American Journal of Engineering Research (AJER)
e-ISSN: 2320-0847 p-ISSN : 2320-0936
Volume-5, Issue-5, pp-06-14
www.ajer.org
Research Paper Open Access

Probability Analysis for One Day to Three Consecutive Days of Annual Maximum Rainfall: The Case of Gimbi Town, Oromia Region, Ethiopia

Gemechu Mosisa

Department of Hydraulic and Water Resources Engineering, College of Engineering and Technology, Wallaga University, Nekemte, Ethiopia

Email: ansifgemechu1995@gmail.com

Received: 2025 / Revised: 2025 / Accepted: 2025

Abstract. *Rainfall data frequency analysis and probability distribution enable future extreme events. Determining the magnitude of an extreme rainfall event for a given probability level is crucial for constructing irrigation and other hydraulic systems. On Earth, rainfall is a rare but significant hydrological characteristic. The analysis was for one to three consecutive days of maximum annual rainfall using a variety of widely used probability distributions. In order to determine the best-fit probability distribution, daily rainfall data for Gimbi Town were taken from 1995 to 2019 and gathered from the Ethiopian Meteorological Institute (EMI). The chi-square (χ^2) test was used to measure the goodness of fit between the expected and observed values. The chi-square value of the 1, 2 and 3-day maximum annual daily rainfall was 8.8, 3.8, and 5.4 respectively. Chow method was the best-fit probability distribution for predicting the annual 1 and 2-day maximum rainfall for various return periods and the log-Pearson type-III distribution was the best-fit probability distribution for predicting the annual 3-day maximum rainfall for various return periods. The results of this study would be useful for agricultural scientists, decision-makers, policy planners, and researchers for agricultural development and construction of small soil and water conservation structures, irrigation, and drainage systems in Gimbi Town, Ethiopia.*

Keywords: *Chi-square test, Gimbi, Gumbel, Rainfall, Return period, Probability distribution.*

I. INTRODUCTION

One of the significant hydrologic events that affects many agricultural and non-agricultural operations is rainfall[1]. Rainfall depth and return period must be accurately estimated from existing historical data for a number of water resources engineering applications[2]. Comprehensive and trustworthy hydrological data from the area being studied is necessary for local or regional water resource planning and development[3].

The detrimental effects of extreme storms may worsen if a region lacks consistent, trustworthy rainfall records[4]. Interpreting historical records of hydrological events in terms of future probabilities of occurrence is the first acknowledged issue in hydrology[5]. Extreme occurrences and statistical distributions that can understand the data's fitness are predicted using historical rainfall event statistics[6]. Spatial and temporal variations in rainfall distribution lead to severe hydrological issues (extreme events), including droughts and floods[7]. Return periods can be predicted using various probability distribution functions, despite the fact that rainfall characteristics are erratic and vary over time and space [8].

The practice of identifying the consistent conditions of a hydrological event is known as frequency analysis[9].

In order to plan and design structural and non-structural measures safely and economically, as well as small and medium hydraulic structures like small dams, bridges, culverts, spillways, check dams, ponds, irrigation mid-drainage work in watershed management and command area development programs, and plant protection activities on a more scientific basis by applying climatological data, it is essential to analyze consecutive days return periods[10]. We can determine the likelihood of encountering excessive rainfall at various dates by analyzing rainfall data using probability and frequency analysis[11].

The probability distribution functions most commonly employed to estimate rainfall frequency are the Chows, Gumbel, log-normal, and log-Pearson type-III distributions[12]. Only by carefully examining past rainfall data can one determine the design rainfall event. 25 years or more is typically regarded as sufficient, even though the necessary duration of the time series depends on the temporal variability in precipitation. The present study aimed to establish the statistical parameters and yearly maximum rainfall for one day and two to three consecutive days using various probability levels, as well as to select the ideal probability distribution scheme. The functions of the probability distribution are: log-normal, log-pearson type-III, Gumbel, distribution and chow method.

II. MATERIALS AND METHODS

The materials used for this research were, daily maximum rainfall data for 25 years, ArcGIS 10.8 software, Spreadsheet/MS Excel 2010 for data analysis.

Methodology

In order to calculate the rainfall values that correspond to desired return periods for one, two, and three consecutive days, the methodology comprises collecting historical rainfall data, selecting appropriate probability distributions (such as Gumbel, Chow's method, log Pearson Type III, and log-normal), fitting the distribution to the data using statistical tests, and then computing the rainfall values. Plotting position methods to calculate likelihood, goodness-of-fit testing, and data pre-processing are typical steps in this process.

Location and Description of the Study Area

Gimbi Town is situated 441 km from Addis Ababa and 110 km from Nekemte on the main road to Assosa in the West Wallaga Zone in Western Ethiopia. With latitudes 9°7′30"N to 9°12′30"N and 35°49′30"E to 35°51′0"E, and elevations ranging from 1845 m at the lowest to 1930 m above mean sea level at the highest, Gimbi Town receives an average of 2711 mm of rainfall annually.

