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Determination of Reference Evapotranspiration of Harnai and Wakawali station using FAO-56 Penman-Monteith model

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Abstract

The attempt was made for estimating reference evapotranspiration for and Harnai and Wakawali station and also the trends of different meteorological parameters were also studied. The study observed that the reference evapotranspiration for Harnai station was nearly constant, while for Wakawali station it was decreasing by -12.22 mm. The trend of different meteorological parameters showed that for Harnai and Wakawali station annual mean temperature was increasing trend was by 0.008°C and 0.044°C respectively. For Harnai station mean relative humidity was decreasing at the rate of -0.07% per annum and for wakawali station was decreasing at the rate of -0.033% per annum. Average annual wind speed for Harnai station was decreasing by -0.029 km/hr and for Wakawali station was also decreasing by of -0.15 km/hr.It is concluded that reference evapotranspiration for Harnai station was nearly constant throughout the year.

Keywords: Reference evapotranspiration, metrological parameters.

Introduction

Water is scare natural resource and its distribution and its distribution and frequency is eratic in nature therefore it is necessary to use water efficiently for crop production. For optimize and efficient use of water proper scheduling and management was done by many ways[1]. The prediction of crop water demand depends on climatic parameters. The climatic parameter parameters affect the rate of evapotranspiration[2]. There it is necessary to estimate reference evapotranspiration accurately on time basis. For effective planning and implementation of policies on irrigation projects, it is very necessary to compute the crop water requirement in terms of reference evapotranspiration. For accurate computation of crop water requirements a standard, precise and globally acceptable method of estimating reference evapotranspiration i.e. Penman-Monteith (FAO-56, PM) was recommended by many authors. The method predicts reference evapotranspiration based on different climatic parameters and each parameter had individual effect on reference evapotranspiration[8].

Material and Methods

Metrological data was collected for Harnai from 1957- 1972 and for Wakawali from 1990-2009 for analysis. The Penman Monteith method was used to predict the daily reference evapotranspiration for both of the stations.

$$ET_o = \frac{0.408\Delta(R_n - G) + \gamma \frac{900}{T+273} u_2 (e_s - e_a)}{\Delta + (1 + 0.34 u_2)} \quad (1)$$

Where: ET_o = Reference evapotranspiration [mm day^{-1}], R_n = Net radiation at the crop surface [MJ m^{-2} day^{-1}], G =Soil heat flux density [MJ m^{-2} day^{-1}], T = Mean daily air temperature at 2m height [ºC], u_2 = Wind sped at 2m height [m s-1], e_s = Saturation vapour pressure [kPa], e_a =Actualvapour pressure deficit [kPa], e_s-e_a = Saturation vapour pressure deficit [kPa], Δ = Slope vapour pressure curve [kPa ºC-1], γ = Psychrometric constant [kPa ºC-1].

The trend of différent climatic paramètres was also studied using simple trend analysis[3and 4]

Results and Discussion

The results obtained for various parameters at different stations discussed as follows.

Reference Evapotranspiration: The reference evapotranspiration for Harnai and Wakawali station was calculated using Penman Monteith method. It was observed that the reference evapotranspiration for Harnai and Wakawali station was ranges from 1101.09 mm to 1195.69 mm and 1237.03 mm to1512.48 mm. The mean value for Harnai is 1137.77 mm and for Wakawali is 1362.54 mm. Similarly, seasonal that is for Summer season for Harnai 392.24 mm and for Wakawali 562.42mm, and Monsoon season contributes 18.8 mm more than winter and for wakawali station in monsoon and winter 382.97 mm and 418.5 mm respectively. The trend of both the stations for Reference evapotranspiration is given in figure[5].

Wind Speed: The trend of wind speed of the Harnai and Wakawali station was studied for the period of 1957- 1972 and 1990-2009. It was observed that the mean wind speed for Harnai and Wakawali was 3km/hr and 3.30 km/hr respectively. Wind speed is more in summer season followed by the winter season.

