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Estimation of Reference Evapotranspiration in Bhavanisagar Block of Tamil Nadu Using FAO ETo Calculator

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Short Research Article

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ABSTRACT

The FAO Penman-Monteith equation is used by the ETo calculator software to calculate reference evapotranspiration – ETo from meteorological data. FAO chose this technique as the standard because it is physically based, roughly approximates grass ETo in the studied region, and explicitly considers both physiological and aerodynamic aspects. The application can handle climate data on a daily, ten-day, and monthly basis. The data may be supplied in a variety of units, and it can be analyzed using regularly used meteorological parameters. In this study, ETo calculator version 3.2 is used to estimate the ETo in Bhavanisagar. The results revealed that, it is possible to estimate ETo by using the ETo calculator. The concept of the reference evapotranspiration was introduced in this study and the result obtained are used further to estimate the evaporative demand of the atmosphere independently of crop type, crop development and management practices.

Keywords: ETo calculator; potential evapotranspiration; southwest monsoon; northeast monsoon.

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1. INTRODUCTION

The FAO's Land and Water Division created the ETo calculator software. Its main purpose is to compute FAO-recommended reference evapotranspiration (ETo) [1]. ETo is the evapotranspiration rate from a non-water-scarce reference surface. The reference surface is a huge, homogeneous grass field that is used all throughout the world. The reference crop is kept short, properly hydrated, and actively developing under ideal agronomic circumstances [2]. The FAO Penman-Monteith equation is used by the ETo calculator to calculate ETo from meteorological data [3]. FAO chose this technique as the standard because it is physically based, roughly approximates grass ETo in the studied region, and explicitly considers both physiological and aerodynamic aspects. The application can handle climate data on a daily, ten-day, and monthly basis [4]. The data may be supplied in a variety of units, and it can be analyzed using regularly used meteorological parameters. When data for some meteorological variables is absent, processes are utilised to estimate missing climatic data using temperature data or specified climatic circumstances, as detailed in the Irrigation and Drainage Paper No. 56: "Crop Evapotranspiration" [1]. Even if the information just provides maximum and lowest air temperatures, credible estimates for ten-day or monthly ETo can be obtained [5]. The FAO-ETo calculator version 3.1 was used to estimate reference evapotranspiration in the Bhavanisagar block in this study.

2. MATERIALS AND METHODS

2.1 Study Area

Bhavanisagar is a revenue block in the Erode district of Tamil Nadu, India. Bhavani River, a major tributary of the Kaveri River originates from Nilgiri hills of the Western Ghats flows through this block and forms the major source of irrigation in this area. Bhavanisagar dam is located on the river Bhavani and the dam is used to divert water to the lower Bhavani Project for irrigating dry parts of the district (Fig. 1).