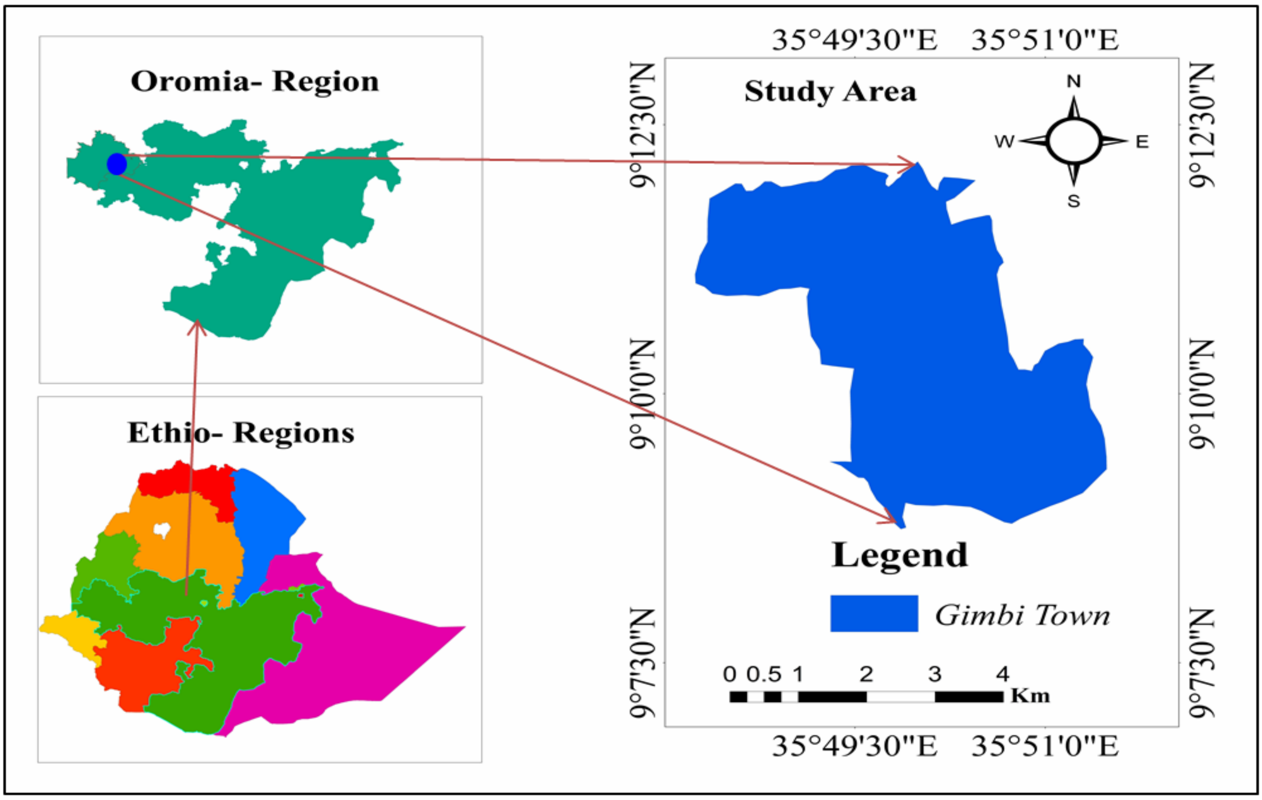

Figure1. Location map of the study

Data Collection

The Ethiopia Meteorological Institute (EMI) provided the Gimbi station with the daily rainfall data. As seen in Figure 2 below, the daily maximum rainfall data spans 25 years, from 1995 to 2019.

Gimbi rainfall station			
	Annual Maximum Daily Rainfall in mm		
Year	**1 day**	**2 days**	**3days**
1995	40.2	79	101.1
1996	45	82.3	85.7
1997	55.2	97.2	98.3
1998	65.5	127.5	158.7
1999	62.4	85.2	118.8
2000	64.9	70	92.1
2001	65.9	96	96
2002	61.3	113.9	114.8

2003	79.7	114.2	120.5
2004	56.3	98.2	117.6
2005	56.8	101	113.6
2006	66.3	71.1	100.7
2007	116.8	137.6	141.5
2008	72.9	99.6	120.5
2009	47.7	71.7	95.2
2010	101.3	117	124.2
2011	64.3	80.4	95.9
2012	51.6	89.3	105.4
2013	69.9	101.4	114.6
2014	61.3	101.1	115.4
2015	72	112	131.6
2016	91.3	125.9	136.8
2017	54	80.9	89.1
2018	63.7	77.3	84
2019	50.2	80.9	89.1

Table 2.1: Annual maximum daily rainfall data for 25 years for Gimbi town

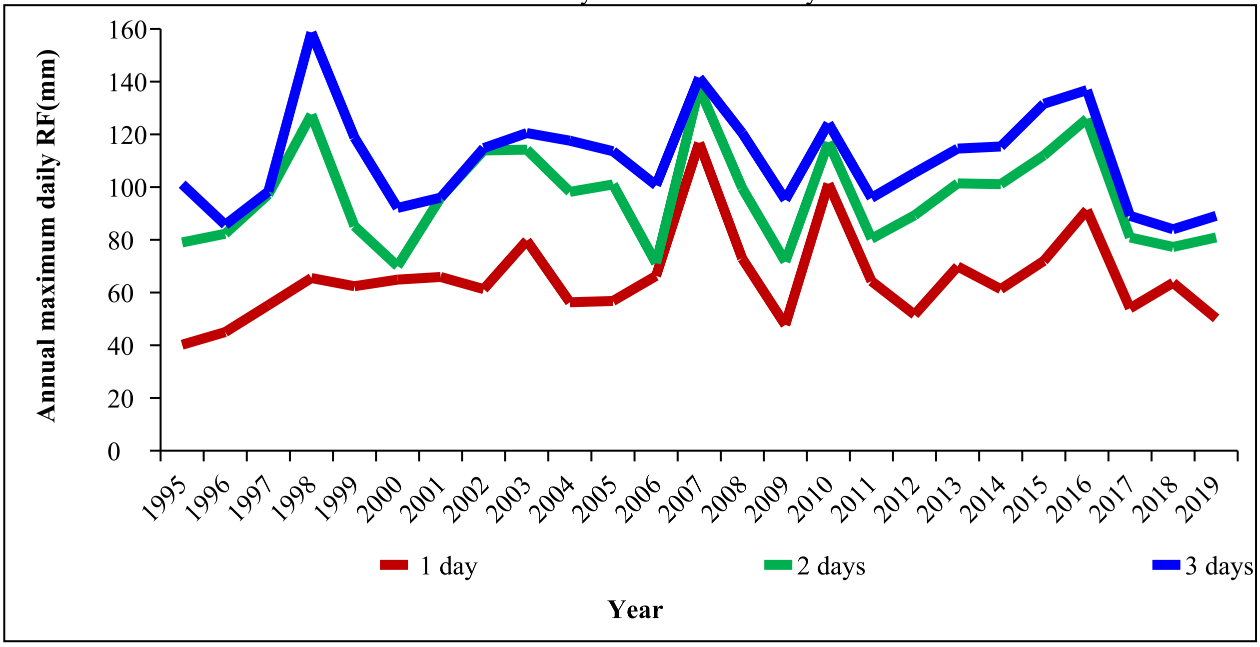

Figure2. Graph of consecutive annual maximum daily rainfall data for 25 years for Gimbi town

Analysis of Data

The maximum rainfall for 1, 2, and 3 day rainfall days were analyzed as per the procedure detailed above. Figure 3 shows the rainfall depth at different return periods computed using the plotting position method. The 1-day maximum rainfall for the town is obtained as 122.1mm for the 100-year return period determined by log-person type III distribution. The maximum daily rainfall values for 2, and 3-day consecutive days, corresponding to 100 years of return period, are obtained to be 156mm and 170mm, determined by Gumbel distribution respectively. The 1, 2 to 3 consecutive days' maximum rainfall corresponding to the 50-year return period is obtained as 112.3, 145.7, and 159.7mm respectively.

Analysis Methods

Probabilistic Methods

Probability distributions are widely used in understanding the rainfall pattern and computation of probabilities. In the present study, the probability of exceedance of rainfall recommended by Weibul(1939) cited by[13].

P = (1)

Where m is the order or rank and N is the total number of events. It was computed using the Wei bull's plotting position formula and applied to the observed rainfall data. The continuous probability distribution log normal (LN), log-Pearson type III (LP III), extreme value type I (EV I) and Chow were used to evaluate suitable probability functions.

