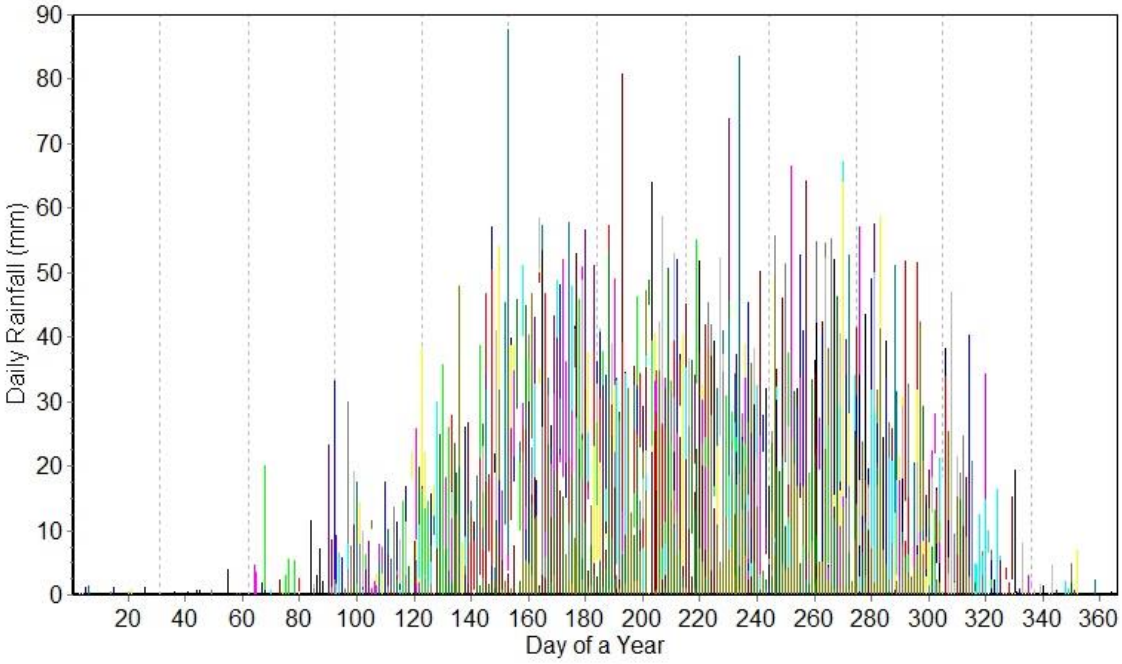

Figure 1. Mbeya Daily rainfall distribution for a period of 60 years starting July 1st

From figure 1 above, daily rain picks are seen to be staring form September although from the condition which was set in the software, rains of more than 20 mm of rainfall for more than two days the condition fits well from 1st December (day 155 from July 1st). Just by Observation, figure 1 also gives a clue of probably the end of rain season.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 5 July 2018 doi:10.20944/preprints201807.0102.v1

