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Short communication

Rainfall probability modeling for Chandrabanda area of Raichur, Karnataka (India)

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In India, the agricultural scenario is closely linked with the rainfall distribution, the major part of which is received during the monsoon months (June to September). Knowledge of its distribution and probability is helpful for agriculture planning especially in dry land areas with the principle that water is the limiting factor and one needs to maximize the efficiency of rain water for agricultural production and its economic implications of rain-sensitive operations.

Anil Kumar (1999) analysed annual maximum daily rainfall using Log-Pearson type III, Log-normal and Gumbel distributions. From the analysis, the Log-normal distributions was found the best fit for the annual maximum daily rainfall data.Tomar *et al.,* (2001) developed deterministic empirical equations to forecast the cumulative monthly rainfall. The results so obtained for Chinaware region of Madhya Pradesh clearly showed that the Gompertz curve technique can be utilized to forecast the monthly rainfall with reasonable accuracy.

The present study was conducted at Chandrabanda area in Raichur district located at $16^{0}14^{1}$ N latitude, $77^{0}26^{1}$ E longitudes and 389.5 meters above mean sea level. The climate is semi arid and the region is characterized by high day temperature, low humidity and excessive evaporation during summer and pre-monsoon periods. The actual forecasting of occurrence of rainfall seems to be still elusive. Hence, the information on short and long term analysis based on the data of past years gains urgency. The present analysis would provides an answer to identify the pattern indicating the variations of rainfall in the region.

The daily rainfall data were collected from the meteorological observatory of Chandrabanda in Raichur district of Karnataka. The rainfall data of 34 years from 1975 to 2008 were used for one day maximum rainfall, maximum monthly rainfall and annual rainfall. The rainfall analysis was done by fitting different theoretical distributions viz., Normal, Log-normal, Gumbel and Log-Pearson type III distributions. For the analysis of the maximum one day rainfall, data was chosen from maximum one day annual rainfall for thirty four years. The rainfall amounts associated with 10, 25, 50 and 75 percent probability of exceedence were estimated by using standard methods of selected distribution Normal, Log-normal, Gumbel and Log-Pearson type III. The observed rainfall was calculated by Interpolation method at 10, 25, 50 and 75 percent probabilities of exceedence. The different types of rainfall were fitted by the selected probability distribution, which are given below. The fitting of rainfall at different probability distribution will be identified based on observed and estimated rainfall with reference to minimum D-Index.

The computation of observed and estimated rainfall at different probabilities of exceedence at one day maximum, maximum monthly and annual rainfall at different distributions namely Normal, Log-normal, Gumbel and Log-Pearson III type are described below.

Annual one day maximum rainfall

The observed and estimated one day maximum rainfall at different probabilities is presented in Table 1. The percentage deviations from observed rainfall data in Gumbel distribution is more at 10 per cent probability of exceedence. The percentage deviation value ranged from 0.09 to 34.39 at 10 percent probability with a minimum in Log-normal distribution. Similarly the percentage numerical deviation is minimum in Log-normal distribution for 10 and 50 percent probability of exceedence as compared to Log-Pearson type III, Normal and Gumbel distribution. But for 25 and 75 percent probability of exceedence, the deviation is minimum for Normal distribution. Also, D-Index value is observed to be minimum for Log-normal (0.15) followed by Log-Pearson type III (0.16), Normal (0.19) and Gumbel (0.89) distribution. Hence, Log-normal, Log-Pearson type III and Normal distribution fitted better with the one day maximum rainfall and give the reliable estimates in the selected study regions.

Maximum monthly rainfall

The estimated maximum monthly rainfall is shown in Table 2. It is inferred from the table that the percentage deviations were registered maximum (from 1.21 to 182.39) at 75 percent probability of exceedence. Normal distribution were identified the more numerical deviation when compared

Table 1: One day maximum rainfall

Probability of Exceedence (%)	Observed Rainfall (mm)	Estimated rainfall(mm)			
		Normal	Log-normal	Gumbel	Log-Pearson III type
10	42.20	36.28	42.29	7.81	42.58
		(5.92)	(-0.09)	(34.39)	(-0.38)
25	55.80	54.83	53.65	45.51	53.61
		(0.97)	(2.15)	(10.29)	(2.19)
50	71.15	75.45	69.88	78.51	69.55
		(-4.30)	(1.27)	(-7.36)	(1.60)
75	97.29	96.07	91.02	104.52	90.63
		(1.22)	(6.27)	(-7.23)	(6.66)
Mean	66.61	65.66	64.21	59.09	64.09
D-Index		0.19	0.15	0.89	0.16
Fitting Condition		Fit	Best fit	Un fit	Fit

Note: The value in parenthesis represents the deviation of observed and estimated rainfall

Table 2: Maximum monthly rainfall

Probability of Exceedence (%)	Observed Rainfall (mm)	Estimated rainfall(mm)			
		Normal	Log-normal	Gumbel	Log-Pearson III type
10	106.94	78.42	115.24	182.51	121.34
		(28.52)	(-8.30)	(-75.57)	(-14.40)
25	165.63	145.06	149.41	282.88	147.95
		(20.57)	(15.95)	(-117.25)	(17.68)
50	199.80	219.11	199.41	370.76	191.00
		(-19.31)	(0.39)	(-170.96)	(8.80)
75	257.63	293.14	266.11	440.02	256.42
		(-35.51)	(-8.48)	(-182.39)	(1.21)
Mean	182.50	183.93	137.54	319.04	179.18
D-Index		0.57	0.18	2.99	0.23
Fitting Condition		Un fit	Best fit	Un fit	Fit

Note: The values in parenthesis represents the deviation of observed and estimated rainfall

Table 3: Annual rainfall

Probability of Exceedence (%)	Observed Rainfall (mm)	Estimated rainfall(mm)			
		Normal	Log-normal	Gumbel	Log-Pearson III type
10	326.19	310.07	318.54	304.47	316.72
		(16.12)	(7.65)	(21.72)	(9.47)
25	482.74	461.55	421.47	499.83	441.01
		(21.19)	(61.27)	(-17.09)	(41.73)
50	621.00	629.86	575.27	670.87	606.74
		(-8.86)	(45.73)	(-49.87)	(14.26)
75	753.61	798.17	785.21	805.68	795.19
		(-44.56)	(-31.60)	(-52.07)	(-41.58)
Mean	545.89	549.91	525.12	570.21	539.92
D-Index		0.17	0.27	0.26	0.20
Fitting Condition		Best fit	Fit	Fit	Fit

Note: The values in parenthesis represents the deviation of observed and estimated rainfall

to all other distributions. Also D-Index was observed to be minimum for Log-normal distribution (0.18) is considered as best fitted and followed by Log-Pearson Type III and Gumbel distributions which are normal fit for the maximum monthly rainfall and gave the reliable results for the selected study region.

Annual rainfall

The estimated annual rainfall at different probabilities is presented in Table 3. The percentage deviations were identified at more in all the 10, 25, 50 & 75 percentage probability of exceedence. The percentage deviation values ranged from 17.09 to 52.07 (Gumbel), 7.65 to 61.27 (Log-normal) distributions at different probability exceedence. Also, the D-Index was found to be vary minimum in Normal (0.17) distribution. From the results, it could be inferred that the two distributions namely Normal and Log-Pearson Type III were best fitted for annual rainfall to give the reliable estimates in the selected study region.

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