

Assessment of Variability in Climatic Factors at Selected Location of Karnataka

T. Vasanth Kumar¹, D. M. Gowda², K. N. Krishnamurthy³

College of Horticulture, UAHS, Mudigere, Karnataka, India¹

College of Agriculture, UAS, Bengaluru, Karnataka, India^{2 & 3}

ABSTRACT: The climate variability in general, weather and climatic factors in particular, are very important for scientific research in biological sciences. The climatic data of a region plays vital role in deciding the crop of a region. The present investigation on variability in weather parameters was carried out at Kathalagere station of Karnataka State. The daily data on weather parameters viz., maximum temperature, minimum temperature, relative humidity, rainfall, evaporation, and sun shine hours were collected from Zonal Agricultural Research Station, Kathalagere for the period 1984 to 2013. Trend analysis was carried out by fitting suitable polynomials for each of the weather parameters during study the period. The results revealed that minimum temperature, relative humidity, evaporation and sun shine hours were found to be best fit with a 5th degree polynomial having R² values of 0.57, 0.45, 0.53 and 0.44 respectively. Whereas maximum temperature and rainfall was found to be best fit at 6th degree level with R² values of 0.32 and 0.40 respectively.

KEYWORDS: Weather parameters, Descriptive statistics, Trend analysis.

I. INTRODUCTION

Climate has a vital role on biosphere of the earth. A very slight change in climate will lead to a major change in plant and animal life. For example, some crops will not tolerate even a minute variation in temperature. Climate change could seriously threaten production levels required to feed the burgeoning population. Phenomenon of warming across the globe along with other falling consequences in the form of shift in rainfall pattern, melting of ice, rise in sea level etc. is getting accepted by the World community.

The long-range climate change has been observed Worldwide and also the changes in food production and productivity of individual crops. This change is slow in nature and caused some area to lose their traditional crops and to go for alternative crops. Further, it led to shifting of cropping pattern and cropping season. The productivity of an individual crop has been changed resulting in variation in total production of the food grains.

There are many questions that arise on the climate change and agriculture practices; these are interrelated processes, both of which take place on a global scale. Global warming is projected to have significant impacts on conditions affecting agriculture, including temperature, carbon dioxide, glacial run-off, precipitation and the interaction of these elements. These conditions determine the carrying capacity of the biosphere to produce enough food for the human population and domesticated animals. The overall effect of climate change on agriculture will depend on the balance of these effects. Assessment of the effects of global climate changes on agriculture might help to properly anticipate and adapt farming to maximize agricultural production. At the same time, agriculture has been shown to produce significant effects on climate change, primarily through the production and release of greenhouse gases such as carbon dioxide, methane, and nitrous oxide, but also by altering the earth's land cover, which can change its ability to absorb or reflect heat and light, thus contributing to radioactive forcing. Land use change such as deforestation and desertification, together with use of fossil fuels, are the major anthropogenic sources of carbon dioxide; agriculture itself is the major contributor to increasing methane and nitrous oxide concentrations in earth's atmosphere.

Karnataka has an annual average rainfall of 1248 mm for the period from 1991 to 2005. The State is divided into three meteorological zones viz., North Interior Karnataka (Zones-1, 2, 3 and 8), South Interior Karnataka (Zones-4, 5 and 6)

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and Coastal Karnataka (Zones-9 and 10). Coastal Karnataka with an average annual rainfall of 3456 mm is one of the rainiest regions in the country. Contrasting to this, the region of South Interior Karnataka and North Interior Karnataka receive only 1286 and 731 mm of average annual rainfall respectively. Out of 1248 mm of average annual rainfall of the State, about 886 mm (71%) was received during the period October-December (North-East monsoon) and only 149 mm (12%) during January to May. June receives highest monthly rainfall of 283 mm followed by 190 mm in August. The average annual rainfall in the districts of Karnataka varies from 562 mm in the Bagalkot district to 4119 mm in the Udupi district. Bagalkot, Chitradurga and Koppal are the districts which receive the least rainfall whereas Uttara Kannada, Dakshina Kannada, Chickmagalur and Udupi districts receive the heaviest rainfall.