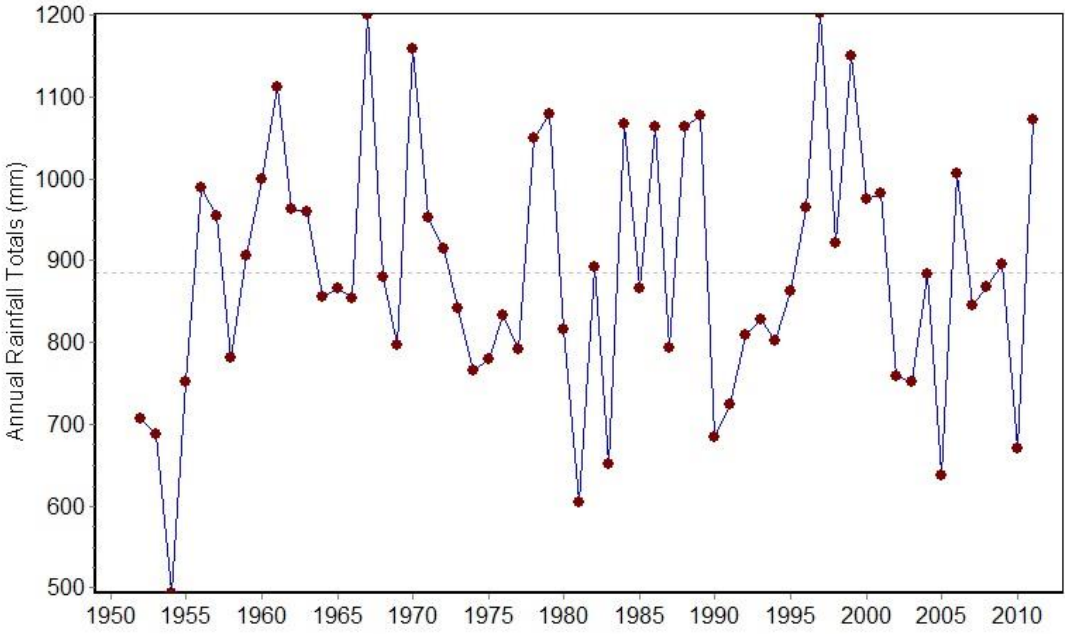

Figure 2: Rainfall Totals for Mbeya Meteorological Station

With respect to the number of rain days (Figure 2), the study found that, 31 years out of 60 (one in two years) were below normal and the rest were above normal. Annual rainfall totals are going up to 1200 mm and a mean of 885 mm. The standard deviation and coefficient of variation are stipulated in table 1. On the other hand, number of rain days (figure 3) behave the same (one in two years) number of rains days is below normal

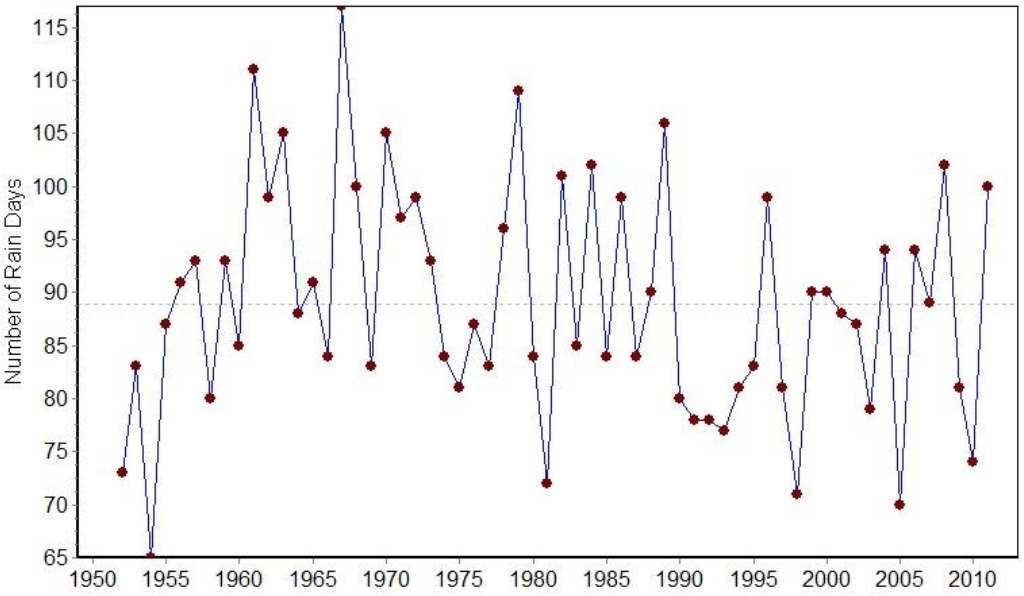

Figure 3: Number of rains days for Mbeya Meteorological Station

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 5 July 2018 doi:10.20944/preprints201807.0102.v1

Table 1: Statistical Analysis for all the parameters under investigation

Parameter	Number of Rain	Annual Total Rainfall	Start of rains	End of rains	Length of the Season
Mean	88.91	885.23	161.35	309.41	148
Standard Deviation	10.94	153.56	6.2891	5.3502	8.1579
Maximum	117	1202.3	182	329	169
Minimum	65	493.5	155	306	124
Coefficient of variation (%)	12.3	17	3.9	1.7	5.5