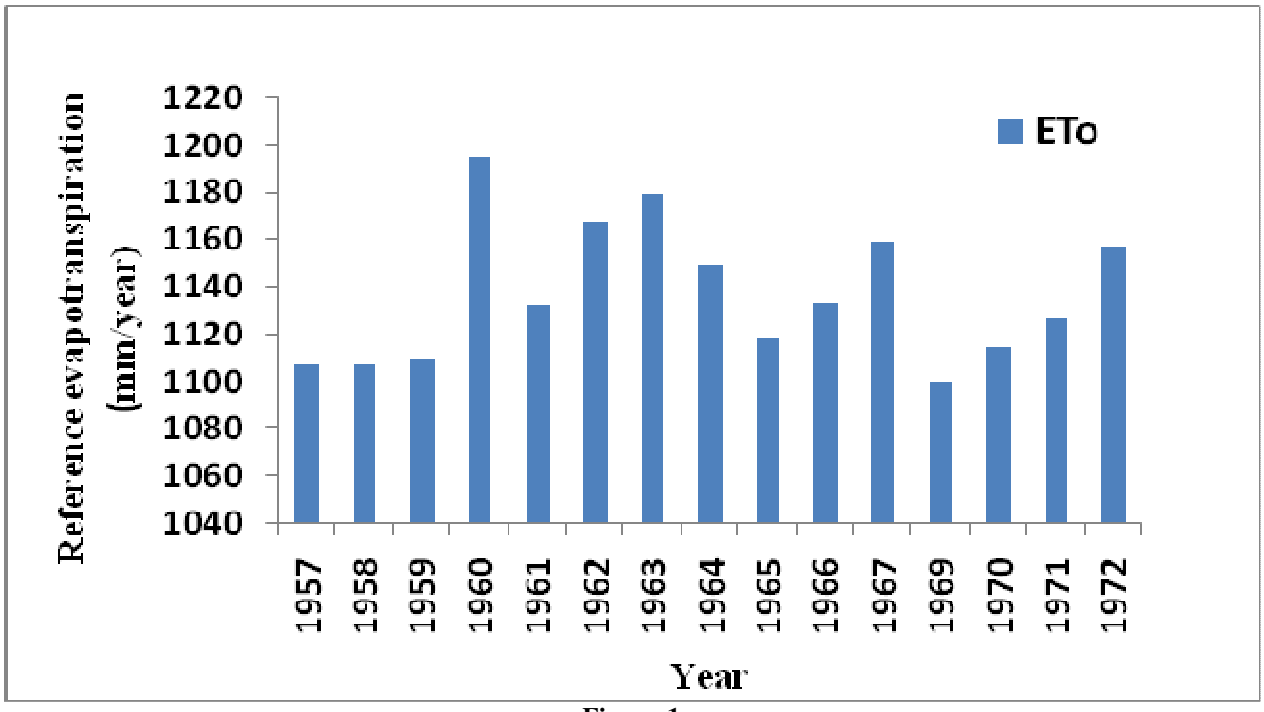

Figure-1
Trend of annual reference evapotranspiration for Harnai station

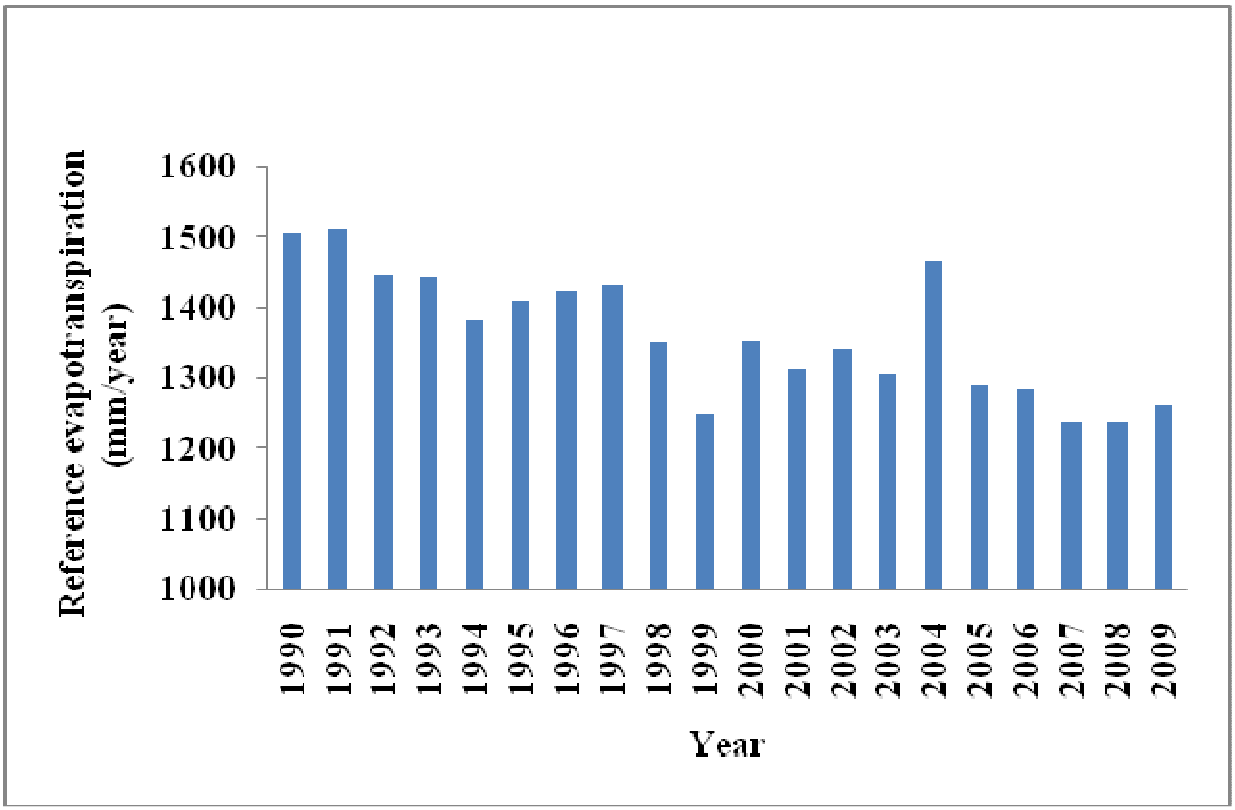

Figure-1
Trend of annual reference evapotranspiration for Wakawali station

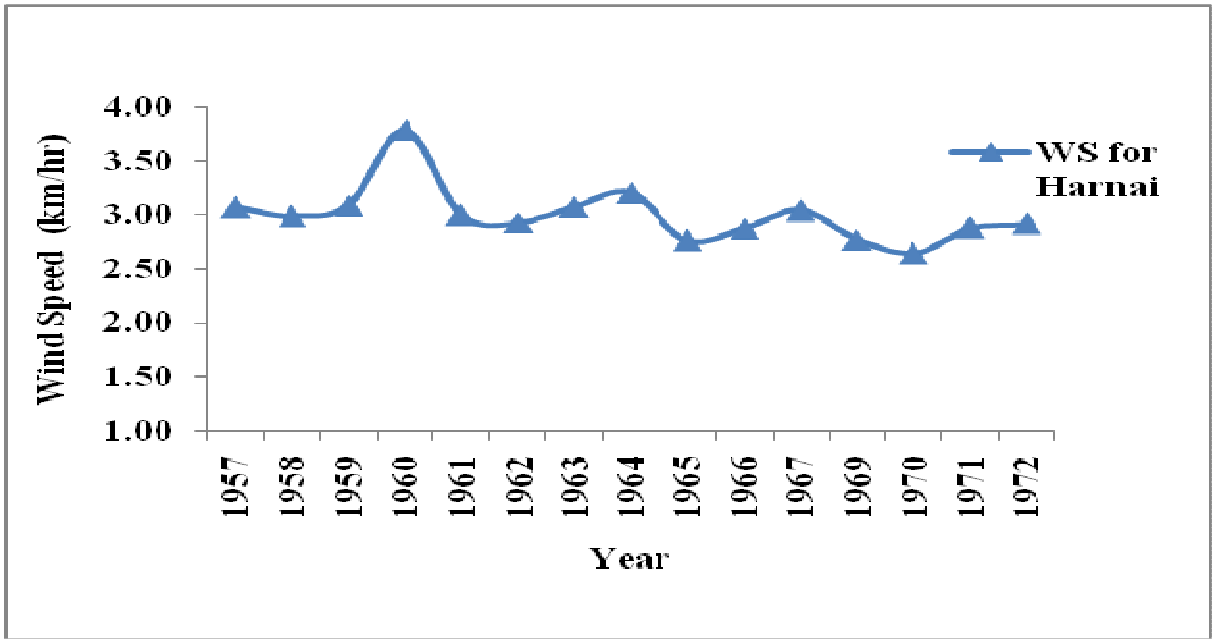

