

# Statistical Analysis of Rainfall for Development of Intensity-Duration-Frequency curves for Upper Cauvery Karnataka by Log-Normal Distribution

Mohammed Badiuddin Parvez<sup>1\*</sup>, M Inayathulla<sup>2</sup>

<sup>1,2</sup>Dept. of Civil Engineering, UVCE, Bangalore University, Bangalore, Karnataka, India

\*Corresponding Author: [parvezuvce@gmail.com](mailto:parvezuvce@gmail.com) Tel.: +919060506390

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**Abstract** Intensity-duration-frequency (IDF) curves are among the most demandable information in meteorology, hydrology and engineering water resources design, planning, operation, and management works. The IDF Curves accessible are for the most part done by fitting arrangement of yearly greatest precipitation force to parametric dispersions. Intensity-duration-frequency (IDF) curves represent the relationship between storm intensity, storm duration and return period. Environmental change is relied upon to intensify the boundaries in the atmosphere factors. Being prone to harsh climate impacts, it is very crucial to study extreme rainfall-induced flooding for short durations over regions that are rapidly growing. One way to approach the extremes is by the application of the Intensity-Duration-Frequency (IDF) curves. The annual maximum rainfall intensity (AMRI) characteristics are often used to construct these IDF curves that are being used in several infrastructure designs for urban areas. Thus, there is a necessity to obtain high temporal and spatial resolution rainfall information. Many urban areas of developing countries lack long records of short-duration rainfall. The shortest duration obtained is normally at a daily scale/24 h. This paper suggests their generation based on annual daily maximum rainfall (ADMR) records. Rainfall data of 23 (Twenty three) hydrological years of all stations were used. Maximum rainfall frequency analysis was made by Log-Normal Distribution method.

**Keywords-** Climate change, Daily Maximum Rainfall, Intensity Duration Frequency (IDF), Log-Normal Distribution, Rainfall Duration.

## I. INTRODUCTION

The total rainfall and its intensity for a certain period of time are variable from year to another. The variation for depth of rainfall and its intensity depend on the climate type and the length of the studied period. It can be noted in arid and semi-arid areas, there is a significant change in the value of rain from time to another. Due to the significant variation in rainfall and its intensity in a consider time, the design and construction of storm water drainage systems and flood control systems are not depend only on the average of long-term rainfall records but on particular depths of precipitation that can be predicted for a certain probability or return period. These depths of rainfall can only be determined through a comprehensive analysis of a long time series of historical rainfall data. The historical rainfall data series are distinguished by medium and standard deviation, this information cannot be randomly used to predict the rainfall depths that can be estimated with a specific probability or return period for design and

management of storm water drainage. Application of this technique to a data set can lead to misleading results where the actual properties of the distribution are neglected. To avoid mistake, it is necessary to verify the integrity of the assumed distribution before estimating the design depths of the rainfall. There is a need for information of the extreme amounts of rainfall for various durations in the design of hydraulic structures and control storm runoff, such as dams and barriers, and conveyance structures etc. The information that is used hydraulic structure design is usually expressed as a relationship between Intensity-Duration-Frequency (IDF) of rainfall. IDF is one of the most important tools for assessing the risks of water resources and also used for planning, design and operation in water resources engineering. Many studies were conducted on rainfall analysis and the regionalization of the IDF curves for different areas. The Objective of the study is to derive the IDF relationship of rainfall for forty three rain gauge station in the study area using Log-Normal distribution.

## II. MATERIALS AND METHODS

### A. Study Area

The study area geographically lies between  $75^{\circ} 29' 19''$  E and  $76^{\circ} 37' 40''$  E longitude and  $11^{\circ} 55' 54''$  N and  $13^{\circ} 23' 12.8''$  N latitude, as shown in Figure 1, the study area has an area of 10874.65 Sq km. The maximum length and width of the study area is approximately equal to 143.73 km and 96.75 km respectively. The maximum and minimum elevation of the basin is 1867 m and 714 m above MSL, respectively. Fourty three raingauge stations namely kushalnagar, malalur, mallipatna, nuggehalli, periyapatna, ponnampet, sakaleshpur, salagame, shantigrama, arehalli, arkalgud, basavapatna, bettadapura, bilur, channenhally, chikkamagalur, doddabemmatti, galibidu, gonibeedu, gorur, hagare, hallimbailu, hallimysore, harangi, hassan, hosakere, hunsur, kechamanna hosakote, naladi, shantebachahalli, belur, belagodu, javali, talakavery, shravanabelagola, siddapura, srimangala, sukravarsanthe, krishnarajpet, virajpet and yelawala were considered as shown in Figure 2.

### B. Methodology

Equation I was used for the estimation of various duration like 5minutes, 10minutes, 15minutes, 30minutes, 1-hr, 2-hr, 6-hr, 12-hr rainfall values from annual maximum values.

$$P_t = P_{24} \left( \frac{t}{24} \right)^{\frac{1}{3}} \quad \text{(Equation I)}$$