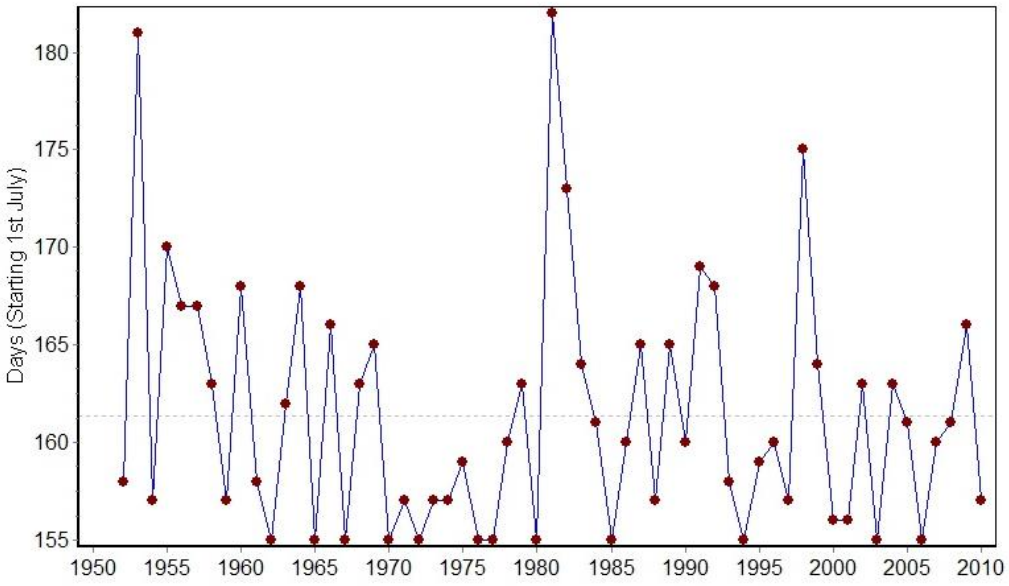

Figure 4: Start of the rains in Mbeya station without dry spells (Dates starting 1st July)

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 5 July 2018 doi:10.20944/preprints201807.0102.v1

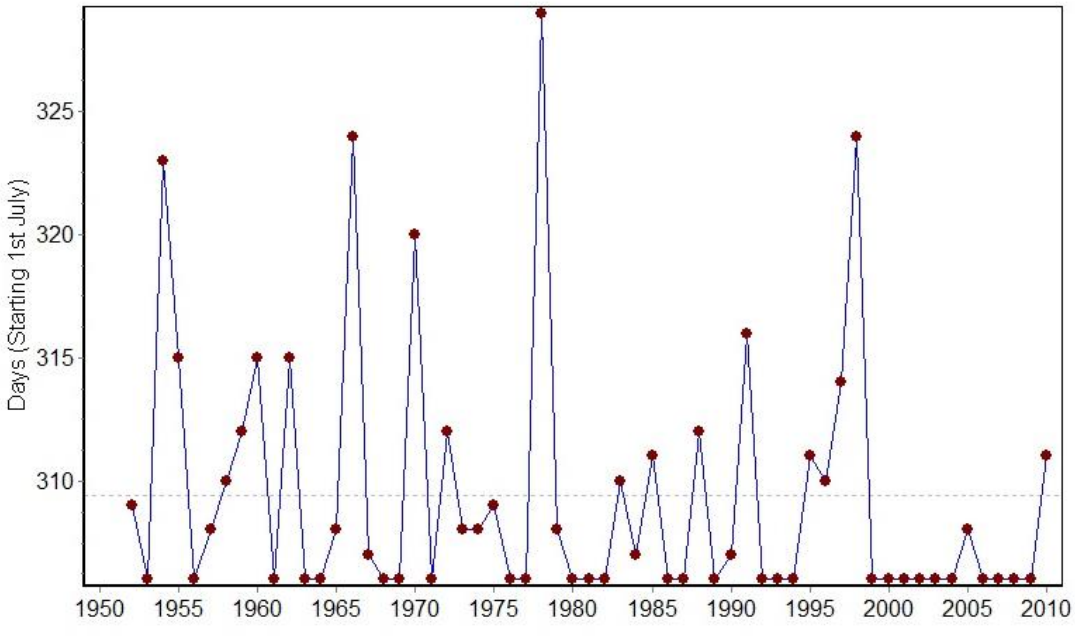

Figure 5: End of rains in Mbeya station without dry spells (Dates starting 1stJuly)