Figure-2.1
Trend of wind speed for Harnai station

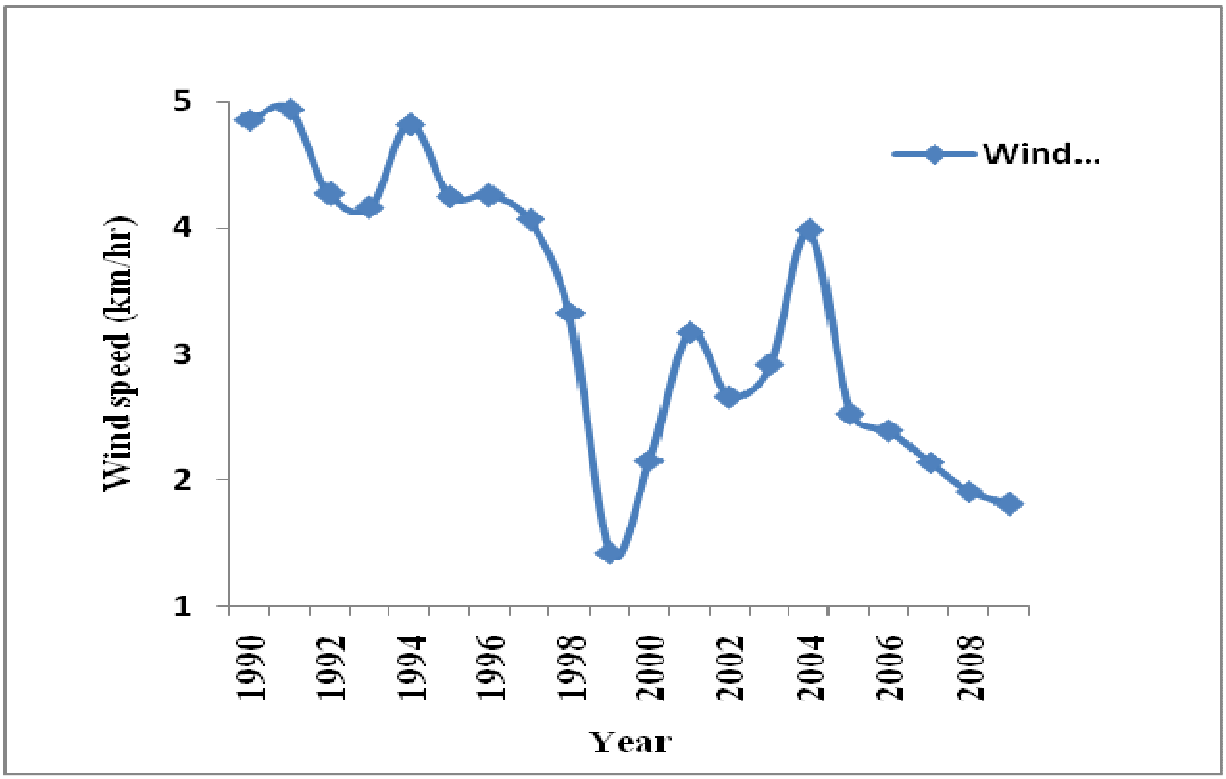

Figure 2.2
Trend of wind speed for Wakawali station

Temperature: The temperature analysis for both stations was done for maximum temperature, minimum temperature, and mean temperature. The annual average maximum temperature of Harnai and Wakawali station were 29.42° C and 33.12 °C respectively. From figure 3.1 and figure 3.2 it is observed that the increasing trend was found in the annual mean maximum temperature[6].