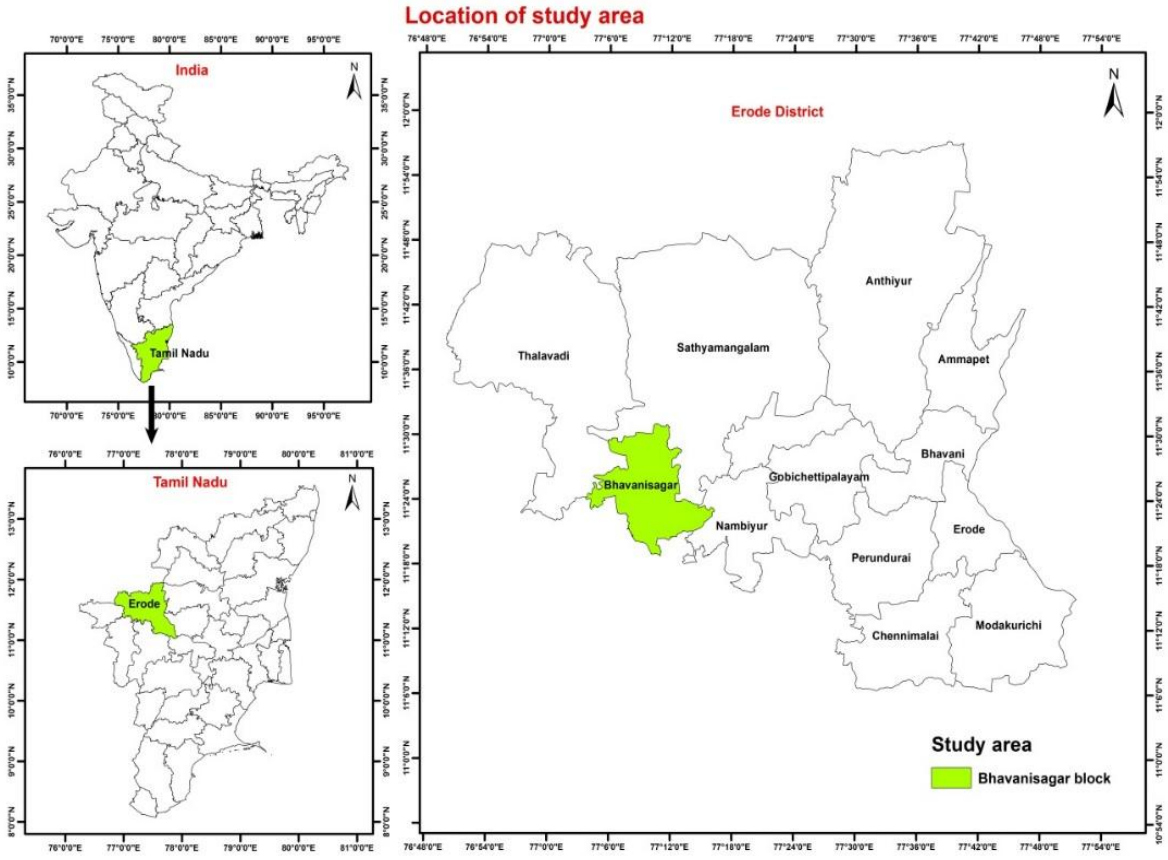

Fig. 1. Study area of Bhavanisagar block

2.2 Weather Data and Estimation of Reference Evapotranspiration

Indian Meteorological Department (IMD) data from 1980 to 2020 was used in this study.

The Penman - Monteith equation is used widely for computing the ETo, recommended by the FAO in 1998 (equation 1). Many studies found that the Penman-Monteith is more appropriate for many region [6]. In PAP basin, total ETo was estimated through built in FAO Penman – Monteith equation as shown below using ETo calculator version 3.2 developed by the FAO [7].

$$ET_0 = \frac{0.408\Delta(R_n - G) + \gamma \frac{900}{T+273} U_2 (es - ea)}{\Delta + \gamma(1 + 0.34U_2)} \quad \text{(Equation 1)}$$

Where,

ETo is the reference evapotranspiration rate (mm day^{-1}); G is the soil heat flux density (MJ m^{-2} day^{-1}); T is the mean daily air temperature at 2 m height (^oC); U_2 is the wind speed at 2 m height (m s^{-1}); es is the saturation vapour pressure (KPa); ea is the actual vapour pressure (KPa); Δ is slope of vapour pressure curve (KPa $^0C^{-1}$); γ is the psychrometric constant (KPa $^0C^{-1}$); Rn is the net radiation at the crop surface (MJ m^{-2} day^{-1}).

3. RESULTS AND DISCUSSION

The average annual ETo of Bhavanisagar was 3.9 mm day^{-1}. The ETo values ranged between 3.8 to 4.4 mm day^{-1}. While analyzing the seasonal ETo variations over Bhavanisagar, the average ETo value of southwest monsoon season (Fig. 2) was 3.6 mm day^{-1}, and the ETo values varied between 3.4 to 4 mm day^{-1}. In northeast monsoon season (Fig. 3), the average ETo value was 3.4 mm day^{-1}, and it is varied between 3.2 to 3.7 mm day^{-1}. In winter season (Fig. 4) the average ETo value was 4.0 mm day^{-1} and varied between 3.6 to 4.3 mm day^{-1}. During the summer season (Fig. 5), the average ETo was 4.6 mm day^{-1}, and it was varied between 4.3 to 5.1 mm day^{-1}. While comparing to all the four seasons, the ETo was higher during summer season, it is due to increased temperature during this season, followed by winter season it may due to the diurnal variation prevailed in the area, followed by southwest monsoon season. The northeast monsoon season had least ETo in the Bhavanaisagar, it may due to the rainfall effect, while northeast monsoon is considered to the major rainfall season in Bhavanaisagar.