where,  $P_t$  is the required rainfall depth in mm at t-hr duration,

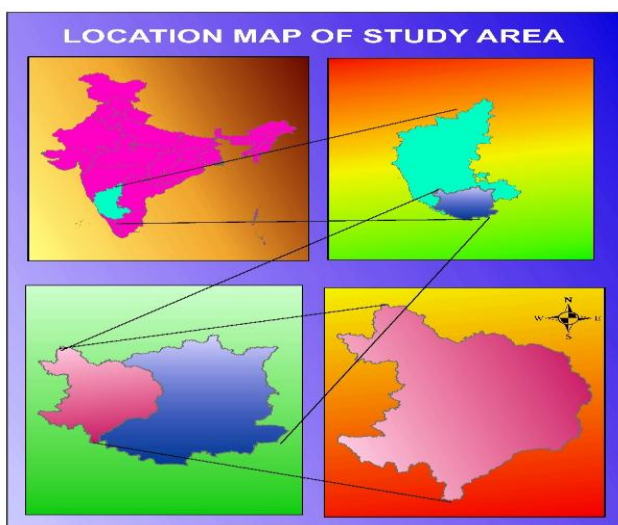


Figure 1 Location Map of Study Area

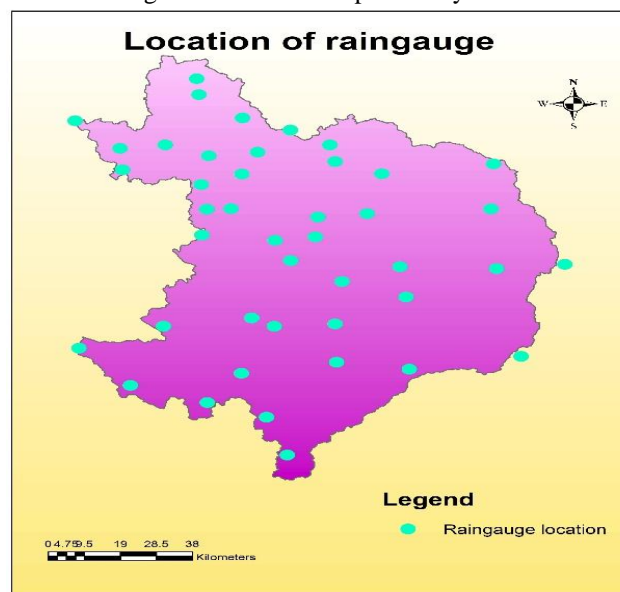


Figure 2 Location of raingauge stations

$P_{24}$  is the daily rainfall in mm and t is the duration of rainfall for which the rainfall depth is required in hr.

Twenty three years (1995-2017) rainfall data was used for the estimation of Short duration rainfall by using above equation for various stations as tabulated in Table 1 to Table 3. Table 1 shows the tabulation of short duration rainfall of station Malalur. Table 2 shows the tabulation of short duration rainfall of station Shravanabelagola. Table 3 shows the tabulation of short duration rainfall of station Hallimysore. Table 4 shows the tabulation of short duration rainfall of station Javali. Similarly the short duration rainfall was tabulated for the remaining Thirty Nine stations.

Log-Normal Distribution was applied for the above estimated short duration rainfall to obtain the maximum depth and maximum intensity for various durations of all the stations and a graph of maximum intensity against the duration was plotted for different return periods. Using this values IDF equation for various durations and return period was generated for all the stations and is tabulated in the Table 22.

## III. RESULTS AND DISCUSSIONS

### A. Estimation of Short Duration Rainfall

Table 1 Short duration rainfall for Malalur

Year	Rainfall (mm)	$P_t = P_{24} \left( \frac{t}{24} \right)^{\frac{1}{3}}$ in mm where, time t is in hours							
Duration in minutes		5	10	15	30	60	120	720	1440
1995	50.200	7.602	9.577	10.963	13.813	17.403	21.927	39.844	50.200
1996	47.000	7.117	8.967	10.265	12.933	16.294	20.529	37.304	47.000

1997	55.200	8.359	10.531	12.055	15.189	19.137	24.111	43.812	55.200
1998	65.000	9.843	12.401	14.196	17.885	22.534	28.391	51.591	65.000
1999	40.200	6.087	7.670	8.779	11.061	13.937	17.559	31.907	40.200
2000	44.500	6.738	8.490	9.719	12.245	15.427	19.437	35.320	44.500
2001	52.000	7.874	9.921	11.357	14.308	18.027	22.713	41.272	52.000
2002	50.200	7.602	9.577	10.963	13.813	17.403	21.927	39.844	50.200
2003	53.000	8.026	10.112	11.575	14.584	18.374	23.150	42.066	53.000
2004	68.800	10.418	13.126	15.026	18.931	23.852	30.051	54.607	68.800
2005	49.500	7.496	9.444	10.811	13.620	17.161	21.621	39.288	49.500
2006	28.600	4.331	5.456	6.246	7.870	9.915	12.492	22.700	28.600
2007	58.200	8.813	11.104	12.711	16.014	20.177	25.421	46.193	58.200
2008	61.000	9.237	11.638	13.322	16.785	21.148	26.644	48.416	61.000
2009	74.000	11.206	14.118	16.161	20.362	25.654	32.322	58.734	74.000
2010	47.500	7.193	9.062	10.374	13.070	16.467	20.748	37.701	47.500
2011	30.000	4.543	5.724	6.552	8.255	10.400	13.104	23.811	30.000
2012	42.600	6.451	8.127	9.304	11.722	14.769	18.607	33.812	42.600
2013	53.300	8.071	10.169	11.640	14.666	18.478	23.281	42.304	53.300
2014	42.000	6.360	8.013	9.173	11.557	14.561	18.345	33.335	42.000
2015	28.800	4.361	5.495	6.290	7.925	9.984	12.580	22.859	28.800
2016	60.000	9.086	11.447	13.104	16.510	20.801	26.207	47.622	60.000
2017	58.100	8.798	11.085	12.689	15.987	20.142	25.378	46.114	58.100

Table 2 Short duration rainfall for Shravanabelagola

Year	Rainfall (mm)	$P_t = P_{24} \left(\frac{t}{24}\right)^{\frac{1}{3}}$ in mm where, time t is in hours							
		5	10	15	30	60	120	720	1440
1995	65.600	9.934	12.516	14.327	18.051	22.742	28.653	52.067	65.600
1996	75.800	11.478	14.462	16.554	20.857	26.278	33.109	60.162	75.800
1997	98.600	14.931	18.811	21.534	27.131	34.183	43.068	78.259	98.600
1998	40.200	6.087	7.670	8.779	11.061	13.937	17.559	31.907	40.200
1999	116.800	17.687	22.284	25.509	32.139	40.492	51.017	92.704	116.800
2000	79.200	11.993	15.110	17.297	21.793	27.457	34.594	62.861	79.200
2001	60.000	9.086	11.447	13.104	16.510	20.801	26.207	47.622	60.000
2002	60.200	9.116	11.485	13.147	16.565	20.870	26.295	47.781	60.200
2003	69.200	10.479	13.202	15.113	19.041	23.990	30.226	54.924	69.200
2004	82.000	12.417	15.644	17.908	22.563	28.428	35.817	65.083	82.000
2005	140.000	21.200	26.710	30.575	38.522	48.535	61.151	111.118	140.000
2006	46.000	6.966	8.776	10.046	12.657	15.947	20.092	36.510	46.000
2007	71.800	10.872	13.698	15.681	19.757	24.892	31.362	56.988	71.800
2008	70.400	10.660	13.431	15.375	19.371	24.406	30.750	55.877	70.400
2009	182.200	27.590	34.761	39.792	50.134	63.165	79.583	144.612	182.200
2010	95.400	14.446	18.201	20.835	26.250	33.073	41.670	75.719	95.400
2011	90.800	13.750	17.323	19.830	24.985	31.479	39.661	72.068	90.800
2012	73.000	11.054	13.927	15.943	20.087	25.308	31.886	57.940	73.000
2013	72.800	11.024	13.889	15.899	20.032	25.238	31.798	57.781	72.800
2014	57.600	8.722	10.989	12.580	15.849	19.969	25.159	45.717	57.600
2015	38.900	5.890	7.422	8.496	10.704	13.486	16.991	30.875	38.900
2016	42.000	6.360	8.013	9.173	11.557	14.561	18.345	33.335	42.000
2017	77.700	11.766	14.824	16.969	21.380	26.937	33.939	61.671	77.700