Log-Normal Distribution

A log-normal distribution is a probability distribution of a random variable whose logarithm is normally distributed. The maximum rainfall for a particular return period is calculated using the following equation[14].

$XT = \bar{X} + KT * \sigma x$ (2)

Where $\bar{X}$ is the mean of the observed rainfall, σx is the standard deviation for x; K_T - frequency factor which is calculated by the formula given by Gumbel (1958) and

recommended by Ven Te Chow cited by [15].
= (3)
In which is the standard deviation and N is the sample size. The value of KT is determined considering the coefficient of skewness as zero obtained from the theoretical table available on the chow table[11].

Log-Pearson Type III Distribution

In this type of probability distribution, the coefficient of skewness is calculated using the formula given below[12].
= (4)
$X_T = +K_T * \sigma x$ (5)
The frequency factor KT is obtained from the theoretical table available on the chow's table for the Pearson type III distribution with skew coefficient **(Chow, 1987)**.

Extreme Value/ Gumbel Distribution

Gumbel probability distribution is widely used for extreme value analysis of hydrologic and meteorological data such as floods, maximum rainfalls and other events:
= {0.5772+ ln (ln ((6)
The above empirical relation holds well when the record length is 100 years or more[12].

Chow's Method

Chow (1964) derived the frequency factors (KT) for log normal distribution and presented a theoretical table. The value of k can be obtained using the skewness coefficient (Cs) and coefficient of variation (Cv). In log-normal distribution, these two parameters are related as[12].
= + (7)
In which the coefficient of variation is obtained as follows[10].
= (8)
Where: is coefficient of variation measures of variability of any hydrologic series. is used to classify the degree of variability of rainfall events as less, moderate and high.
When < 20% it is less variable, from 20% to 30% is moderately variable, and >30% is highly variable. Areas with when is > 30% are said to be extreme events[5].
The main difference between the log-normal approach and Chow approach is that calculated Cs value is adopted in case of Chow method, whereas for the log-normal approach Cs value is considered as zero.

Goodness of Fit Criteria

Chi-Square Test

A commonly used test for testing the goodness of fit of empirical data to specific theoretical distribution is the Chi square test[16]. The goodness of fit between the observed events and the fitted distribution can be tested. The Chi-square value can be determined for each distribution for a particular return period[17]. A relation between the observed number of occurrence Ro and expected number of occurrence Re can be developed as[18].
= (9)
Ro and Re are the observed and estimated rainfall magnitudes, respectively. This statistical test judges whether or not a particular distribution adequately

III. RESULTS AND DISCUSSION

Computation of Statistical Parameters of One to Three Consecutive Days Maximum Annual Rainfall

Table 1. Value of estimated statistical parameters for one day and two to three consecutive days

S.No	Statistical parameters	Unit	One day	Two days	Three days
1	Total	mm	1636.5	2410.7	2761.2
2	Maximum	mm	116.8	137.6	158.7
3	Minimum	mm	40.2	70	84
4	Mean	mm	65.5	96.4	110.4
5	Standard deviation	mm	17	19	19
6	Coefficient of variation	%	26	20	17
7	Coefficient of skewness	-	1.5	0.5	0.7

One Day Maximum Annual Rainfall

Table 2. Maximum rainfall for 1, 2, and 3 consecutive days using the plotting position method

Return period (T) in year	Probability (P) in %	1-day RF in mm	2-day RF in mm	3-day RF in mm
5	20	77.9	110.1	124.1
10	10	88.1	121.2	135.2
25	4	100.9	135.2	149.2
50	2	110.4	145.7	159.7
100	1	119.8	156	170