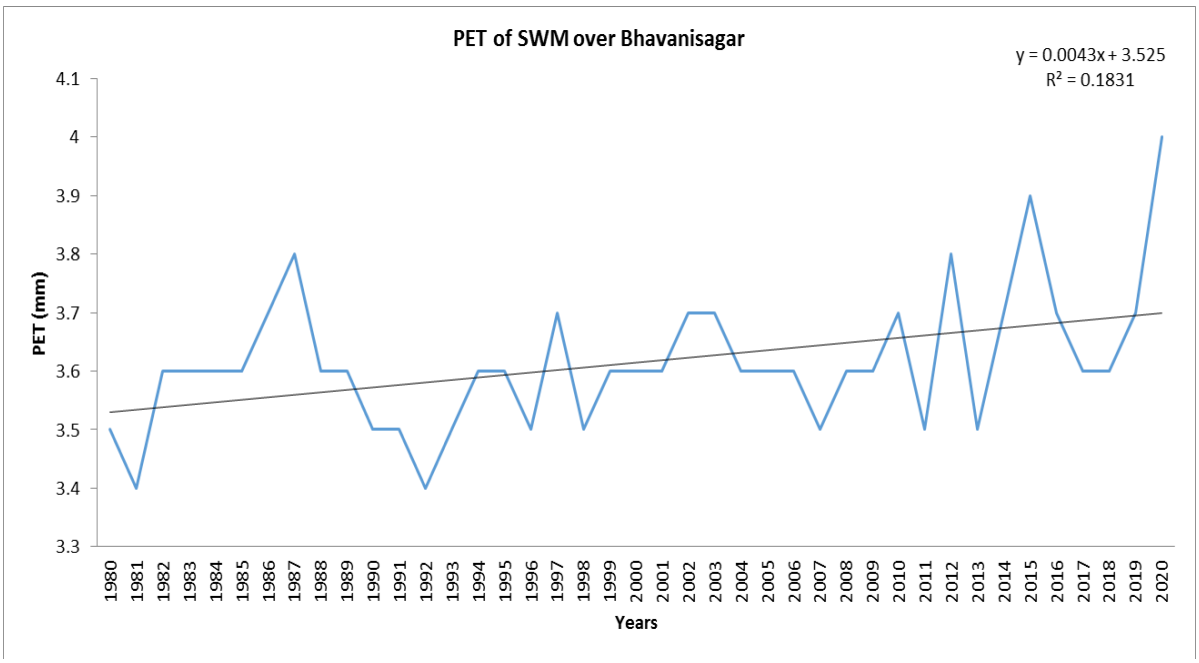

Fig. 2. Reference evapotranspiration in the southwest monsoon season over Bhavanisagar