Table 3 Short duration rainfall for Hallimysore

Year	Rainfall (mm)	$P_t = P_{24} \left(\frac{t}{24}\right)^{\frac{1}{3}}$ in mm where, time t is in hours							
		5	10	15	30	60	120	720	1440
1995	56.600	8.571	10.798	12.361	15.574	19.622	24.722	44.923	56.600
1996	66.800	10.115	12.744	14.589	18.381	23.158	29.178	53.019	66.800
1997	84.400	12.780	16.102	18.433	23.224	29.260	36.865	66.988	84.400
1998	37.000	5.603	7.059	8.081	10.181	12.827	16.161	29.367	37.000
1999	91.200	13.810	17.400	19.918	25.095	31.617	39.835	72.385	91.200
2000	54.200	8.207	10.341	11.837	14.914	18.790	23.674	43.019	54.200
2001	85.400	12.932	16.293	18.651	23.499	29.607	37.302	67.782	85.400
2002	56.300	8.525	10.741	12.296	15.492	19.518	24.591	44.685	56.300
2003	63.200	9.570	12.058	13.803	17.390	21.910	27.605	50.162	63.200
2004	60.200	9.116	11.485	13.147	16.565	20.870	26.295	47.781	60.200
2005	58.200	8.813	11.104	12.711	16.014	20.177	25.421	46.193	58.200

2006	50.800	7.692	9.692	11.094	13.978	17.611	22.189	40.320	50.800
2007	46.200	6.996	8.814	10.090	12.712	16.017	20.180	36.669	46.200
2008	60.200	9.116	11.485	13.147	16.565	20.870	26.295	47.781	60.200
2009	72.400	10.963	13.813	15.812	19.922	25.100	31.624	57.464	72.400
2010	72.800	11.024	13.889	15.899	20.032	25.238	31.798	57.781	72.800
2011	62.200	9.419	11.867	13.584	17.115	21.564	27.168	49.368	62.200
2012	58.800	8.904	11.218	12.842	16.179	20.385	25.683	46.670	58.800
2013	64.800	9.812	12.363	14.152	17.830	22.465	28.304	51.432	64.800
2014	83.800	12.690	15.988	18.302	23.058	29.052	36.603	66.512	83.800
2015	66.800	10.115	12.744	14.589	18.381	23.158	29.178	53.019	66.800
2016	55.500	8.404	10.589	12.121	15.271	19.241	24.242	44.050	55.500
2017	87.700	13.280	16.732	19.153	24.132	30.404	38.307	69.608	87.700

Table 4 Short duration rainfall for Javali

Year	Rainfall (mm)	$P_t = P_{24} \left(\frac{t}{24}\right)^{\frac{1}{3}}$ in mm where, time t is in hours							
		5	10	15	30	60	120	720	1440
1995	140.000	21.200	26.710	30.575	38.522	48.535	61.151	111.118	140.000
1996	87.000	13.174	16.598	19.000	23.939	30.161	38.001	69.052	87.000
1997	136.000	20.594	25.947	29.702	37.422	47.149	59.403	107.943	136.000
1998	124.000	18.777	23.657	27.081	34.120	42.988	54.162	98.419	124.000
1999	121.000	18.323	23.085	26.426	33.294	41.948	52.852	96.038	121.000
2000	156.600	23.713	29.877	34.201	43.090	54.290	68.401	124.294	156.600
2001	119.000	18.020	22.704	25.989	32.744	41.255	51.978	94.450	119.000
2002	131.000	19.837	24.993	28.610	36.046	45.415	57.220	103.975	131.000
2003	129.600	19.625	24.726	28.304	35.661	44.930	56.608	102.864	129.600
2004	170.000	25.743	32.434	37.127	46.777	58.936	74.254	134.929	170.000
2005	127.000	19.231	24.230	27.736	34.945	44.028	55.472	100.800	127.000
2006	146.400	22.169	27.931	31.973	40.284	50.754	63.946	116.198	146.400
2007	209.000	31.648	39.874	45.645	57.509	72.456	91.289	165.883	209.000
2008	158.000	23.925	30.144	34.506	43.475	54.776	69.013	125.405	158.000
2009	218.000	33.011	41.591	47.610	59.985	75.576	95.220	173.027	218.000
2010	112.500	17.035	21.463	24.569	30.956	39.002	49.139	89.291	112.500
2011	187.500	28.392	35.772	40.949	51.593	65.003	81.898	148.819	187.500
2012	149.300	22.608	28.484	32.606	41.081	51.759	65.213	118.499	149.300
2013	170.300	25.788	32.491	37.193	46.860	59.040	74.385	135.167	170.300
2014	210.000	31.800	40.065	45.863	57.784	72.803	91.726	166.677	210.000
2015	214.000	32.405	40.828	46.737	58.884	74.190	93.473	169.852	214.000
2016	112.500	17.035	21.463	24.569	30.956	39.002	49.139	89.291	112.500
2017	148.500	22.487	28.332	32.432	40.861	51.482	64.863	117.865	148.500

**B. Log-normal distribution**

Variables in a system sometimes follow an exponential relationship as  $x = \exp(w)$ . If the exponent is a random variable, say  $W$ ,  $X = \exp(W)$  is a random variable and the distribution of  $X$  is of interest. An important special case occurs when  $W$  has a normal distribution. In that case, the distribution of  $X$  is called a lognormal distribution. The name follows transformation  $\ln(X) = W$ . That is, the natural logarithm of  $X$  is normally distributed. (Kreyszig, 2006)

Probabilities for  $x$  are obtained from the transformation to  $W$ , but we need to recognize that the range of  $X$  is  $(0, \infty)$ . Suppose that  $W$  is normally distributed with mean  $\theta$  and variance  $\omega^2$ ; then the cumulative distribution function for  $x$  is

$$F(x) = \int_0^x \frac{1}{xb\sqrt{2\pi}} \exp\left\{-\frac{(\ln x - a)^2}{2b^2}\right\} dx; \quad 0 < x < \infty$$

(Equation II)

Since the random variable  $X$  is log normally distributed, then the random variable:

$$Y = \ln X$$

(Equation III)

is normally distributed. With transformation

$$Z = \frac{Y - a}{b}$$

(Equation IV)

Lognormal distribution becomes the standard normal distribution.