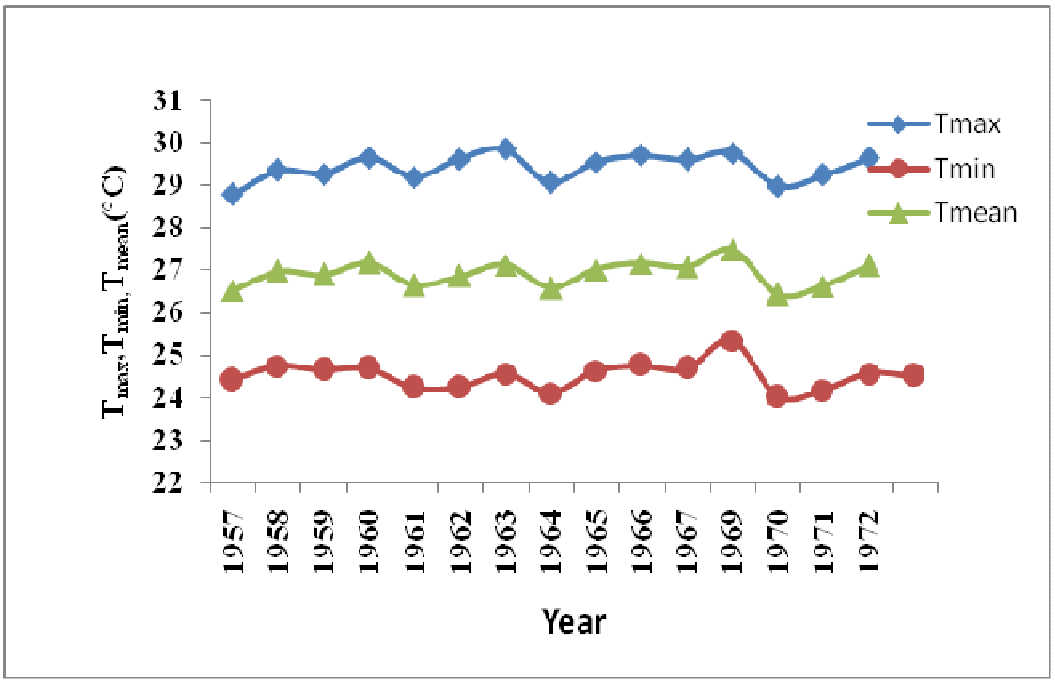

Figure 3.1
Trends of maximum, minimum and mean Temperature for Harnai station

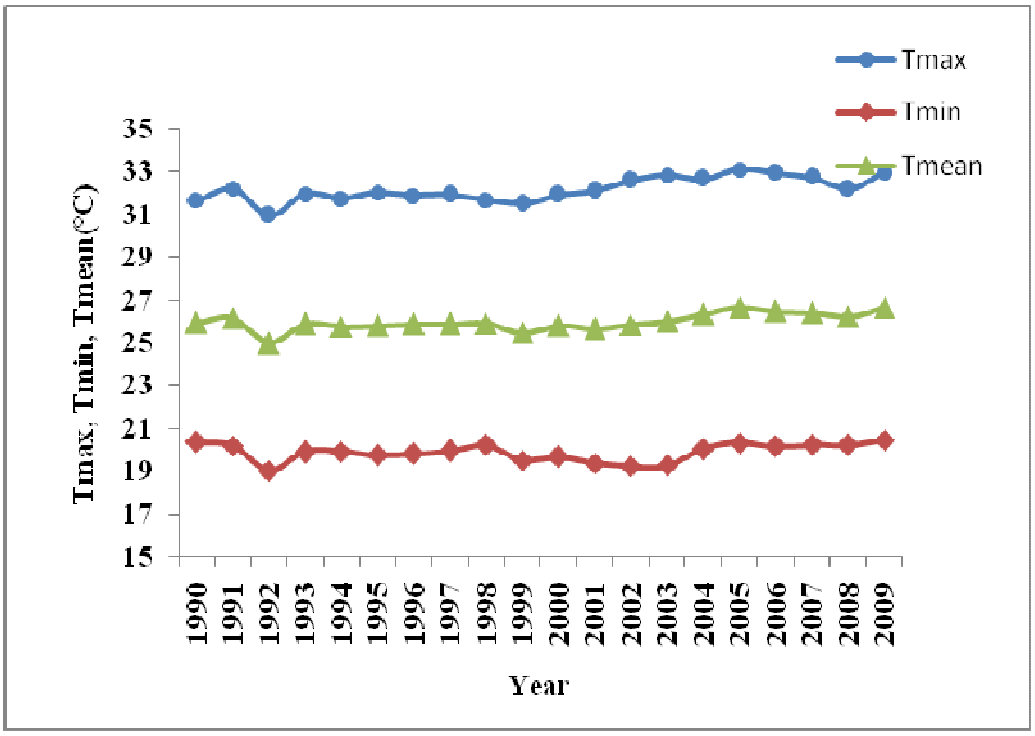

Figure 3.2
Trends of maximum, minimum and mean Temperature for Wakawali station

Relative Humidity: The relative humidity analysis for Harnai and Wakawali was done for maximum relative humidity, minimum relative humidity and mean relative humidity for period of 1957-1972 and 1990-2009. The annual mean relative humidity of Harnai and Wakawali station was found 79.60% and 88.37% respectively[7].

