International Journal of Research in Environmental Science (IJRES)
Volume 4, Issue 4, 2018, PP 22-26
ISSN No. (Online) 2454-9444
DOI: http://dx.doi.org/10.20431/2454-9444.0404003
www.arcjournals.org

Analyzing Preciptation at Quiha District, Southeastern, Tigray, Ethiopia

Mekonnen Yibrah[1]*, Tilahun Dandesa[2], Bezuneh Sego[3], Bekele Kebebe[3]

[1]*Tigray Meteorology Service Center, Mekele, Ethiopia*

[2]*Agricultural Transformations Agency, Addis-Ababa, Ethiopia*

[3]*National Meteorological Agency, Addis-Ababa, Ethiopia*

Corresponding Author: ***Mekonnen Yibrah,*** *Tigray Meteorology Service Center, Mekele, Ethiopia.*

Abstract: *Climate change has a significant impact on the environment as well as the social, economy. Tigray is one of the sensitive regions to climate variation particularly to rainfall changes. In this study, we analyzed rainfall variability at annual and seasonal time scales, for the periods 1984-2014. Daily observed climate data was collected from the National Meteorological Agency of Ethiopia (NMA). Temporal rainfall variability was assessed through the timing of onset date, end date, length of growing season and dry spell length using INSTAT climate guide. Moreover, long term monthly Eto was calculated using CROPWATH MODEL. The variation was high due to the variability of daily and monthly weather condition over the study area.*

The long-term annual rainfall in the study area showed high variability from year to year which was 22.9%. Seasonally, the ONDJF, JJAS and MAM total rainfall also showed high variability which was 89.7%, 24.7% and 62.7% respectively. Except onset date, cessation date and length of growing season were highly variable. The onset date, offset date and length of the rainy season/JJAS were on 184DOY/02JUL, 261DOY/17SEPT and 77 days respectively. Moreover, the minimum dry spell days length converges from 201DOY-241DOY (19July-28Aug) and turn upward again from 241DOY-261DOY (28Aug-17Sep). Thus the maximum Probability of occurrence of dry spell length during the main (JJAS) season implies a negative impact on the agricultural activities of the study area during the study period (1984-2014).

Keywords: *Analysis, Quiha, Rainfall, variability, Eto.*

1. INTRODUCTION

As climate varies or changes, several direct influences alter precipitation amount, intensity, frequency and type (Mendelsohn and Dinar, 1999; Ravindranath and Sathaye, 2002; Winkler, 2005; Aklilu and Alebachew, 2009). Although there are many impacts expected from climate change, one of the largest impacts is expected to be on agriculture (Nordhaus, 1991; Pearce, 1996). The majority of the rural people in developing countries and in the northern Ethiopian highlands in particular depend heavily on rain fed subsistence agriculture and the daily exploitation of natural resources (Alebachew, 2011). Therefore, site specific rainfall analysis is crucial for agricultural planning. Hence, contributes to fill the gaps on scientific information in the agricultural sector of Tigray region in particular the study area and its nearby

The aim of this study is to evaluate precipitation variability in *Quiha District which is located in Mekelle Alula Abanega International Air-port, Tigray region, Ethiopia.* To be able achieve our goals we conducted an examination of climatic data from 1984-2014 in order to identify annual and seasonal rainfall variability and other characteristics of precipitation at different time scales. The main purpose of this study is to detect significant characteristics or fluctuations in the annual and seasonal climatic conditions.

2. Materials And Methods

2.1. Description of the Study Area

2.1.1. Location

The study area is located in the Tigray National Regional State of the Federal Democratic Republic of Ethiopia. Geographically, it is located at 13.47 ^{O}N Latitude, 39.52 ^{O}E Longitude and 2257 meter Altitude. The study area shares border areas with Kilte Awlalo in the north, Degua-Temben in the west, Saharti Saharti in the south west, Hintalo Wajirat in the south and the Afar region in the east.