The frequency factor for log-normal distribution is same as normal distribution except that it is applied to the logarithms of the variables and their mean and standard deviations are used in  $y_T = \bar{y} + k_T s_y$

Where  $\bar{y} = \mu_y = \frac{1}{2} \ln \left[ \frac{\mu_x^4}{\mu_x^2 + \sigma_x^2} \right]$  and  $\sigma_y^2 = \ln \left[ \frac{\sigma_x^2 + \mu_x^2}{\mu_x^2} \right]$

Table 5 Estimation of maximum rainfall intensity for various return period For Chikkamangalore Station

Duration in minutes	Return period 2 yrs		Return period 5 yrs		Return period 10 yrs		Return period 25 yrs		Return period 50 yrs		Return period 75 yrs		Return period 100 yrs	
	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)
5	11.599	139.189	11.857	142.282	11.932	143.184	11.974	143.691	11.988	143.854	11.992	143.908	11.995	143.934
10	14.614	87.684	14.939	89.632	15.033	90.201	15.087	90.520	15.104	90.622	15.109	90.656	15.112	90.673
15	16.729	66.915	17.101	68.402	17.209	68.836	17.270	69.079	17.289	69.158	17.296	69.184	17.299	69.196
30	21.077	42.154	21.545	43.091	21.682	43.364	21.759	43.517	21.783	43.567	21.791	43.583	21.795	43.591
60	26.555	26.555	27.145	27.145	27.318	27.318	27.414	27.414	27.445	27.445	27.456	27.456	27.461	27.461
120	33.458	16.729	34.201	17.101	34.418	17.209	34.540	17.270	34.579	17.289	34.592	17.296	34.598	17.299
720	60.796	5.066	62.148	5.179	62.542	5.212	62.763	5.230	62.834	5.236	62.858	5.238	62.869	5.239
1440	76.599	3.192	78.301	3.263	78.798	3.283	79.076	3.295	79.166	3.299	79.196	3.300	79.210	3.300

Table 6 Estimation of maximum rainfall intensity for various return period For Hagare Station

Duration in minutes	Return period 2 yrs		Return period 5 yrs		Return period 10 yrs		Return period 25 yrs		Return period 50 yrs		Return period 75 yrs		Return period 100 yrs	
	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)
5	11.540	138.484	11.885	142.622	11.986	143.835	12.043	144.517	12.061	144.737	12.067	144.809	12.070	144.845
10	14.540	87.240	14.974	89.847	15.102	90.611	15.173	91.040	15.196	91.179	15.204	91.224	15.208	91.247
15	16.644	66.576	17.141	68.566	17.287	69.149	17.369	69.477	17.396	69.582	17.404	69.617	17.409	69.634
30	20.970	41.940	21.597	43.194	21.780	43.561	21.884	43.767	21.917	43.834	21.928	43.856	21.933	43.867
60	26.421	26.421	27.210	27.210	27.442	27.442	27.572	27.572	27.614	27.614	27.628	27.628	27.634	27.634
120	33.288	16.644	34.283	17.141	34.574	17.287	34.738	17.369	34.791	17.396	34.809	17.404	34.817	17.409
720	60.489	5.041	62.296	5.191	62.826	5.235	63.124	5.260	63.220	5.268	63.251	5.271	63.267	5.272
1440	76.211	3.175	78.488	3.270	79.156	3.298	79.531	3.314	79.652	3.319	79.692	3.320	79.711	3.321

Table 7 Estimation of maximum rainfall intensity for various return period For Basavapatna Station

Duration in minutes	Return period 2 yrs		Return period 5 yrs		Return period 10 yrs		Return period 25 yrs		Return period 50 yrs		Return period 75 yrs		Return period 100 yrs	
	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)
5	11.183	134.201	11.508	138.097	11.603	139.238	11.657	139.880	11.674	140.087	11.680	140.155	11.682	140.188
10	14.090	84.541	14.499	86.996	14.619	87.715	14.686	88.119	14.708	88.249	14.715	88.292	14.719	88.313
15	16.129	64.517	16.598	66.390	16.735	66.939	16.812	67.247	16.837	67.347	16.845	67.379	16.849	67.396
30	20.322	40.643	20.912	41.823	21.084	42.169	21.182	42.363	21.213	42.426	21.223	42.446	21.228	42.457
60	25.604	25.604	26.347	26.347	26.565	26.565	26.687	26.687	26.727	26.727	26.740	26.740	26.746	26.746
120	32.259	16.129	33.195	16.598	33.469	16.735	33.624	16.812	33.673	16.837	33.690	16.845	33.698	16.849
720	58.618	4.885	60.319	5.027	60.818	5.068	61.098	5.092	61.188	5.099	61.218	5.102	61.233	5.103
1440	73.854	3.077	75.998	3.167	76.626	3.193	76.979	3.207	77.093	3.212	77.130	3.214	77.149	3.215

Table 8 Estimation of maximum rainfall intensity for various return period For harangi Station

Duration in minutes	Return period 2 yrs		Return period 5 yrs		Return period 10 yrs		Return period 25 yrs		Return period 50 yrs		Return period 75 yrs		Return period 100 yrs	
	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)
5	11.183	134.201	11.508	138.097	11.603	139.238	11.657	139.880	11.674	140.087	11.680	140.155	11.682	140.188
10	14.090	84.541	14.499	86.996	14.619	87.715	14.686	88.119	14.708	88.249	14.715	88.292	14.719	88.313
15	16.129	64.517	16.598	66.390	16.735	66.939	16.812	67.247	16.837	67.347	16.845	67.379	16.849	67.396
30	20.322	40.643	20.912	41.823	21.084	42.169	21.182	42.363	21.213	42.426	21.223	42.446	21.228	42.457
60	25.604	25.604	26.347	26.347	26.565	26.565	26.687	26.687	26.727	26.727	26.740	26.740	26.746	26.746
120	32.259	16.129	33.195	16.598	33.469	16.735	33.624	16.812	33.673	16.837	33.690	16.845	33.698	16.849
720	58.618	4.885	60.319	5.027	60.818	5.068	61.098	5.092	61.188	5.099	61.218	5.102	61.233	5.103
1440	73.854	3.077	75.998	3.167	76.626	3.193	76.979	3.207	77.093	3.212	77.130	3.214	77.149	3.215

