In this study 5 temperature-based, 2 radiation-based, 9 mass transfer based techniques have been assessed in opposition to the FAO 56 PMF method; as well as the good and bad equations have been found using weather details from the Regional Agriculture Research Station, Jagtial, Karimnagar, Tealangana state. The assessed methods were: equations Schendel and Hargreaves M1, M2, M3 and M4 (temperature based), FAO 24 radiation and Priestley-Taylor (radiation based), Dalton, Trabert, Meyer, Rohwer, penman, Albrecht, Brockamp-Wenner, WMO and Mahringer (mass transfer based).

MATERIALS AND METHODS

Study Area and Collection of Weather Data

To understand and evaluate the Evapotranspiration of Karimnagar district of Telangana state is selected as the proposed area of study. It is lies between 18°59' N and 19° N latitude on 79°29'E and 80 º E longitudes. Weather data on daily basis for a period of 21 years (1996-2016), include maximum and minimum temperature; highest as well as least comparative humidity, wind speed, sunshine hours, atmospheric pressure, precipitation along with solar radiation have been gathered from the Regional Agricultural Research station (RARS), Jagtial, Telangana state.

Methods used for Estimation of Reference Evapotranspiration

FAO 56 Penman- Monteith Formula

$$ET_0 = \frac{0.408\,\Delta(R_n - G) + \gamma\left(\frac{900}{T+273}\right)u_2(e_s - e_a)}{\Delta + \gamma(1 + 0.34u_2)} \quad (1)$$

Where ET_0 was citation evapotranspiration (mm day^{-1}), R_n was net radiation in crop surface (MJ m^{-2} day^{-1}), G was soil heat flux density (MJ m^{-2} day^{-1}), T was mean daily air temperature (° C), U_2 was wind rate in 2 m height (m s^{-1}), e_s was saturation vapour pressure (kPa), e_a was real vapour pressure (kPa), e_s-e_a was saturation vapour pressure shortfall (kPa), Δ was incline vapour pressure curve (kPa° C^{-1}), as well as γ was psychometric continuous (kPa°C^{-1}).

Temperature-Based Methods

Hargreaves Equations

$$ET_0 = 0.408 \times 0.0030 \times (T_a + 20.0) \times (T_{max} - T_{min})^{0.4} \times R_a \quad (2)$$

$$ET_0 = 0.408 \times 0.0025 \times (T_a + 16.8) \times (T_{max} - T_{min})^{0.5} \times R_a \quad (3)$$

$$ET_0 = 0.408 \times 0.0013 \times (T_a + 17) \times (T_{max} - T_{min} - 0.0123P)^{0.76} \times R_a. \quad (4)$$

$$ET_0 = 0.408 \times 0.0023 \times (T_a + 17.8) \times (T_{max} - T_{min})^{0.424} \times R_a \quad (5)$$

Where ET_0 is in mm day^{-1} and p was monthly rainfall (mm). The coefficient of 0.408 was for transforming MJ m^{-2} day^{-1} into mm day^{-1} (Allen et al. 1998). TheEqs.2, 3, 4 and 5 was described from now on as Hargreaves-M1, Hargreaves-M2, Hagreaves-M3 and Hagreaves-M4 respectively.

Schendel (1967)

$$ET_0 = \frac{16\,T_a}{RH} \quad (6)$$

Where ET_0 is in mm day^{-1} and T_{av} was mean air temperature in °C.

Radiation-based Methods

FAO24-RadiationMethod

$$ET_0 = a\left(\frac{\Delta}{\Delta+\gamma}R_s\right) + b \quad (7)$$

Where R_s was solar radiation in mm day^{-1}, "a" and "b" were adaptation elements. The value of "a" differs with mean comparative humidity as well as day time wind speed, given as:

$$a = 1.066 - 0.13 \times 10^{-2}RH + 0.045U_d - 0.20 \times 10^{-3}RH \times U_d - 0.315 \times 10^{-4}RH^2 - 0.11 \times 10^{-2}U_d^{\ 2} \quad (8)$$

Where RH was mean comparative humidity in percent and U_d was mean day time wind rate sec^{-1} and value of adjustment factor "b" is -0.3 mm day^{-1}.

Priestley-Taylor

$$ET_0 = 1.26\left(\frac{\Delta}{\Delta+\gamma}\frac{R_n - G}{\lambda}\right) \quad (9)$$

Where ET_0 is in mm day^{-1}, Δ was incline of saturation vapour pressure-temperature curve (kPa$^{\circ}$ C^{-1}), R_n was net radiation (MJ m^{-2} day^{-1}) and G was soil hest flux (MJ m^{-2} day^{-1}).

Mass Transfer-Based Methods

Following nine mass transfer-based equations have been utilized:

Method	Equation	
Dalton (1802)	$ET_0 = (0.3648 + 0.07223u)(e_s - e_a)$	... (10)
Trabert (1896)	$ET_0 = 0.3075 \times \sqrt{u}(e_s - e_a)$	... (11)
Meyer (1926)	$ET_0 = (0.375 + 0.05026u)(e_s - e_a)$	... (12)
Rohwer (1931)	$ET_0 = 0.44\ (1 + 0.27u)(e_s - e_a)$	... (13)
Penman (1948)	$ET_0 = 0.35\left(1 + \frac{0.98}{100u}\right)(e_s - e_a)$	...(14)
Albrecht (1950)	$ET_0 = (0.1005 + 0.297u)(e_s - e_a)$	...(15)
Brockamp-Wenner (1963)	$ET_0 = 0.543(u)^{0.456}(e_s - e_a)$	...(16)
WMO (1966)	$ET_0 = (0.1298 + 0.0934u)(e_s - e_a)$	...(17)
Mahringer (1970)	$ET_0 = 0.15072 \times \sqrt{3.6u}(e_s - e_a)$	... (18)

In all the above equations (Eqs.10- 18), ET_0 is in mm day^{-1}; e_s along with e_a were saturation and real vapour pressure respectively and u is wind rate. The values of e_s along with e_a were in hPa in all equations (except Rohwer and penman models, where it was in mmHg), u is in m s^{-1} in every equations (excluding penman model, where it was in miles day^{-1}).

STATISTICAL ANALYSIS

To check and assess the function of dissimilar temperature, radiation, mass transfer-based ET_0 techniques in differentiation with FAO 56 PMF technique. By using Root Mean Square error (RMSE), Mean Bias Error (MBE), coefficient of determination (R^2) and correlation coefficient (r) was tackled using the assist of Microsoft Excel as calculating instrument