In total, the crop growth period in rainfed areas extends from June to October. There is definite declining trend in rainfall in Kodagu, Chikkamagalur and South Canara districts. Few districts of the State have shown increasing trend in the annual rainfall. Bangalore, Kolar and Tumkuru districts have shown increasing trend in the annual rainfall. Though the onset of monsoon remains during the 1st week of June, the adequate rainfall for crop growing period is shifted by about 15 to 20 days. Hence, crop growing season itself has shifted.

The climatic factors play an important role in agricultural productivity and sustainability of water bodies around a region. The study of variability in weather parameters will reflect on the planning of agricultural operations. There are many studies relating to variability in climatic factors. Prominent among them by Indrani and Al-tabbaa (2009), Mishra and Norman (2009), Rejegovda *et al.*, (2009, 2010), Hanumanthappa *et al.*, (2010), Halikatti *et al.*, (2010), Rao *et al.*, (2010), Srivastava *et al.*, (2010) and Yengoh *et al.*, (2010). In the present investigation, variability in weather parameters was studied at Kathalagere station of Karnataka State.

II. MATERIAL AND METHODS

The daily data of weather parameters for the period from 1984 to 2013 were collected from the Zonal Agricultural Research Station (ZARS), Kathalagere. The Kathalagere region is located near to Davanagere about 16 kilometres, belongs to Channagiri taluk of Davanagere district of Karnataka State. It is the administrative headquarters of Davanagere District, positioned at the geographical Centre of the State of Karnataka. The Kathalagere region is surrounded by Channagiri, Davanagere, Harihara and Honnali of Davanagere district. The region is at the center of Karnataka, located 14° 17' N latitude, 75° 50' longitude and 602.5 meters (1,977 ft) above sea level. Davanagere district receives an average annual rainfall of 644 mm. The weather parameters considered were: X₁: Maximum temperature (°C), X₂: Minimum temperature (°C), X₃: Relative humidity (%), X₄: Rainfall (mm), X₅: Evaporation (mm) and X₆: Sunshine (hrs).

The descriptive statistics such as Mean, Median, Standard Deviation (SD) and Coefficient of Variation (CV) were computed and used to study the variability of the weather parameters at selected location. Trend analysis was carried out by fitting suitable polynomials for each of the weather parameters during study the period.

III. RESULTS AND DISCUSSION

The descriptive statistics of weather parameters are presented in Table-1. The result shows that there was wide variations in rainfall (CV = 26.17%). Whereas less variability was seen with respect to other climatic factors such as mean maximum temperature (CV = 2.88%), mean minimum temperature (CV = 6.99%), mean relative humidity (CV = 4.57%), mean evaporation (CV = 5.77%) and mean sun shine hours (CV = 5.56%).

Also it was observed that the highest maximum temperature recorded to be 32.8^oC during the year 1986 followed by 32.7^oC in the year 2012 where as the lowest maximum temperature was observed to be 29^oC during the year 1990. The results revealed that the highest among the minimum temperature was recorded to be 21.5^oC and lowest was 15.8^oC during the years 2005 and 1992 respectively. The relative humidity was found to be maximum with 73.5% and the minimum with 62.1% during the years 2013 and 1985 respectively.

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The results revealed that the highest and the lowest rainfalls recorded to be 1200.1mm and 388.6mm during the years 2010 and 2003 respectively. There was wide variation in rainfall (26.17%) during the study period.

The evaporation was maximum at 5.99mm and minimum at 4.5mm during the years 2009 and 2003 respectively.

The results revealed that the maximum sun shine hours recorded to be 8.2 hours and minimum was 6.5 hours during the years 2011 and 1998 respectively.

To model temporal variations in weather parameters

The temporal variations in weather parameters over the study period were carried out by fitting suitable polynomial equations (Table – 2). It was observed that the parameters such as minimum temperature, relative humidity, evaporation and sun shine hours fitted well with a 5th degree polynomial having R² values of 0.57, 0.45, 0.53 and 0.44 respectively. However, the parameters such as maximum temperature and rainfall fitted well with 6th degree polynomial equations whose R² values are 0.32 and 0.40 respectively.