5	12.225	146.702	12.629	151.543	12.747	152.965	12.814	153.765	12.835	154.023	12.842	154.108	12.846	154.150
10	15.403	92.417	15.911	95.467	16.060	96.362	16.144	96.866	16.171	97.029	16.180	97.082	16.185	97.108
15	17.632	70.527	18.214	72.855	18.385	73.538	18.481	73.923	18.512	74.047	18.522	74.087	18.527	74.108
30	22.215	44.429	22.948	45.896	23.163	46.326	23.284	46.568	23.323	46.646	23.336	46.672	23.342	46.685
60	27.989	27.989	28.912	28.912	29.184	29.184	29.336	29.336	29.385	29.385	29.402	29.402	29.410	29.410
120	35.263	17.632	36.427	18.214	36.769	18.385	36.961	18.481	37.023	18.512	37.044	18.522	37.054	18.527
720	64.078	5.340	66.193	5.516	66.814	5.568	67.163	5.597	67.276	5.606	67.313	5.609	67.331	5.611
1440	80.733	3.364	83.398	3.475	84.180	3.508	84.620	3.526	84.762	3.532	84.809	3.534	84.832	3.535

Table 9 Estimation of maximum rainfall intensity for various return period For Hallimysore Station

Duration in minutes	Return period 2 yrs		Return period 5 yrs		Return period 10 yrs		Return period 25 yrs		Return period 50 yrs		Return period 75 yrs		Return period 100 yrs	
	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)
5	11.151	133.810	11.382	136.589	11.450	137.399	11.488	137.854	11.500	138.000	11.504	138.048	11.506	138.072
10	14.049	84.295	14.341	86.046	14.426	86.556	14.474	86.843	14.489	86.935	14.494	86.965	14.497	86.980
15	16.082	64.329	16.416	65.665	16.514	66.055	16.568	66.273	16.586	66.344	16.592	66.367	16.595	66.378
30	20.262	40.525	20.683	41.367	20.806	41.612	20.875	41.750	20.897	41.794	20.904	41.809	20.908	41.816
60	25.529	25.529	26.059	26.059	26.214	26.214	26.301	26.301	26.329	26.329	26.338	26.338	26.342	26.342
120	32.165	16.082	32.833	16.416	33.027	16.514	33.137	16.568	33.172	16.586	33.183	16.592	33.189	16.595
720	58.447	4.871	59.661	4.972	60.015	5.001	60.213	5.018	60.277	5.023	60.298	5.025	60.309	5.026
1440	73.638	3.068	75.168	3.132	75.614	3.151	75.864	3.161	75.945	3.164	75.971	3.165	75.984	3.166

Table 10 Estimation of maximum rainfall intensity for various return period For Hosakere Station

Duration in minutes	Return period 2 yrs		Return period 5 yrs		Return period 10 yrs		Return period 25 yrs		Return period 50 yrs		Return period 75 yrs		Return period 100 yrs	
	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)
5	39.231	470.777	40.145	481.742	40.412	484.941	40.562	486.738	40.610	487.317	40.626	487.507	40.633	487.601
10	49.429	296.571	50.580	303.479	50.916	305.495	51.104	306.626	51.165	306.991	51.185	307.111	51.195	307.170
15	56.582	226.326	57.899	231.597	58.284	233.136	58.500	234.000	58.569	234.278	58.592	234.369	58.604	234.415
30	71.288	142.577	72.949	145.897	73.433	146.866	73.705	147.411	73.793	147.586	73.822	147.643	73.836	147.672
60	89.818	89.818	91.910	91.910	92.520	92.520	92.863	92.863	92.973	92.973	93.010	93.010	93.027	93.027
120	113.163	56.582	115.799	57.899	116.568	58.284	117.000	58.500	117.139	58.569	117.185	58.592	117.207	58.604
720	205.631	17.136	210.420	17.535	211.818	17.651	212.603	17.717	212.856	17.738	212.939	17.745	212.980	17.748
1440	259.079	10.795	265.113	11.046	266.874	11.120	267.863	11.161	268.181	11.174	268.286	11.179	268.338	11.181

Table 11 Estimation of maximum rainfall intensity for various return period For Hunsur Station

Duration in minutes	Return period 2 yrs		Return period 5 yrs		Return period 10 yrs		Return period 25 yrs		Return period 50 yrs		Return period 75 yrs		Return period 100 yrs	
	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)
5	12.009	144.103	12.393	148.720	12.506	150.075	12.570	150.837	12.590	151.083	12.597	151.164	12.600	151.204
10	15.130	90.779	15.615	93.688	15.757	94.542	15.837	95.022	15.863	95.177	15.871	95.228	15.875	95.253
15	17.319	69.278	17.874	71.497	18.037	72.149	18.129	72.515	18.158	72.633	18.168	72.672	18.173	72.691
30	21.821	43.642	22.520	45.040	22.725	45.451	22.841	45.682	22.878	45.756	22.890	45.781	22.896	45.793
60	27.493	27.493	28.374	28.374	28.632	28.632	28.778	28.778	28.825	28.825	28.840	28.840	28.848	28.848
120	34.639	17.319	35.749	17.874	36.074	18.037	36.258	18.129	36.317	18.158	36.336	18.168	36.346	18.173

720	62.943	5.245	64.960	5.413	65.551	5.463	65.884	5.490	65.992	5.499	66.027	5.502	66.044	5.504
1440	79.303	3.304	81.844	3.410	82.590	3.441	83.009	3.459	83.144	3.464	83.189	3.466	83.211	3.467

Table 12 Estimation of maximum rainfall intensity for various return period For Krishnarajpet Station

Duration in minutes	Return period 2 yrs		Return period 5 yrs		Return period 10 yrs		Return period 25 yrs		Return period 50 yrs		Return period 75 yrs		Return period 100 yrs	
	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)
5	12.168	146.013	12.445	149.345	12.526	150.317	12.572	150.862	12.587	151.038	12.591	151.096	12.594	151.125
10	15.330	91.983	15.680	94.082	15.782	94.694	15.840	95.038	15.858	95.148	15.864	95.185	15.867	95.203
15	17.549	70.196	17.949	71.798	18.066	72.265	18.132	72.527	18.153	72.612	18.160	72.640	18.163	72.653
30	22.110	44.221	22.615	45.230	22.762	45.524	22.845	45.689	22.871	45.743	22.880	45.760	22.884	45.769
60	27.857	27.857	28.493	28.493	28.678	28.678	28.782	28.782	28.816	28.816	28.827	28.827	28.832	28.832
120	35.098	17.549	35.899	17.949	36.132	18.066	36.264	18.132	36.306	18.153	36.320	18.160	36.327	18.163
720	63.777	5.315	65.232	5.436	65.657	5.471	65.895	5.491	65.972	5.498	65.997	5.500	66.010	5.501
1440	80.354	3.348	82.188	3.424	82.723	3.447	83.023	3.459	83.120	3.463	83.151	3.465	83.167	3.465