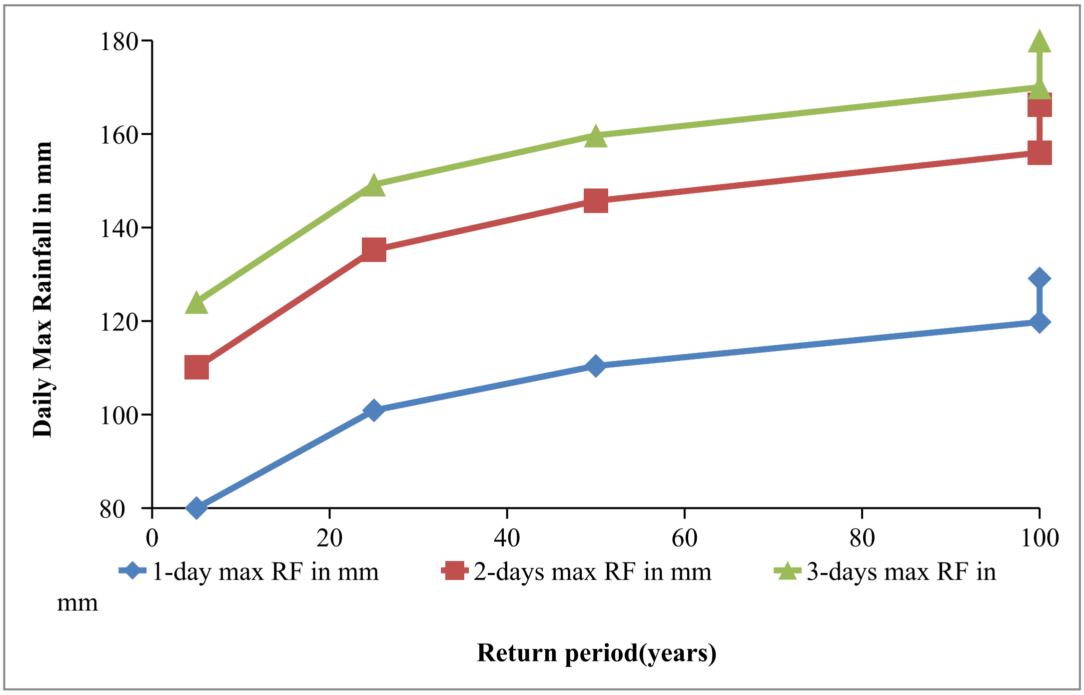

Figure 3. Maximum rainfall for various return periods

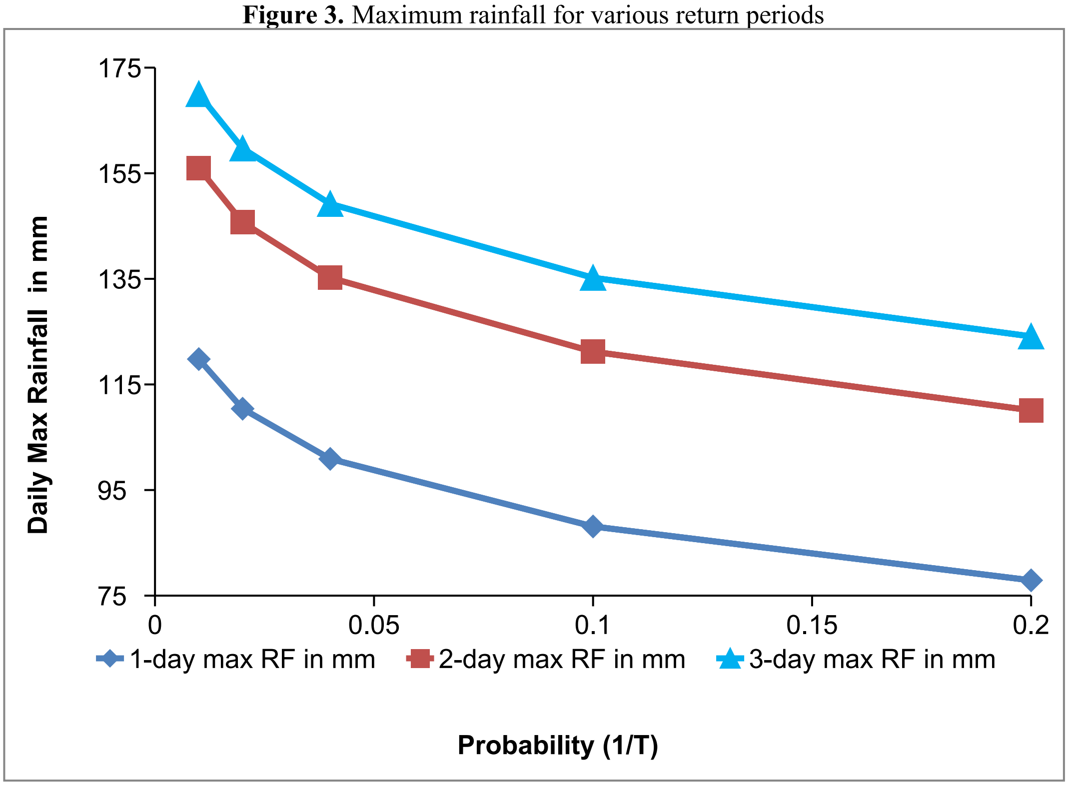

Figure 4. Variation of observed 1day and 2 to 3 days consecutive Maximum Rainfall with probability

Table 3. Prediction of one day maximum annual rainfall using Log-normal distribution

Return period (T), in year	C_s= 0 read KT (from table)	Estimated rainfall in mm
5	0.842	79.8
10	1.282	87.3
25	1.751	95.3
50	2.054	100.4
100	2.326	105.0

Table 4. Estimation of one-day maximum rainfall using Log Pearson type-III distribution

Return period (T) in years	= 65.5, when C_s= 1.5 Read KT (from table)	Estimated rainfall in mm
5	0.690	77.7

10	1.333	88.6
25	2.146	102.3
50	2.743	112.3
100	3.330	122.1

Note: The value of KT based on the coefficient of skewness read from Ven Te Chow table on ***page 392 or 393***

Table 5. Estimation of one day maximum rainfall using Gumbel distribution

$\bar{X}$= 65.5	
Return period (T) in years	**Estimated rainfall in mm**
5	77.9
10	88.1
25	100.9
50	110.4
100	119.8

Table 6. Estimation of one day maximum rainfall using Chow method

Return period (T) in years	= 65.5, when C_s= 0.8 Read KT (From Table)	Estimated rainfall in mm
5	0.780	79.0
10	1.336	88.6
25	1.993	100.0
50	2.453	107.9
100	2.891	115.5

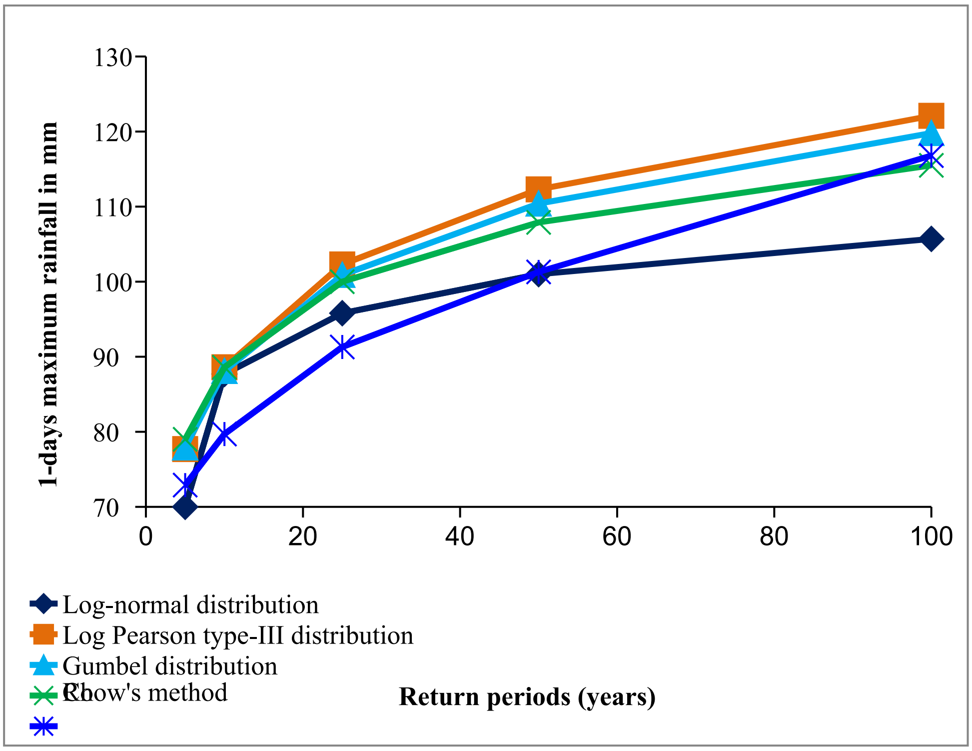

Figure 5. One-day maximum rainfall based on various probability functions

Table 5 show that predictable 1Day maximum annual daily rainfall using Log Pearson type-III distribution for return periods of 5, 10, 25, 50, and 100 were 77.7, 88.6, 102.3, 112.3, and 122.1mm respectively. The comparisons between the observed 1Day maximum annual daily rainfall and predicted maximum value of annual rainfall clearly show that the developed model can be efficiently used for the prediction of rainfall.