The graphs of the fitted equations of weather parameters are presented in Fig. 1. From the graph, it was found that the maximum temperature, minimum temperature, relative humidity, evaporation and sun shine hours indicated an increasing trend. However, rainfall showed a decreasing trend. Further, climatic factors such as maximum temperature, minimum temperature, relative humidity, evaporation and sun shine hours showed positive trend whereas rainfall, indicated a negative trend.

Table -1 : Descriptive statistics of weather parameters of Kathalagere station

	Mean T _{Max}	Mean T _{Min}	Mean R H	Total RF	Mean ET	Mean SS
1984	30.0	17.6	66.1	877.5	4.7	6.8
1985	31.6	18.2	62.1	738.1	4.7	6.8
1986	32.8	18.5	68.3	854.7	4.9	7.0
1987	31.1	17.7	67.5	841.6	5.0	7.1
1988	30.7	18.0	68.8	795.2	5.2	7.2
1989	30.1	17.9	66.4	805.3	5.1	7.2
1990	29.0	18.2	65.4	743.8	5.2	7.3
1991	30.2	18.2	62.4	821.9	5.4	7.4
1992	31.5	15.8	65.9	795.3	5.0	7.5
1993	30.7	18.0	68.0	782.4	5.1	7.5
1994	31.6	17.1	70.8	718.9	5.1	7.4
1995	32.4	18.2	71.4	656.0	5.3	7.6
1996	31.3	17.5	70.4	592.4	5.3	7.5
1997	31.7	18.0	72.6	625.5	5.4	7.5
1998	31.5	18.6	71.4	610.8	5.6	6.5
1999	30.4	17.3	72.7	449.5	5.9	6.6
2000	30.7	16.7	69.2	699.2	5.0	6.7
2001	31.9	17.6	65.4	547.5	5.2	6.6
2002	31.6	19.4	63.5	559.9	5.3	7.8
2003	31.8	20.6	66.0	388.6	4.5	7.0
2004	31.7	20.4	65.9	524.8	4.8	6.9

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2005	31.6	21.5	65.8	1138.7	4.9	7.0
2006	31.3	19.6	65.0	701.5	5.0	7.1
2007	30.4	18.2	67.3	939.8	5.2	7.1
2008	29.5	19.5	66.1	648.5	5.5	7.1
2009	32.0	20.3	70.3	981.3	5.9	7.1
2010	31.2	19.2	71.5	1200.2	5.2	7.9
2011	31.5	18.4	68.6	453.1	5.4	8.2
2012	32.7	21.0	71.1	590.8	5.9	7.3
2013	32.2	20.7	73.5	607.6	6.0	7.3
MEAN	31.2	18.6	67.9	723.1	5.2	7.2
MIN	29	15.8	62.1	388.6	4.5	6.5
MAX	32.8	21.5	73.5	1200.2	5.9	8.2
STD	0.9	1.3	3.1	189.2	0.3	0.4
CV(%)	2.88	6.99	4.57	26.17	5.77	5.56

Table - 2: Trend equations for different weather parameters.

Weather parameters	Fitted trend equations	R ²
Maximum temperature (°C)	$Y_t = 29.1 + 2.07t - 0.63t^2 + 0.08t^3 - 0.004t^4 - 0.0001t^5 - 0.000001t^6$	0.32
Minimum temperature (°C)	$Y_t = 16.25 + 1.52t - 0.35t^2 + 0.03t^3 - 0.001t^4 + 0.0001t^5$	0.57
Relative humidity (%)	$Y_t = 69.2 - 3.1t + 0.7t^2 - 0.06t^3 + 0.001t^4 - 0.00002t^5$	0.45
Rainfall (mm)	$Y_t = 1047 - 230.9t + 69.2t^2 - 8.7t^3 + 0.5t^4 - 0.01t^5 + 0.0001t^6$	0.40
Evaporation(mm)	$Y_t = 4.72 - 0.02t + 0.03t^2 - 0.002t^3 + 0.0001t^4 - 0.00001t^5$	0.53
Sun shine (hours)	$Y_t = 6.8 - 0.01t + 0.7t^2 - 0.01t^3 + 0.0001t^4 - 0.000004t^5$	0.44