Table 13 Estimation of maximum rainfall intensity for various return period For Javali Station

Duration in minutes	Return period 2 yrs		Return period 5 yrs		Return period 10 yrs		Return period 25 yrs		Return period 50 yrs		Return period 75 yrs		Return period 100 yrs	
	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)
5	26.219	314.627	26.826	321.909	27.003	324.034	27.102	325.228	27.134	325.612	27.145	325.738	27.150	325.801
10	33.034	198.203	33.798	202.791	34.022	204.129	34.147	204.881	34.187	205.123	34.200	205.203	34.207	205.242
15	37.814	151.257	38.690	154.758	38.945	155.780	39.088	156.353	39.135	156.538	39.150	156.599	39.157	156.629
30	47.643	95.286	48.746	97.491	49.068	98.135	49.248	98.496	49.306	98.613	49.326	98.651	49.335	98.670
60	60.026	60.026	61.416	61.416	61.821	61.821	62.049	62.049	62.122	62.122	62.146	62.146	62.158	62.158
120	75.629	37.814	77.379	38.690	77.890	38.945	78.177	39.088	78.269	39.135	78.299	39.150	78.314	39.157
720	137.426	11.452	140.607	11.717	141.535	11.795	142.056	11.838	142.224	11.852	142.280	11.857	142.307	11.859
1440	173.146	7.214	177.154	7.381	178.323	7.430	178.980	7.457	179.191	7.466	179.261	7.469	179.295	7.471

Table 14 Estimation of maximum rainfall intensity for various return period For Malalur Station

Duration in minutes	Return period 2 yrs		Return period 5 yrs		Return period 10 yrs		Return period 25 yrs		Return period 50 yrs		Return period 75 yrs		Return period 100 yrs	
	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)
5	8.730	104.761	8.929	107.149	8.987	107.846	9.020	108.237	9.030	108.363	9.034	108.404	9.035	108.425
10	10.999	65.996	11.250	67.500	11.323	67.939	11.364	68.185	11.377	68.264	11.382	68.291	11.384	68.303
15	12.591	50.364	12.878	51.512	12.962	51.847	13.009	52.035	13.024	52.095	13.029	52.115	13.031	52.125
30	15.864	31.727	16.225	32.451	16.331	32.661	16.390	32.780	16.409	32.818	16.415	32.831	16.418	32.837
60	19.987	19.987	20.443	20.443	20.575	20.575	20.650	20.650	20.674	20.674	20.682	20.682	20.686	20.686
120	25.182	12.591	25.756	12.878	25.923	12.962	26.017	13.009	26.048	13.024	26.058	13.029	26.063	13.031
720	45.759	3.813	46.802	3.900	47.106	3.926	47.277	3.940	47.332	3.944	47.350	3.946	47.359	3.947
1440	57.653	2.402	58.967	2.457	59.350	2.473	59.565	2.482	59.634	2.485	59.657	2.486	59.669	2.486

Table 15 Estimation of maximum rainfall intensity for various return period For Mallipatna Station

Duration in minutes	Return period 2 yrs		Return period 5 yrs		Return period 10 yrs		Return period 25 yrs		Return period 50 yrs		Return period 75 yrs		Return period 100 yrs	
	Rainfall	Rainfall	Rainfall	Rainfall	Rainfall	Rainfall	Rainfall	Rainfall	Rainfall	Rainfall	Rainfall	Rainfall	Rainfall	Rainfall

	Depth(mm)	Intensity (mm/hr)	Depth(mm)	Intensity (mm/hr)	Depth(mm)	Intensity (mm/hr)	Depth(mm)	Depth(mm)	Intensity (mm/hr)	Depth(mm)	Intensity (mm/hr)	Depth(mm)	Intensity (mm/hr)	Depth(mm)
5	11.899	142.793	12.133	145.591	12.200	146.406	12.239	146.863	12.251	147.010	12.255	147.058	12.257	147.082
10	14.992	89.954	15.286	91.717	15.372	92.230	15.420	92.518	15.435	92.611	15.440	92.641	15.443	92.656
15	17.162	68.648	17.498	69.993	17.596	70.385	17.651	70.604	17.669	70.675	17.675	70.698	17.677	70.710
30	21.623	43.245	22.046	44.093	22.170	44.340	22.239	44.478	22.261	44.523	22.269	44.537	22.272	44.544
60	27.243	27.243	27.777	27.777	27.932	27.932	28.019	28.019	28.047	28.047	28.057	28.057	28.061	28.061
120	34.324	17.162	34.996	17.498	35.192	17.596	35.302	17.651	35.338	17.669	35.349	17.675	35.355	17.677
720	62.371	5.198	63.593	5.299	63.949	5.329	64.148	5.346	64.213	5.351	64.234	5.353	64.244	5.354
1440	78.582	3.274	80.122	3.338	80.570	3.357	80.822	3.368	80.903	3.371	80.929	3.372	80.943	3.373

Table 16 Estimation of maximum rainfall intensity for various return period For Melkote Station

Duration in minutes	Return period 2 yrs		Return period 5 yrs		Return period 10 yrs		Return period 25 yrs		Return period 50 yrs		Return period 75 yrs		Return period 100 yrs	
	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)
5	15.047	180.560	15.518	186.219	15.657	187.879	15.734	188.813	15.760	189.114	15.768	189.213	15.772	189.262
10	18.958	113.746	19.552	117.311	19.726	118.357	19.824	118.945	19.856	119.135	19.866	119.197	19.871	119.228
15	21.701	86.804	22.381	89.525	22.581	90.323	22.693	90.772	22.729	90.917	22.741	90.964	22.747	90.988
30	27.342	54.683	28.199	56.397	28.450	56.900	28.591	57.183	28.637	57.274	28.652	57.304	28.659	57.319
60	34.448	34.448	35.528	35.528	35.845	35.845	36.023	36.023	36.080	36.080	36.099	36.099	36.109	36.109
120	43.402	21.701	44.763	22.381	45.162	22.581	45.386	22.693	45.458	22.729	45.482	22.741	45.494	22.747
720	78.867	6.572	81.339	6.778	82.064	6.839	82.472	6.873	82.603	6.884	82.647	6.887	82.668	6.889
1440	99.366	4.140	102.481	4.270	103.394	4.308	103.908	4.329	104.074	4.336	104.128	4.339	104.155	4.340

Table 17 Estimation of maximum rainfall intensity for various return period For Naladi Station