Table 7. Chi-square value of predicted one day's maximum annual rainfall for different distribution for Gimbi town

Return period (T)	Probability (P)	Ro	Calculated Chi-square value			
year	%	mm	LND	LPTIIID	GUMD	CHOW'S
5	20	116.8	40.2	19.7	19.4	18.1
10	10	101.3	2.1	1.8	2.0	1.8
25	4	91.3	0.2	1.2	0.9	0.8
50	2	79.7	4.5	9.5	8.5	7.4

100	1	72.9	10.2	19.8	18.4	15.7
Mean			**11.4**	**10.4**	**9.8**	**8.8**

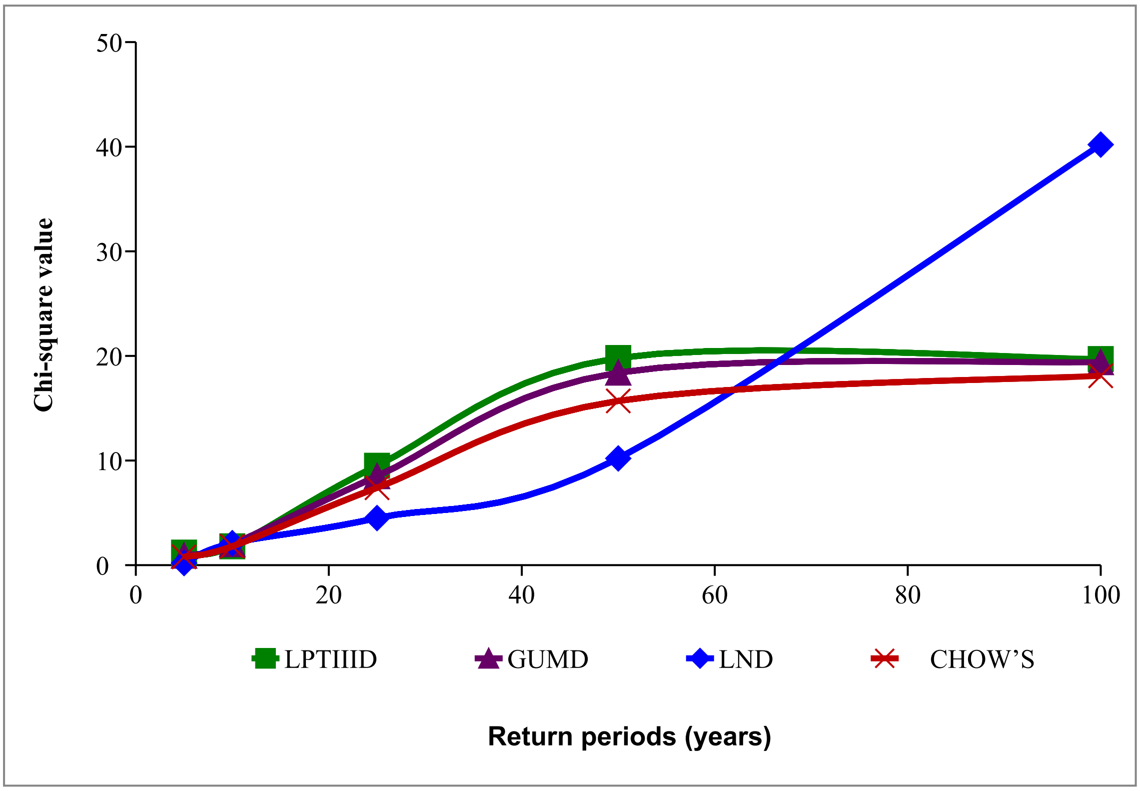

Figure 6. X^2 Value versus return periods for selected probability functions

The chi-square values of 1day maximum annual daily rainfall for Log-normal, Log-pearson type-III, Gumbel's, distributions and chow method were 11.4, 10.4, 9.8 and 8.8 respectively which shows that the chow method was the best-fit probability distribution to forecast annual 1day maximum daily rainfall for different return periods.

Two Days Maximum Annual Rainfall

Table 8. Prediction of two days maximum annual rainfall using Log-normal distribution

Return period (T), in year	KT (From Table)	Estimated rainfall in mm
5	0.842	112.4
10	1.282	120.8
25	1.751	129.7
50	2.054	135.4
100	2.326	140.6

Table 9. Estimation of two days maximum rainfall using Log Pearson type-III distribution

Return period (T) in years	= 96.4, when C_s= 0.5 Read KT (From Table)	Estimated rainfall in mm
5	0.808	111.8
10	1.323	121.5
25	1.910	132.7
50	2.311	140.3
100	2.686	147.4

Table 10. Estimation of two days maximum rainfall using Gumbel distribution

$\bar{X}$= 96.4	
Return period (T) in years	**Estimated rainfall in mm**
5	110.1
10	121.2
25	135.2
50	145.7
100	156

Table 11. Estimation of two days maximum rainfall using Chow method

Return period (T) in years	= 96.4, when C_s= 0.6 Read KT (From Table)	Estimated rainfall in mm
5	0.800	111.6
10	1.328	121.6
25	1.939	133.2