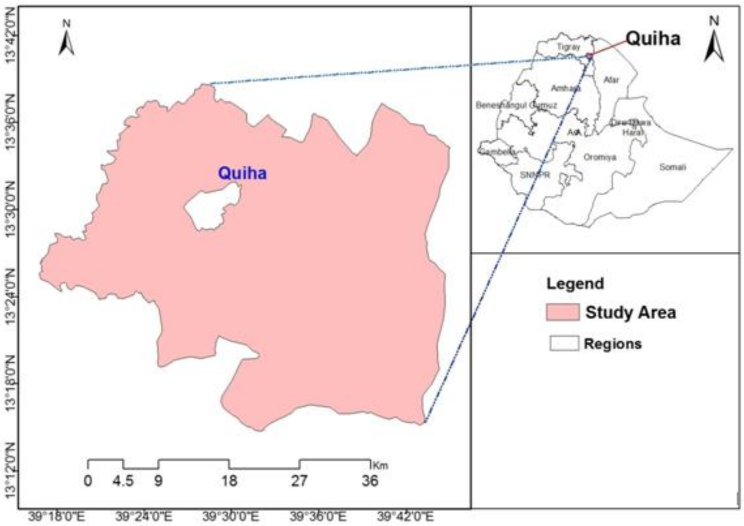

Figure1. *Map of the study area*

2.1.2. Climate Parameters and Database Used for the Study

Quiha District daily observed rainfall and Eto data was collected from the National Meteorological Agency of Ethiopia archives (NMA).

2.2. Rainfall Variability Analysis

Thirty years of observed climate data was used to assess seasonal and annual rainfall variability. The long-term total rainfall amount and temporal range during the growing season of the study area was assessed by processing the daily rainfall data using INSTAT Climatic Guide (Stern et al., 2006). In order to determine onset of rainfall in each seasons (JJAS and MAM), the definition of effective onset of rainfall was employed from past rainfall data. In this study, the first occasion after March 1st when rainfall accumulated in three consecutive days is at least 20 mm and no dry spell of more than 7 days in the next 30 days was used as an actual onset of rainfall. The end of growing season (end date), on the other hand, was defined as the first date after 1st September when the soil water drops to 10 mm/meter within 10 days after which there is no rainfall for the next 10 days. The onset and end date criteria were used to determine the length of growing season as total number of days from the date of onset of rainfall to the end date of the rainfall. The daily rainfall data was processed to give probabilities of maximum dry spell lengths exceeding 5, 7, 10, 15 and 20 days starting from January first. In a box and whiskers plotting, the box represents the middle 50% of the whole data set, while whiskers represent the magnitude of the spread of the rest of the data set about the median or mean (Stern *et al.*, 2006).

2.3. Long Term Monthly Evapotranspiration Analysis

Thirty years of daily Eto data was used to assess long term monthly Eto variability over Quiha District, southeastern Tigray, Ethiopia using the CROP-WATT Model.

3. Results And Discussion

3.1. Annual and Seasonal Rainfall Variability

The amount of annual and seasonal total rainfall, timing of onset, end date and length of growing season (LGS) are critical rainfall features that indicate useful information on temporal rainfall variability over an area. The seasonal total rainfall ranged from 9 to 227.3 mm in MAM and 186 to

642.3 mm in JJAS, respectively (Table 1). The CV is much higher for MAM season rainfall total than JJAS season rainfall indicating higher temporal variability of the MAM season rainfall total. The annual total rainfall also showed high variability and ranged from 269.3 to 836.8 mm. The JJAS season rainfall contributes 76% of the annual rainfall whereas the MAM season contributes 17% of the annual rainfall which might benefit for land preparation, pasture growth and drinking water. The rest of the annual rainfall (7%) is obtained during the dry months of the year (ONDJF).

Table1. *Descriptive statistics of annual and seasonal (MAM and JJAS) rainfall total at Quiha District during the study period (1984-2014).*

Descriptive statistics	Annual rainfall total (mm)	Seasonal rainfall total (mm)	
		JJAS (mm)	MAM (mm)
Maximum	836.8	642.3	227.3
Minimum	269.3	186.0	9.0
Mean	599.4	452.7	103
CV	24	25	55
SD	139	107	55
Proportion (%)	------	76%	17%

3.2. Onset, End Date and Length of Growing Season

Upon the definition set *Using INSTAT climate guide* a time series analysis of daily rainfall of a specific area from the past record gives a good picture to decide the possible onset date, cessation date and length of growing season**.** In line with this, the average onset date at the study area from (1984-2014) was 184/02July followed by the early onset date 166DOY/14Jun with the late onset date 198DOY/16July. The early offset date was 245DOY/01Sep and the late offset was also 283/09Oct. The average cessation of the season JJAS was was 261DOY/17Sep. Therefore, the onset date, offset date and length of the rainy season/JJAS (Figure 2) would be on 184DOY/02JUL, 261DOY/17SEP and 77 days respectively. In line with this, Araya and Stroosnijder (2011) and Hadgu et al. (2013) also reported similar findings.