Duration in minutes	Return period 2 yrs		Return period 5 yrs		Return period 10 yrs		Return period 25 yrs		Return period 50 yrs		Return period 75 yrs		Return period 100 yrs	
	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)
5	49.839	598.069	51.438	617.261	51.908	622.892	52.172	626.061	52.257	627.082	52.285	627.418	52.299	627.584
10	62.793	376.761	64.808	388.851	65.400	392.398	65.732	394.394	65.840	395.038	65.875	395.249	65.892	395.354
15	71.881	287.522	74.187	296.748	74.864	299.456	75.245	300.979	75.368	301.470	75.408	301.632	75.428	301.711
30	90.564	181.128	93.470	186.940	94.323	188.645	94.802	189.605	94.957	189.914	95.008	190.016	95.033	190.066
60	114.103	114.103	117.765	117.765	118.839	118.839	119.444	119.444	119.638	119.638	119.703	119.703	119.734	119.734
120	143.761	71.881	148.374	74.187	149.728	74.864	150.489	75.245	150.735	75.368	150.816	75.408	150.856	75.428
720	261.231	21.769	269.614	22.468	272.074	22.673	273.458	22.788	273.904	22.825	274.050	22.838	274.123	22.844
1440	329.131	13.714	339.692	14.154	342.791	14.283	344.535	14.356	345.097	14.379	345.282	14.387	345.373	14.391

Table 18 Estimation of maximum rainfall intensity for various return period For Talakavry Station

Duration in minutes	Return period 2 yrs		Return period 5 yrs		Return period 10 yrs		Return period 25 yrs		Return period 50 yrs		Return period 75 yrs		Return period 100 yrs	
	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)
5	46.283	555.401	47.600	571.205	47.986	575.833	48.203	578.434	48.273	579.272	48.296	579.548	48.307	579.684
10	58.314	349.881	59.973	359.838	60.459	362.753	60.732	364.391	60.820	364.919	60.849	365.093	60.863	365.179
15	66.752	267.009	68.652	274.607	69.208	276.832	69.521	278.082	69.621	278.485	69.654	278.618	69.671	278.683



30	84.103	168.205	86.496	172.992	87.197	174.393	87.590	175.181	87.717	175.435	87.759	175.518	87.780	175.560
60	105.963	105.963	108.978	108.978	109.861	109.861	110.357	110.357	110.517	110.517	110.570	110.570	110.596	110.596
120	133.505	66.752	137.304	68.652	138.416	69.208	139.041	69.521	139.243	69.621	139.309	69.654	139.342	69.671
720	242.594	20.216	249.497	20.791	251.518	20.960	252.655	21.055	253.021	21.085	253.141	21.095	253.201	21.100
1440	305.649	12.735	314.347	13.098	316.893	13.204	318.325	13.264	318.786	13.283	318.938	13.289	319.013	13.292

Table 19 Estimation of maximum rainfall intensity for various return period For Siddapura Station

Duration in minutes	Return period 2 yrs		Return period 5 yrs		Return period 10 yrs		Return period 25 yrs		Return period 50 yrs		Return period 75 yrs		Return period 100 yrs	
	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)
5	16.955	203.455	17.464	209.563	17.613	211.354	17.697	212.360	17.724	212.685	17.733	212.791	17.737	212.844
10	21.361	128.169	22.003	132.017	22.191	133.145	22.296	133.779	22.331	133.983	22.342	134.051	22.347	134.084
15	24.453	97.811	25.187	100.748	25.402	101.608	25.523	102.092	25.562	102.248	25.575	102.300	25.581	102.325
30	30.809	61.617	31.734	63.467	32.005	64.009	32.157	64.314	32.206	64.412	32.222	64.445	32.230	64.461
60	38.816	38.816	39.982	39.982	40.323	40.323	40.515	40.515	40.577	40.577	40.598	40.598	40.608	40.608
120	48.906	24.453	50.374	25.187	50.804	25.402	51.046	25.523	51.124	25.562	51.150	25.575	51.162	25.581
720	88.867	7.406	91.535	7.628	92.317	7.693	92.757	7.730	92.899	7.742	92.945	7.745	92.968	7.747
1440	111.966	4.665	115.327	4.805	116.313	4.846	116.867	4.869	117.045	4.877	117.104	4.879	117.133	4.881

Table 20 Estimation of maximum rainfall intensity for various return period For Srimangala Station

Duration in minutes	Return period 2 yrs		Return period 5 yrs		Return period 10 yrs		Return period 25 yrs		Return period 50 yrs		Return period 75 yrs		Return period 100 yrs	
	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)
5	27.980	335.765	28.898	346.771	29.167	350.002	29.318	351.820	29.367	352.406	29.383	352.598	29.391	352.694
10	35.253	211.519	36.409	218.452	36.748	220.488	36.939	221.633	37.000	222.002	37.021	222.124	37.031	222.184
15	40.355	161.419	41.678	166.710	42.066	168.263	42.284	169.137	42.355	169.419	42.378	169.512	42.389	169.558
30	50.844	101.688	52.510	105.021	53.000	105.999	53.275	106.550	53.364	106.727	53.393	106.786	53.407	106.815
60	64.059	64.059	66.159	66.159	66.775	66.775	67.122	67.122	67.234	67.234	67.271	67.271	67.289	67.289
120	80.710	40.355	83.355	41.678	84.132	42.066	84.569	42.284	84.710	42.355	84.756	42.378	84.779	42.389
720	146.659	12.222	151.466	12.622	152.877	12.740	153.672	12.806	153.928	12.827	154.012	12.834	154.053	12.838
1440	184.779	7.699	190.836	7.951	192.614	8.026	193.614	8.067	193.937	8.081	194.043	8.085	194.095	8.087

Table 21 Estimation of maximum rainfall intensity for various return period For Salagame Station

Duration in minutes	Return period 2 yrs		Return period 5 yrs		Return period 10 yrs		Return period 25 yrs		Return period 50 yrs		Return period 75 yrs		Return period 100 yrs	
	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)	Rainfall Intensity (mm/hr)	Rainfall Depth(mm)
5	12.007	144.084	12.412	148.944	12.531	150.372	12.598	151.176	12.620	151.435	12.627	151.520	12.630	151.562
10	15.128	90.767	15.638	93.829	15.788	94.729	15.872	95.235	15.900	95.398	15.909	95.452	15.913	95.478
15	17.317	69.268	17.901	71.605	18.073	72.291	18.169	72.678	18.201	72.802	18.211	72.843	18.216	72.864
30	21.818	43.636	22.554	45.108	22.770	45.541	22.892	45.784	22.931	45.863	22.944	45.888	22.951	45.901
60	27.489	27.489	28.416	28.416	28.689	28.689	28.842	28.842	28.892	28.892	28.908	28.908	28.916	28.916
120	34.634	17.317	35.803	17.901	36.146	18.073	36.339	18.169	36.401	18.201	36.422	18.211	36.432	18.216
720	62.934	5.245	65.058	5.421	65.681	5.473	66.032	5.503	66.145	5.512	66.183	5.515	66.201	5.517
1440	79.292	3.304	81.967	3.415	82.753	3.448	83.195	3.466	83.338	3.472	83.385	3.474	83.408	3.475