50	2.359	141.2
100	2.755	148.7

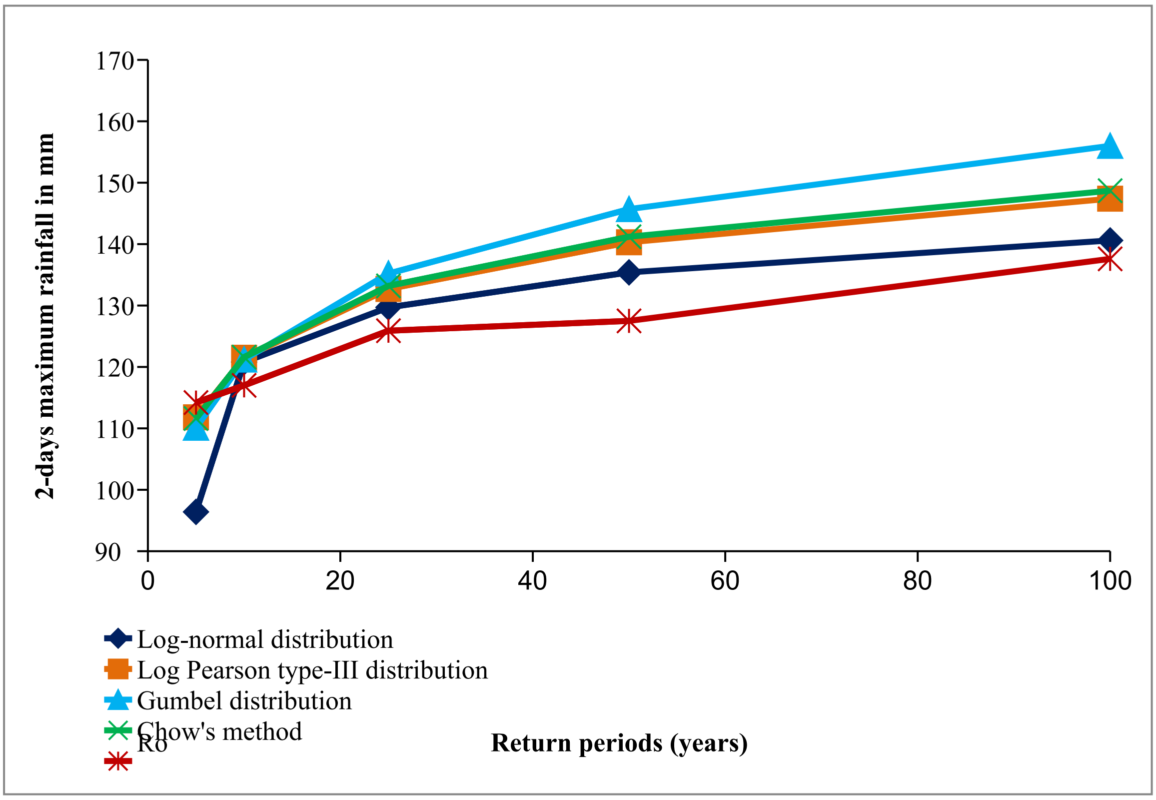

Figure 7. Two days maximum rainfall based on various probability functions

Table 11 show that predictable 2Days maximum annual daily rainfall using Gumbel's distribution for return periods of 5, 10, 25, 50, and 100 were 110.1, 121.2, 135.2, 145.7, and 156mm respectively. The comparisons between the observed 2Day maximum annual daily rainfall and predicted maximum value of annual rainfall clearly show that the developed model can be efficiently used for the prediction of rainfall.

Table 12. Chi-square value of predicted two days maximum annual rainfall for different distribution for Gimbi town

Return period (T)	Probability (P)	Ro	Calculated Chi-square value			
Year	**%**	**mm**	**LND**	**LPTIIID**	**GUMD**	**CHOW**
5	20	137.6	17.61	6.0	6.9	6.1
10	10	127.5	0.37	0.3	0.3	0.3
25	4	125.9	0.11	0.3	0.6	0.4
50	2	117	2.50	3.9	5.7	4.1
100	1	114.2	4.96	7.5	11.2	8.0
Mean			**5.1**	**3.6**	**4.9**	**3.8**

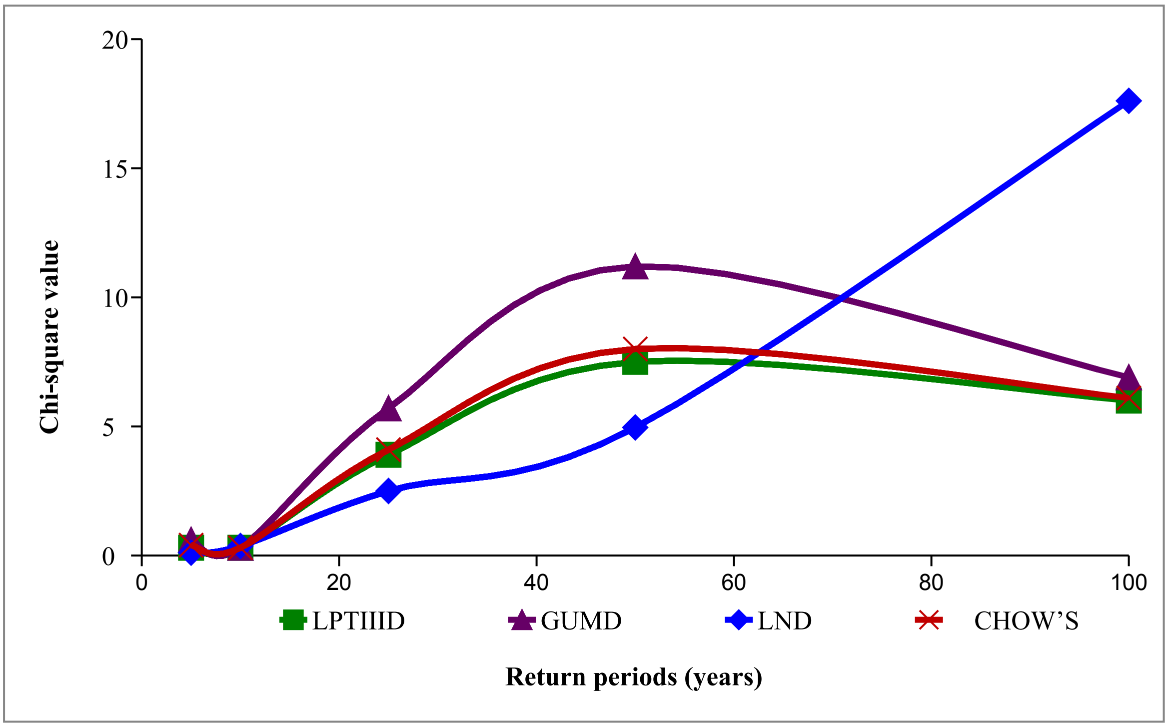

Figure 8. X^2 Value versus return periods for selected probability functions

The chi-square values of 2day maximum annual daily rainfall for Log-normal, Log-pearson type-III, Gumbel's, distributions and chow method were 5.1, 3.6, 4.9 and 3.8 respectively which shows that the Log Person Type III distribution was the best-fit probability distribution to forecast annual 1day maximum daily rainfall for different return periods.

Three Days Maximum Annual Rainfall

Table 13. Prediction of three days maximum annual rainfall using Log-normal distribution

Return period (T), in year	KT (From Table)	Estimated rainfall in mm
5	0.842	126.4
10	1.282	134.8
25	1.751	143.7
50	2.054	149.4
100	2.326	154.6

Table 14. Estimation of three days maximum rainfall using Log Pearson type-III distribution

Return period (T) in years	= 110.4, when C_s= 0.7 Read KT (From Table)	Estimated rainfall in mm
5	0.790	125.4
10	1.333	135.7
25	1.967	147.8
50	2.407	156.1
100	2.824	164.1

Table 15. Estimation of three days maximum rainfall using Gumbel distribution

X= 110.4	
Return period (T) in years	**Estimated rainfall in mm**
5	124.1
10	135.2
25	149.2
50	159.7
100	170

Table 16. Estimation of three days maximum rainfall using Chow method

Return period (T) in years	= 110.4, when C_s= 0.5 Read KT (From Table)	Estimated rainfall in mm
5	0.808	125.8
10	1.323	135.5
25	1.910	146.7
50	2.311	154.3
100	2.686	161.4