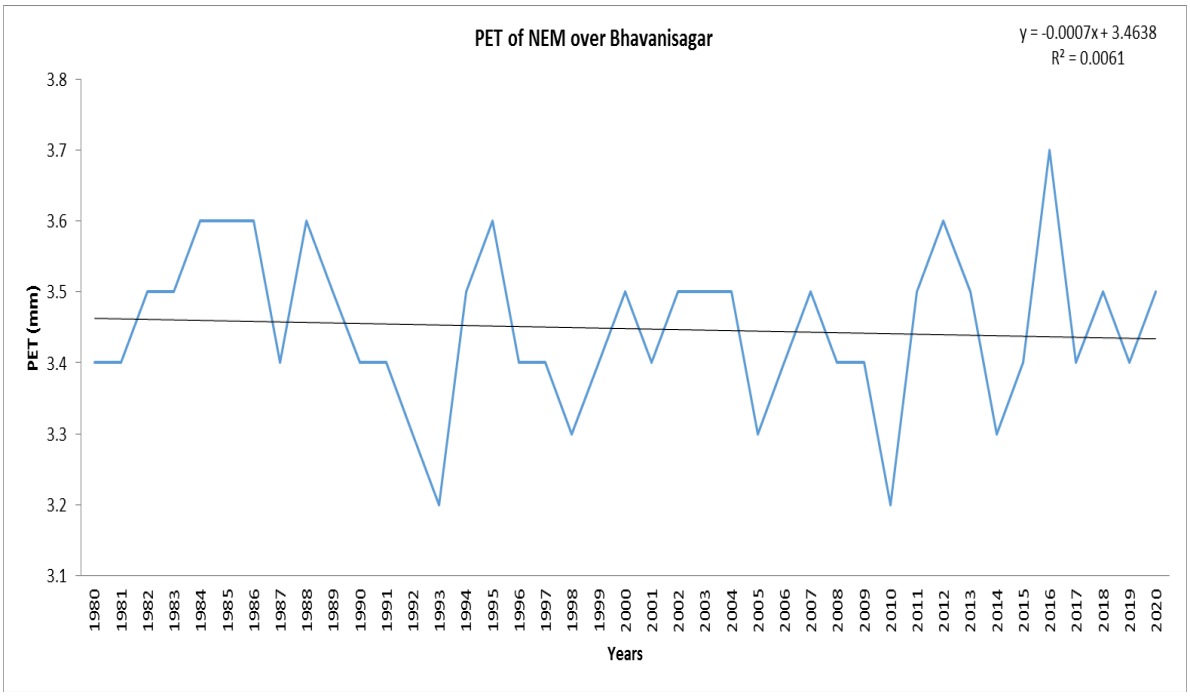

Fig. 3. Reference evapotranspiration in the northwest monsoon season over Bhavanisagar

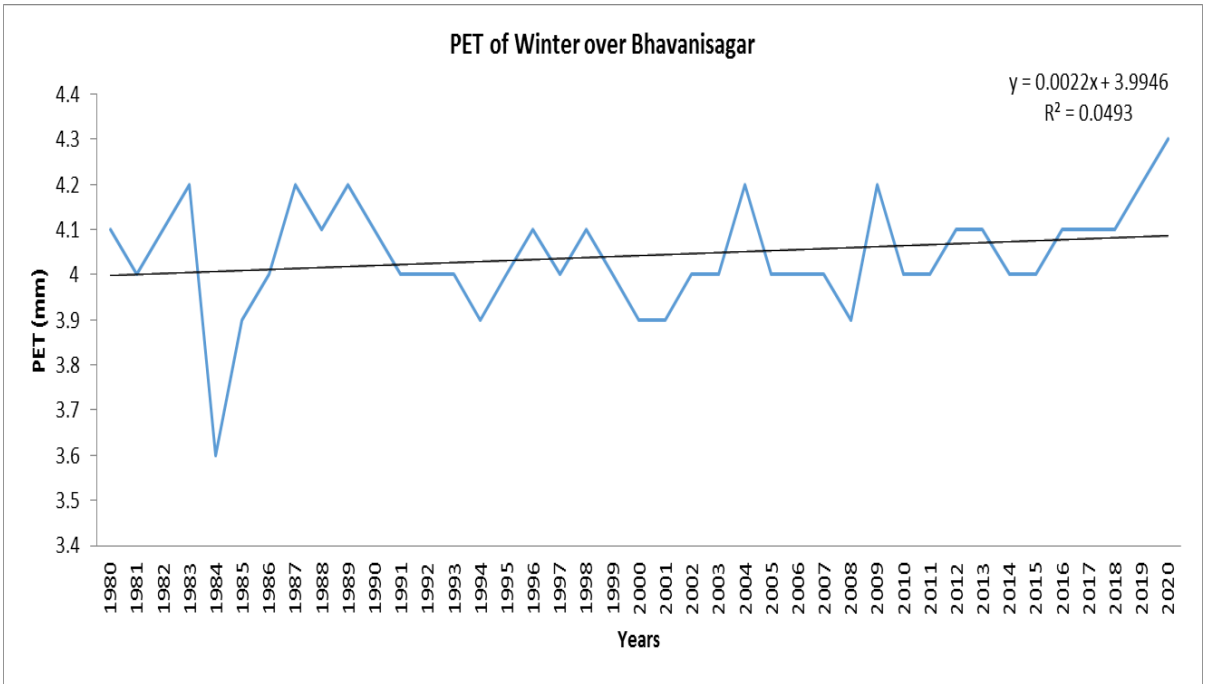

Fig. 4. Reference evapotranspiration in the winter monsoon season over Bhavanisagar