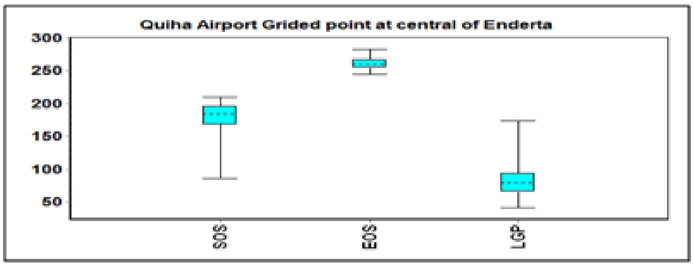

Figure2. *Box whisker plots of onset date, end date and length of growing Period for Kiremt Season at Quiha District (1984-2014).*

On the other hand, the start date (SOS), cessation date (EOS) and length of growing season (LGS) during the *Belg (MAM)* season in the study area for the period (1984-2014) is depicted in Figure3. In the present study, the observed SOS, EOS and LGS for *Belg (MAM)* season revealed that the season was challenging for crop growth rather it might benefit for land preparation, pasture growth and drinking water across the study area due to the late onset date, early cessation date and decreasing in LGS. Thus, the *Belg* (MAM) season was challenging for crop production and to determine its SOS-EOS-LGS during the period (1984-2014) in the study area. But Farmers in the study area and its surrounding should use rainfall of MAM for more productivity by sowing short period growing crops.

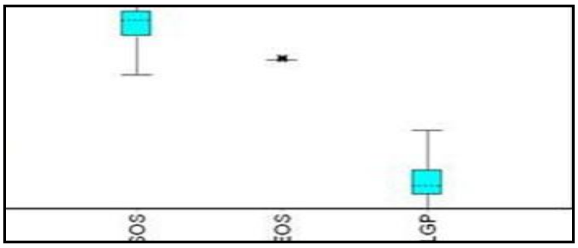

Figure3. *Box whisker plots of onset date, end date and length of growing period for Kiremt Season at Quiha District (1984-2014).*

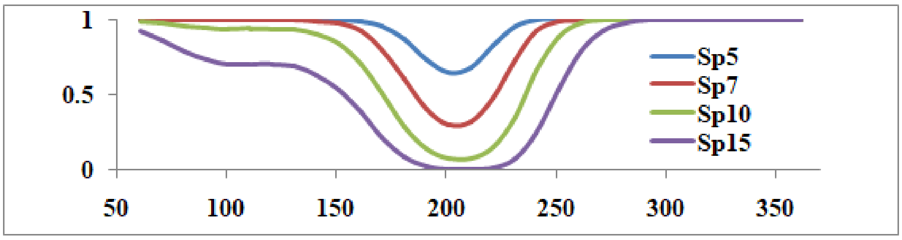

Figure4. *Probabilities of maximum dry spells exceeding 5,7,10, 15 and 20 day's length at Quiha District (1984-2014)*

3.3. Probability of Dry Spell Length

During the main/JJAS season curves of dry spell probability at different lengths converge to their minimum during months of peak rainfall periods from 201DOY-241DOY (19July-28Aug) and turn upward again from 241DOY-261DOY (28Aug-17Sep) signaling end of the growing season. This suggests that standing crops after this time will face greater risk of water shortages in the study area. Hence, it is necessary to choose a terminal drought tolerant variety if one wants to plant a crop variety with a maturing length of more than 77 days in the study area in order to fully utilize the resources.

3.4. Estimated Monthly Evapotranspiration Analysis

Long year mean monthly ETO losses for 30 years were used. Monthly evapotranspiration at Quiha District analysis showed high during March and June months. Similarly, monthly evapotranspiration was high during July to September. In line with this it was preferable to save water as high monthly evapotranspiration rates could result in water stress that would slow growth of crops especially on the month August during the study period (1984-2014). Moisture deficit and the crop-growing risks and suitability of rain-fed agriculture can be evaluated on the basis of relationships between rainfall and reference evapotranspiration (Tilahun, 2006; Araya et al., 2010b). However, effective rainfall, not total rainfall has to be considered, because in semi-arid northern Ethiopia a substantial amount of the rainfall is lost as runoff (Araya and Stroosnijder, 2010).The variation of ETO under the study area and between months was due to the variability of daily and monthly weather condition over the study area.