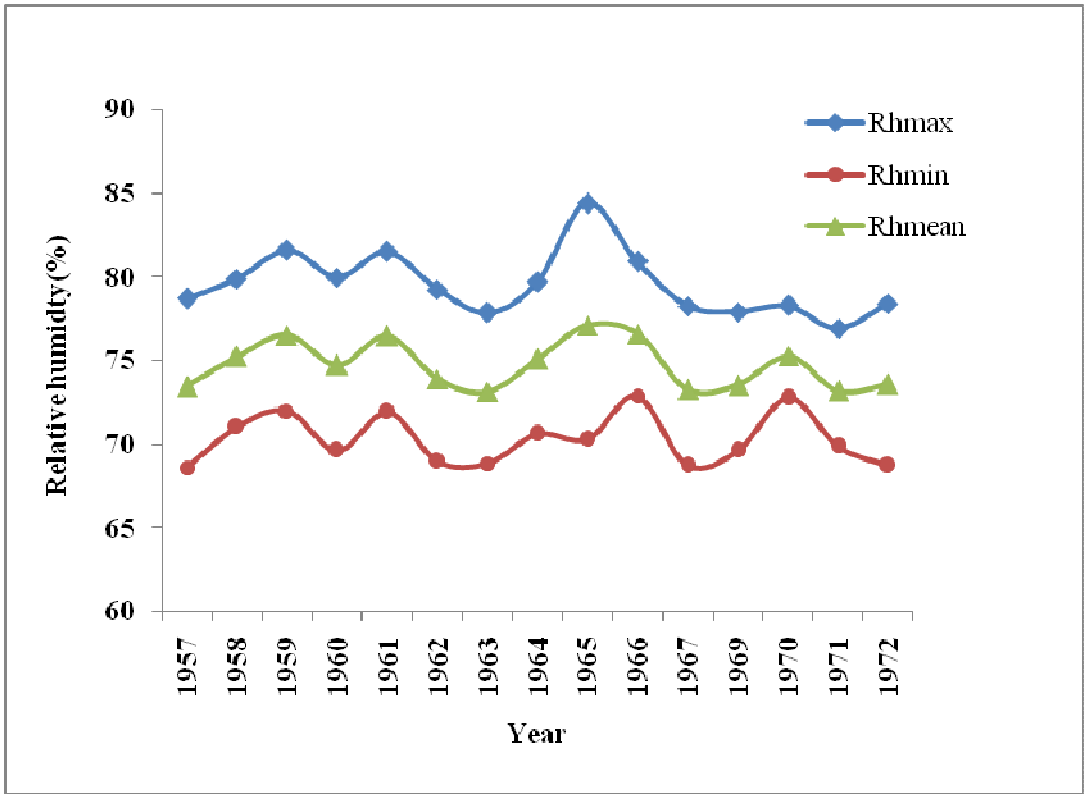

Figure 4.1
Trends of maximum, minimum and mean relative humidity for Harnai station

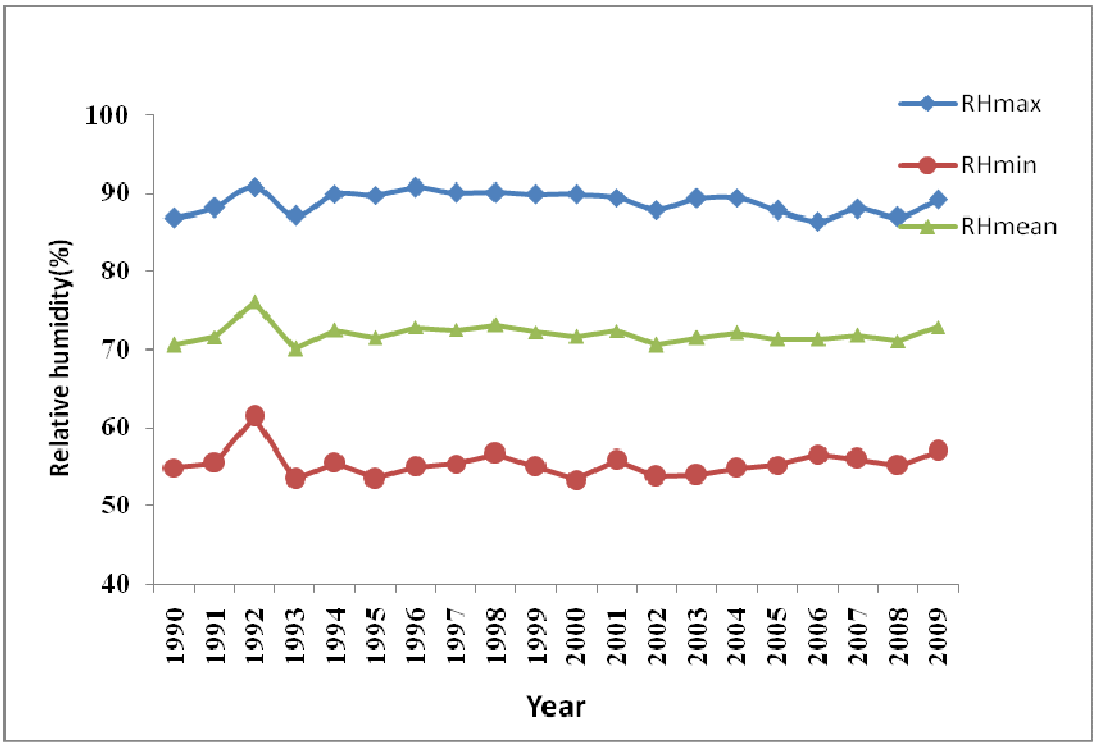

Figure 4.2
Trends of maximum, minimum and mean relative humidity for Wakawali station

Conclusion

The annual reference evapotranspiration was higher for Wakawali station than Harnai station due to high wind speed and higher gradient of temperature and relative humidity[7]. For Harnai and Wakawali station only average annual mean temperature was increasing trend while mean relative humidity, wind speed was decreasing[4].

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