IV. CONCLUSION

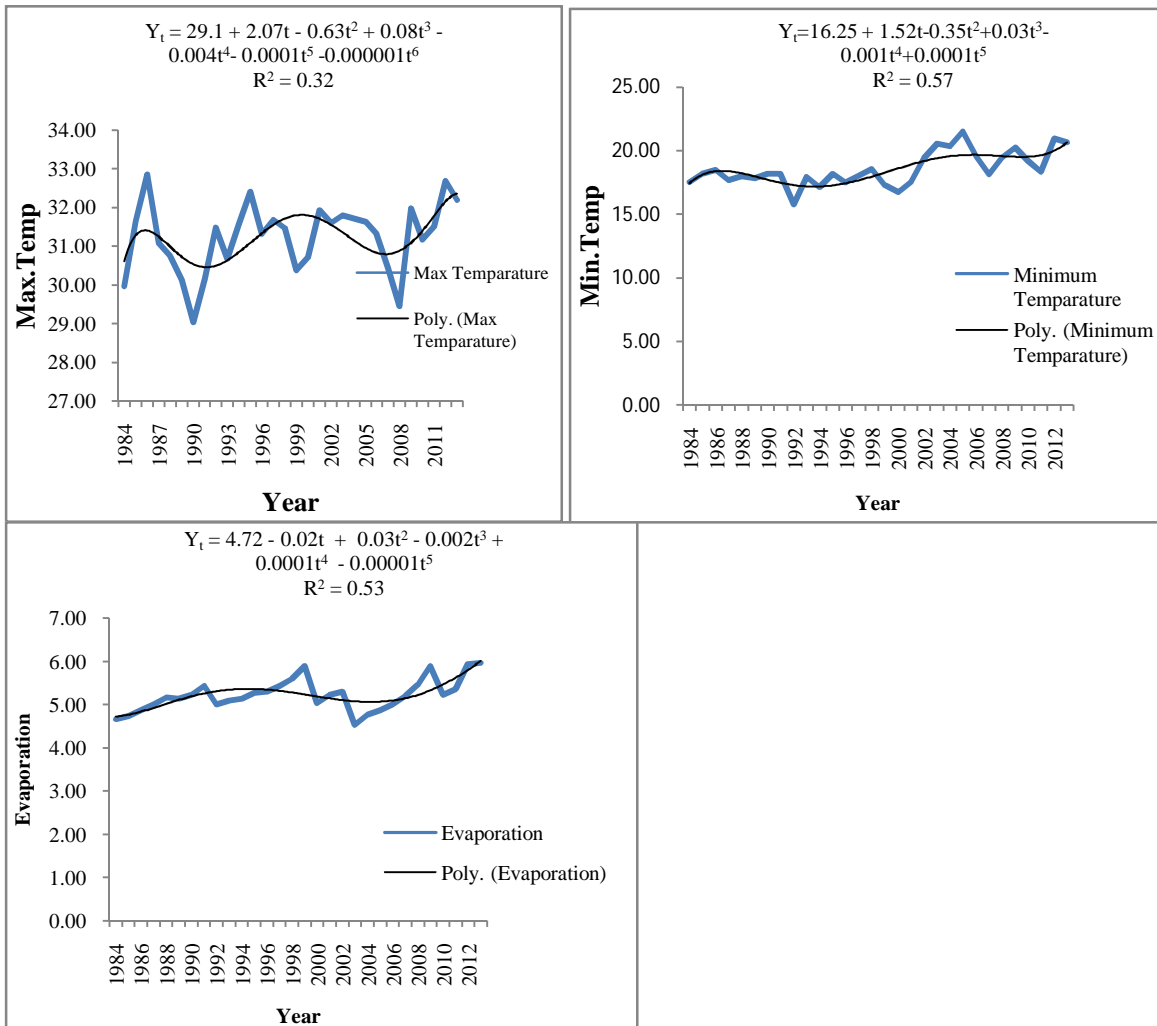
This study has demonstrated that the temporal variability in weather parameters was observed to be highly variable. The results revealed that minimum temperature, relative humidity, evaporation and sun shine hours were found to be best fit with a polynomial of degree 5 whereas maximum temperature and rainfall were found to be best fit with a polynomial of degree 6. Further, among all the weather parameters only rainfall showed a decreasing trend and all other weather parameters were found to be increasing over time.