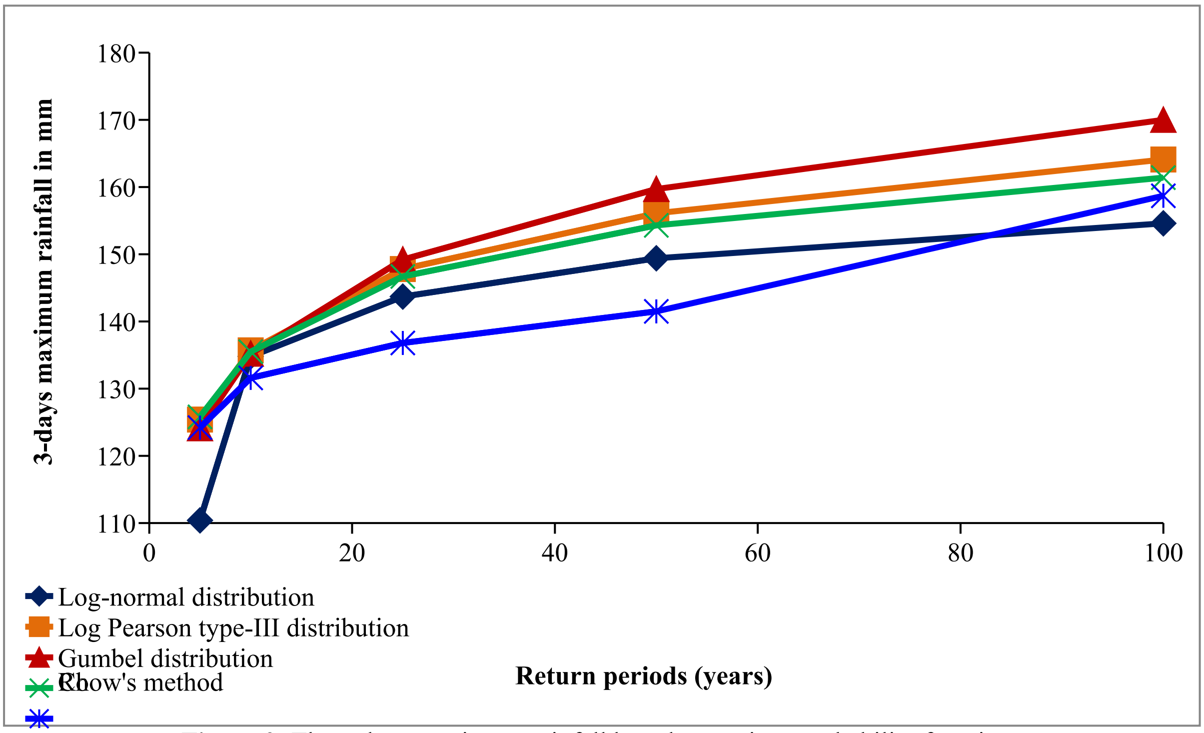

Figure 9. Three days maximum rainfall based on various probability functions

Table 16 show that predictable 3Days maximum annual daily rainfall using Gumbel's distribution for return periods of 5, 10, 25, 50, and 100 were 124.1, 135.2, 149.2, 159.7, and 170mm respectively. The comparisons between the observed 3Day maximum annual daily rainfall and predicted maximum value of annual rainfall clearly show that the developed model can be efficiently used for the prediction of rainfall.

Table 17. Chi-square value of predicted three days maximum annual rainfall for different distribution for Gimbi town

Return period (T)	Probability (P)	Ro	Calculated Chi-square value			
year	%	mm	LND	LPTIIID	GUMD	CHOW'S
5	20	137.6	6.7	1.2	1.5	1.1
10	10	127.5	0.4	0.5	0.4	0.5
25	4	125.9	2.2	3.2	3.6	2.9
50	2	117	7.0	9.8	11.4	9.0
100	1	114.2	10.6	15.2	18.3	13.8
Mean			**5.4**	**6.0**	**7.0**	**5.5**

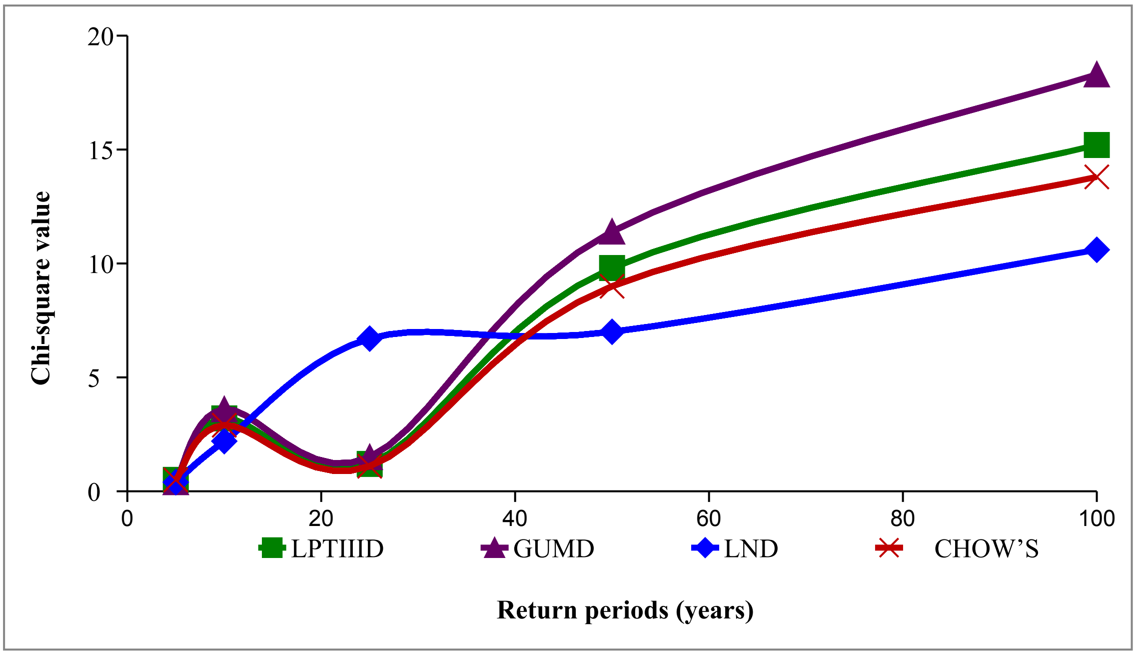

Figure 10. X^2 Value versus return periods for selected probability functions

The chi-square values of 3day maximum annual daily rainfall for Log-normal, Log-pearson type-III, Gumbel's, distributions and chow method were 5.4, 6.0, 7.0 and 5.5 respectively which shows that the Log-normal distribution was the best-fit probability distribution to forecast annual 1day maximum daily rainfall for different return periods.

The statistical comparison by Chi-square test for goodness of fit clearly shows that Chow, LPTIII and Log-normal distribution was best fitting representative function for 1day and 2 to 3 days consecutive annual maximum daily rainfall frequency analysis in Gimbi town respectively. It is generally recommended that 5 to 100 years is the most sufficient return period for Soil and Water Conservation measures, construction of dams, irrigation and drainage works in this town/ region/area.