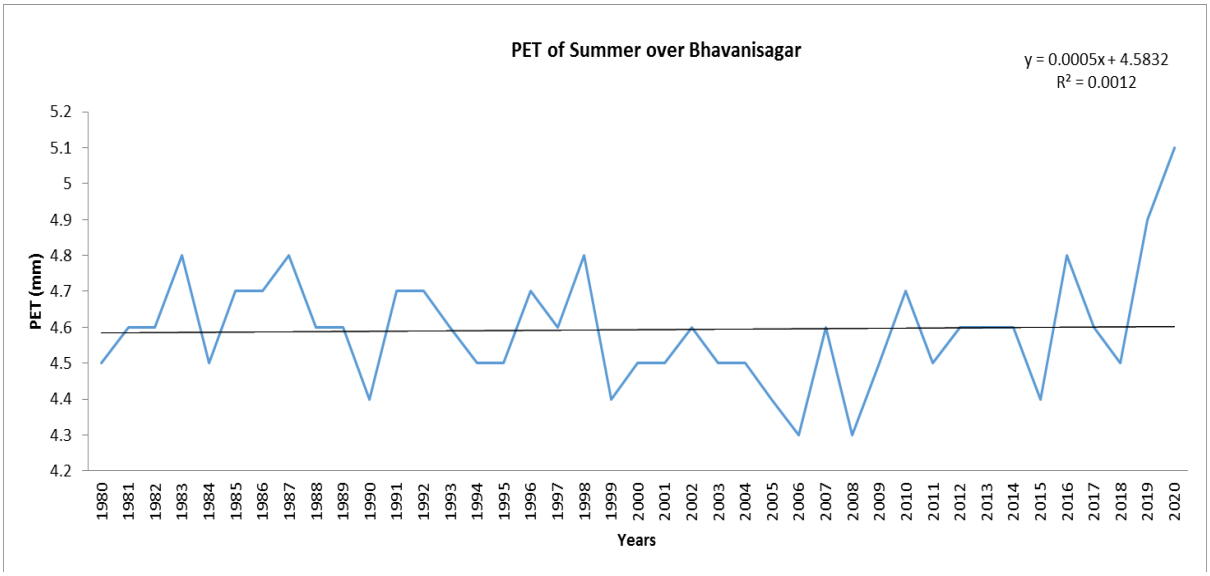

Fig. 5. Reference evapotranspiration in the summer season over Bhavanisagar

4. CONCLUSION

The results revealed that ETo calculator version 3.2 is found be estimating the Reference Evapotranspiration. The concept of the reference evapotranspiration was introduced in this study and the result obtained are used further to estimate the evaporative demand of the atmosphere independently of crop type, crop development and management practices.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Valle Júnior LC, Vourlitis GD, Curado GL, Palácios LFA, Nogueira RDS, Lobo JDS, Rodrigues TR. Evaluation of FAO-56 procedures for estimating reference evapotranspiration using missing climatic data for a Brazilian tropical savanna. Water. 2021;13(13):1763.
2. Jabloun MD, Sahli A. Evaluation of FAO-56 methodology for estimating reference evapotranspiration using limited climatic data: Application to Tunisia. Agricultural Water Management. 2008;95(6):707-715.
3. Alexandris S, Stricevic R, Petkovic S. Comparative analysis of reference evapotranspiration from the surface of rainfed grass in central Serbia, calculated by six empirical methods against the Penman-Monteith formula. European Water. 2008;21(22):17-28.
4. Eilers VHM, Carter RC, Rushton KR. A single layer soil water balance model for estimating deep drainage (potential recharge): An application to cropped land in semi-arid North-east Nigeria. Geoderm. 2007;140(1-2):119-131.
5. Raes D, Munoz G. The ETo calculator. Reference Manual Version, 3. 2009;480.
6. Allen RG, Pereira LS, Raes D, Smith M. FAO Irrigation and drainage paper No. 56. Rome: Food and Agriculture Organization of the United Nations. 1998; 56(97):e156.
7. López-Moreno JI, Hess TM, White S. Estimation of reference evapotranspiration in a mountainous mediterranean site using the Penman-Monteith equation with limited meteorological data; 2009.

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