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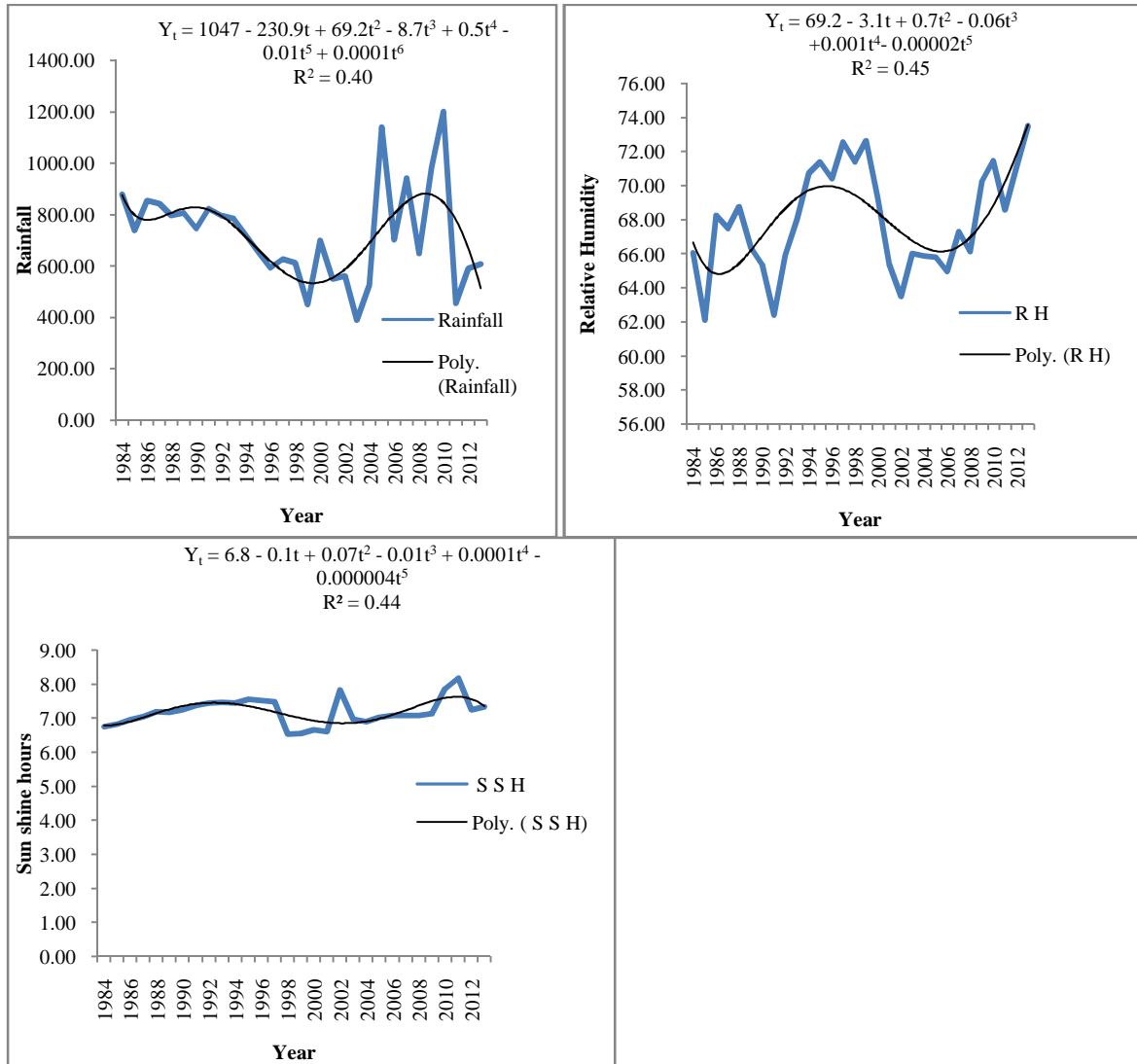
Fig -1: Fitted trend equations for weather parameters of Kathalagere location.



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