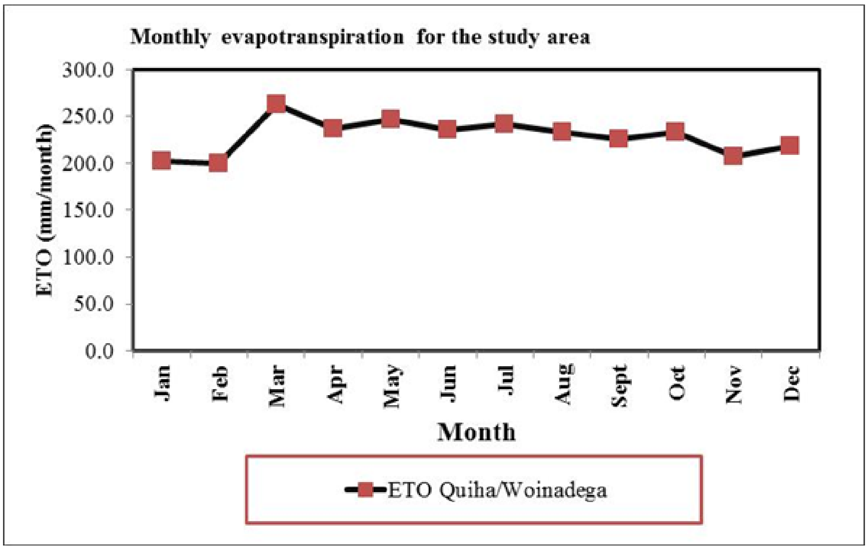

Figure5. *LYM monthly ETo losses at Quiha District during (1984-2014)*

4. Conclusion

ALL rainfall variability indices showed high temporal variability but EOS was more or less predictable. The variation of ETO between months was also highly variable due to the variability of daily and monthly weather conditions over the study area. The average onset date, offset date and length of the rainy season/JJAS was on 184DOY/02JUL, 261DOY/17SEP and 77 days respectively Moreover, the probability of occurrence of 5 to 15 dry spell days had been increasing during 241DOY-261DOY (8August-17 September). Generally, it had negative impact on crop productivity during the study period (1984-2014).

RECOMMENDATIONS

Intensive supplementary irrigation in the dekads of September by harvesting sufficient surface runoff in the month of August, use of more cultivable land and the seasonal climate outlook for adjusting their farm operations and farming system decisions to avert the risk of rainfall variability is highly necessary.

REFERENCES

[1] Araya, A., Keesstra, S.D., Stroosnijder, L., 2010b. A new agro-climatic classification for crop suitability zoning in northern semi-arid Ethiopia. Agric. For. Meteorol. 150, 1047–1064.

[2] Araya, A., Stroosnijder, L., 2010. Effects of tied ridges and mulch on barley (Hordeum vulgare) rainwater use efficiency and production in Northern Ethiopia. Agric. Water Manage. 97, 841–847.

[3] Aklilu, A. and Alebachew, A. 2009. Assessment of climate change-induced hazards, impacts and responses in the Southern lowlands of Ethiopia. Forum for Social Studies, Addis Ababa, Ethiopia.

[4] Alebachew, A. 2011. Climate change and rural livelihoods in Northern Ethiopia. Impacts, local adaptation strategies and implications for institutional interventions. FSS Monograph No.7. Forum for Social Studies, Addis Ababa, Ethiopia.

[5] Hadgu Gebre, Tesfaye K., Mamo G. and Kassa B. 2013. Trend and variability of rainfall in Tigray, Northern Ethiopia: Analysis of meteorological data and farmers' perception. *Academically Journal Environmental Science* 1(8): 159-171.

[6] Pearce, D., Cline, W., Achanta, A., Fankhauser, S., Pachauri, R. and Vellinga, P. 1996. The social costs of climate change: Greenhouse damage and benefits of control. pp.179 – 224. In: Bruce, J., Lee, H. and Haites, E. (Eds.). Climate Change 1995: Economic and Social Dimensions of Climate Change, . Cambridge: Cambridge University Press.

[7] Ravindranath, N.H. and Sathaye, J.A. 2002. Climate change and developing countries. Kluwer Academic Publishers, London, UK. 286pp.

[8] Stern, R., Rijks, D., Dale, I. and Knock, J. 2006. INSTAT climatic guide. Statistical Services Centre, The University of Reading, and UK.

Citation: *Mekonnen Yibrah, " Analyzing Preciptation at Quiha District, Southeastern, Tigray, Ethiopia" International Journal of Research in Environmental Science, vol. 4, no. 4, p. 22-26, 2018. http://dx.doi.org/ 10.20431/2454-9444.0404003*