IV. CONCLUSSIONS

Rainfall is a renewable resource, highly variable in space and time and subject to depletion or enhancement due to both natural and anthropogenic causes. The frequency analysis of annual one day maximum rainfall for identifying the best fit probability distribution can be studied for four probability distributions such as Log Normal, Log Pearson Type-III, Gumbel's distribution, and chow method by using Chi-square goodness of fit test. The results of study were the mean values of annual one day and 2 to 3 consecutive days maximum rainfall was found to be 65.5, 96.4 and 110.4mm, the standard deviation 17, 19 and 19, the coefficient of variation of 0.26, 0.2 and 0.17 with the coefficient of skewness was observed to be 1.5, 0.5 and 0.7 for 1day to 2 to 3 consecutive annual maximum rainfall respectively. . It was observed that all the four probability distribution functions fitted significantly. Log normal distribution was found to be the best fitted to annual one day and 2 to 3days annual maximum daily rainfall data by Chi-square test for goodness of fit. The results will facilitate the design engineers and hydrologist, who require information about annual daily maximum rainfall and consecutive days maximum rainfall of different frequencies or return period for planning and design of the small and medium hydraulic and soil and water conservation structures, irrigation, drainage works.

Acknowledgments

First of all, I want to thank Almighty God for his guidance and mercy on me and for giving me the courage, wisdom, and strength to reach this point in my life, throughout all of my work and its supply complete work. Secondly, I would like to thank the Ethiopian Meteorological Institute (EMI) for providing the necessary data for the research without payment. Last but not least, I would like to express my deepest gratitude to Wallaga University for support to publish my article.

Author contribution

Methodology, writing original draft preparation, writing-review and editing, investigation, software, formal analysis, validation, project administration, and data curation are done by Gemechu Mosisa. Author have read and agreed to the published version of the manuscript.

Data Availability

All data can be obtained from the corresponding author upon request.

Conflicts of Interest

The author declares that there is no conflict of interests regarding the publication of this paper.

References

[1] A. Patel and R. K. Verma, "Probability analysis for prediction of annual maximum rainfall of one to five consecutive months for Sultanpur region," Int. J. Agric. Sci., vol. 15, no. 1, pp. 15–24, 2019, doi: 10.15740/has/ijas/15.1/15-24.

[2] S. R. Bhakar, A. K. Bansal, and N. Chhajed, "Frequency Analysis of Consecutive Days Maximum Rainfall At Banswara, Rajasthan, India," J. Inst. Eng. Agric. Eng. Div., vol. 1, no. 3, pp. 14–16, 2006.

[3] S. S. Idate, D. M. Mahale, H. N. Bhange, and K. D. Gharde, "Frequency Analysis for One day to Six Consecutive Days of Annual Maximum Rainfall for Mulde, Dist: Sindhudurg," Int. J. Curr. Microbiol. Appl. Sci., vol. 8, no. 02, pp. 3069–3075, 2019, doi: 10.20546/ijcmas.2019.802.359.

[4] A. A. Awass, "Hydrological Drought Analysis-occurrence , severity , risks : the case of Wabi Shebele River Basin," p. 220, 2009.

[5] A. Fikru, "Frequency Analysis of Extreme Events and Developing Intensity Duration Frequency Curves: The Case of Jimma Town, Ethiopia," J. Nat. Sci. Res., vol. 12, no. 21, pp. 14–24, 2021, doi: 10.7176/jnsr/12-21-02.

[6] G. Mosisa, "Prediction of Consecutive Days Maximum Rainfall Using Frequency Analysis for Nekemte Town, Oromia, Ethiopia," J. Water Resource. Ocean Sci., no. April, 2023, doi: 10.11648/j.wros.20231201.12.

[7] P. M. Hodlur and R. V Raikar, "Probability Distribution and Frequency Analysis of Consecutive Days Maximum Rainfall at Sambra (Belagavi), Karnataka, India," 2021, [Online]. Available: https://www.researchgate.net/publication/350638049

[8] P. K. Bora, V. Ram, A. K. Singh, R. Singh, and S. M. Feroze, "Probable Annual Maximum Rainfall for Barapani, Meghalaya," vol. 3, no. 1, pp. 16–18, 2012.

[9] S. Bhakar et al., "Probability analysis of rainfall at Kota PROBABLITY ANALYSIS OF RAINFALL AT KOTA," no. December, 2014, [Online]. Available: https://www.researchgate.net/publication/265060521

[10] M. Manikandan, G. Thiyagarajan, and G. Vijayakumar, "Probability Analysis for Estimating Annual One Day Maximum Rainfall in Tamil Nadu Agricultural University," Madras Agric. J., vol. 98, no. 1–3, pp. 69–73, 2011.

[11] B. Singh, D. Rajpurohit, A. Vasishth, and J. Singh, "Probability analysis for estimation of annual one day maximum rainfall of Jhalarapatan Area of Rajasthan, India," Plant Arch., vol. 12, no. 2, pp. 1093–1100, 2012.

[12] R. M. Sabarish, R. Narasimhan, A. R. Chandhru, C. R. Suribabu, J. Sudharsan, and S. Nithiyanantham, "Probability analysis for consecutive-day maximum rainfall for Tiruchirapalli City (south India, Asia)," Appl. Water Sci., vol. 7, no. 2, pp. 1033–1042, 2017, doi: 10.1007/s13201-015-0307-x.

[13] A. Kandpal, S. Kanwal, and A. Gosain, "Estimation of Consecutive Days Maximum Rainfall using Different Probability Distributions and Their Comparsion," pp. 100–106, 2015.

[14] A. Shering and A. Kumar, "Comparative Study of Prediction of Annual Maximum Rainfall By Using three Different Methods in Bijnor District (U . P .)," vol. 10, no. 9, pp. 33–41, 2017, doi: 10.9790/2380-1009013341.

[15] G. Mosisa, "Estimation of One to Two Consecutive Days Maximum Annual Rainfall Using Probability Distributions: The Case of Bedele Town, Oromia, Ethiopia," Eng. Sci., vol. 8, no. 3, pp. 23–29, 2023, doi: 10.11648/j.es.20230802.12.

[16] Z. Al-houri, A. Al-omari, O. Saleh, and S. Centre, "Frequency Analysis of Annual One Day Maximum Rainfall at Amman Zarqa Basin, Jordan," Civ. Environ. Res., vol. 6, no. 3, pp. 44–57, 2014.

[17] M. Barkotulla,M. R.-J. of D., and undefined 2009, "Characterization and frequency analysis of consecutive days maximum rainfall at Boalia, Rajshahi and Bangladesh," Academicjournals.Org, vol. 1, no. 5, pp. 121–126, 2009, [Online]. Available: https://academicjournals.org/journal/JDAE/article-full-text-pdf/AC6BD373876

[18] M. Gundalia, "Monthly and Annual Maximum Rainfall Prediction using Best Fitted Probability Distributions in Junagadh Region (Gujarat- India)," 2022.