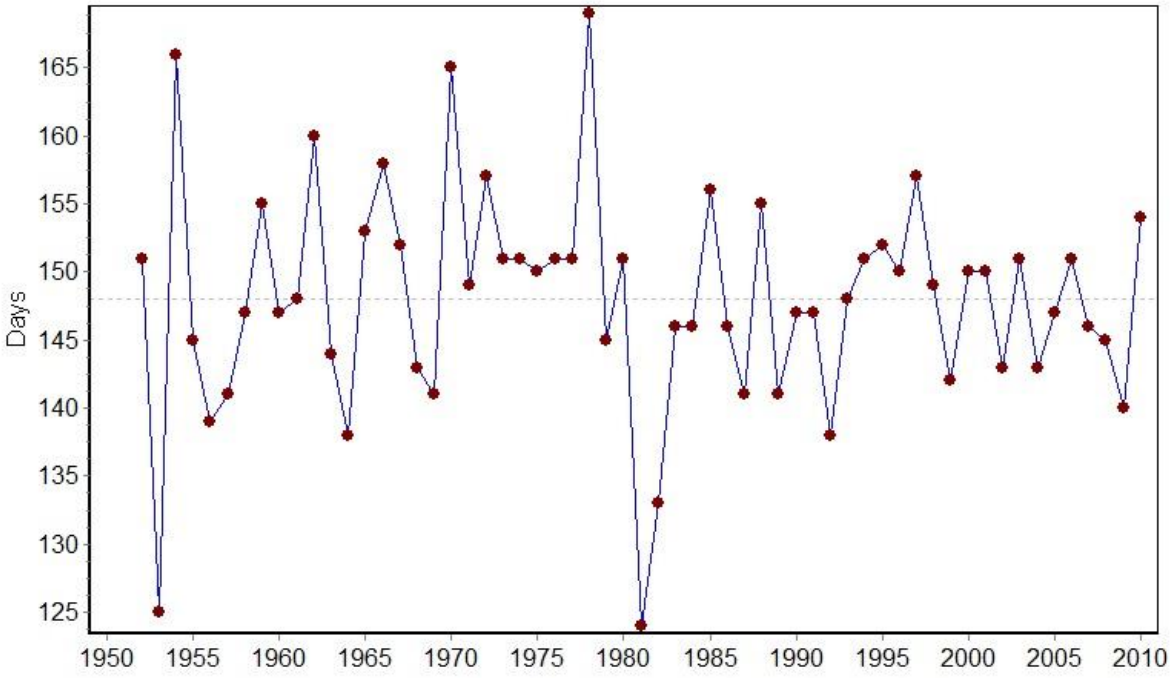

Figure 6: Length of the season (without dry spells) for Mbeya Station

Conclusion

Start and end of rains in Mbeya meteorological station was investigated. In this study it was found that start of rain is pronounced from early December ending early May. It was also found

that, for both rainfall annual totals and number of rain days, one in two years are below means. The variations for all the start, end, and length of the seasons were not significant because they were below 20 percent. The desk study can confirm that farmers need to be informed well on weather updates especially for the seasonal forecasting so that they can make decisions correctly

Acknowledgement

Much appreciation to Tanzania Meteorological Agency (TMA) for supplying their data, Statistical Services Centre (SSC) of the University of Reading through Dr. Roger Stern and his team during both eSIAC and fSIAC, World Meteorological Organization (WMO) for funding the course, Sokoine University of Agriculture (SUA) through its Climate Change Impacts, Adaptation and Mitigation (CCIAM) Project.

References

Edoga, R. N. (2007). Determination of Length of Growing Season in Samaru Using Different Potential Evapotranspiration Models. *AU Joutnal of Technology*, *11*(1), 28–35

Jones, C.A. and J.R. Kiniry (eds.) 1986. CERES-Maize. A Simulation Model of Maize Growth and Development, Texas A&M Press, College Station.

Mazandarani, G. A., Ahmadi, A. Z., & Ramazani, Z. (2013). Investigation Analysis of the Agronomical Characteristics of the Daily Rainfall in Rain-Fed Agriculture (Case study: Tehran). *International Journal of Agricultural and Crop Sciences*, *5*(6), 612–619.

Mugalavai, E. M., Kipkorir, E. C., Raes, D., & Rao, M. S. (2008). Analysis of rainfall onset, cessation and length of growing season for western Kenya. *Agricultural and Forest Meteorology*, *148*(6-7), 1123–1135. http://doi.org/10.1016/j.agrformet.2008.02.013

Mupangwa, W., Walker, S., & Twomlow, S. (2011). Start, end and dry spells of the growing season in semi-arid southern Zimbabwe. *Journal of Arid Environments*, *75*(11), 1097–1104. http://doi.org/10.1016/j.jaridenv.2011.05.011

MTadross, M., Suarez, P., Lotsch, A., Hachigonta, S., Mdoka, M., Unga-nai, L., … Muchinda, M. (2011). Changes in growing-season rainfall characteristics and downscaled scenarios of change over southern Africa: implications for growing maize. In *IPCC regional Expert Meeting on Regional Impacts, Adaptation, Vulnerability, and Mitigation, Nadi, Fiji* (pp. 193–204)

Parry, M., Rosenzweig, C., Iglesias, A., Fischer, G. and Livermore, M. 1999. Climate Change and World Food Security: A New Assessment. Global Environmental Change. 9: S51-S67.

 doi:10.20944/preprints201807.0102.v1

URT, (2007). National Sample Census of Agriculture 2002/2003, Regional Report: Mbeya Region. Available online at http://www.nbs.go.tz/takwimu/Agriculture/MBEYA%20REGION%20REPORT.pdf retrieved on 12th June 2015