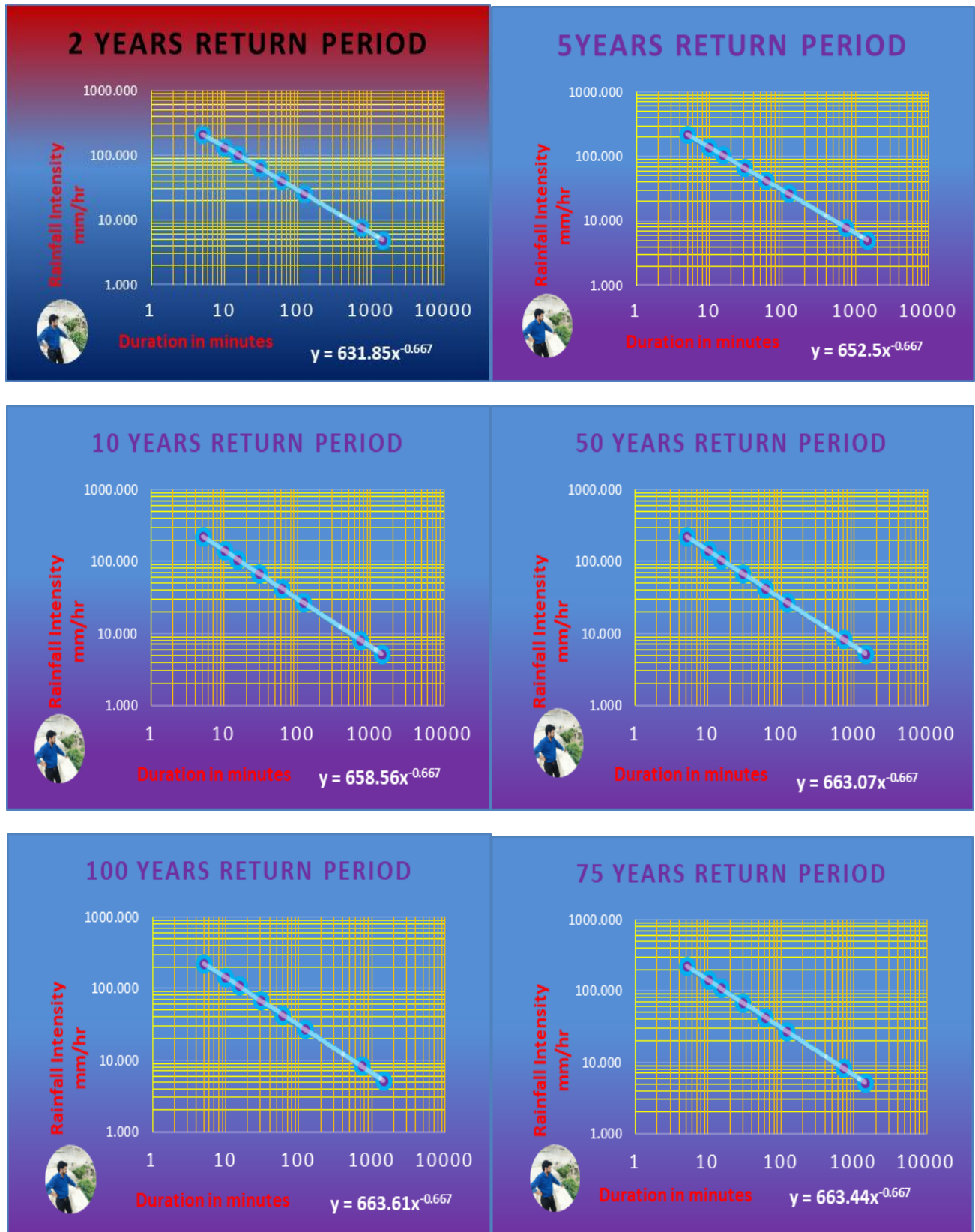
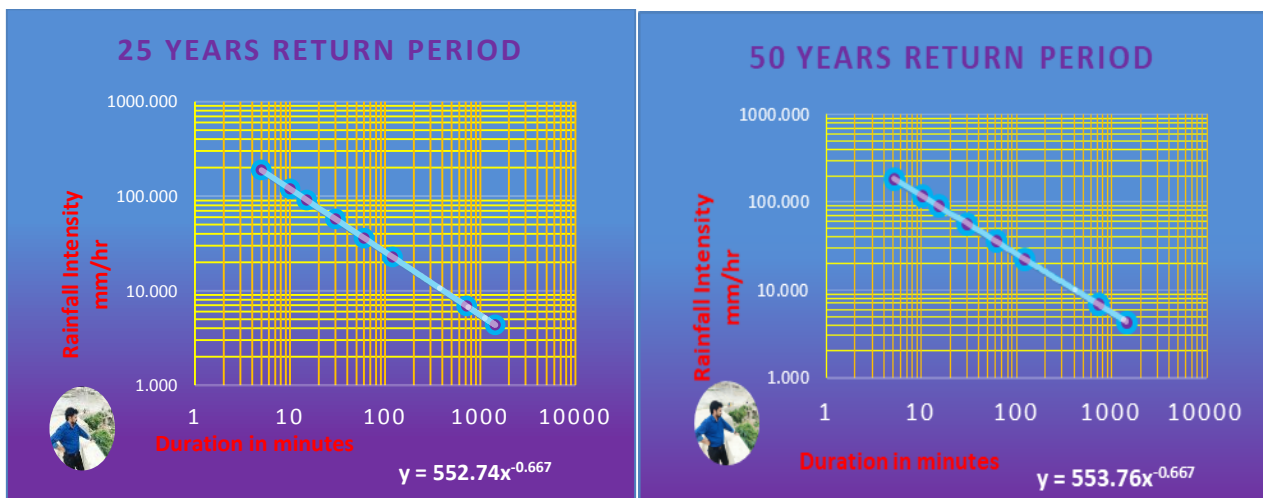


Figure 3 IDF curves for Arehalli Station



Figure 4 IDF curves for Arkalgud Station



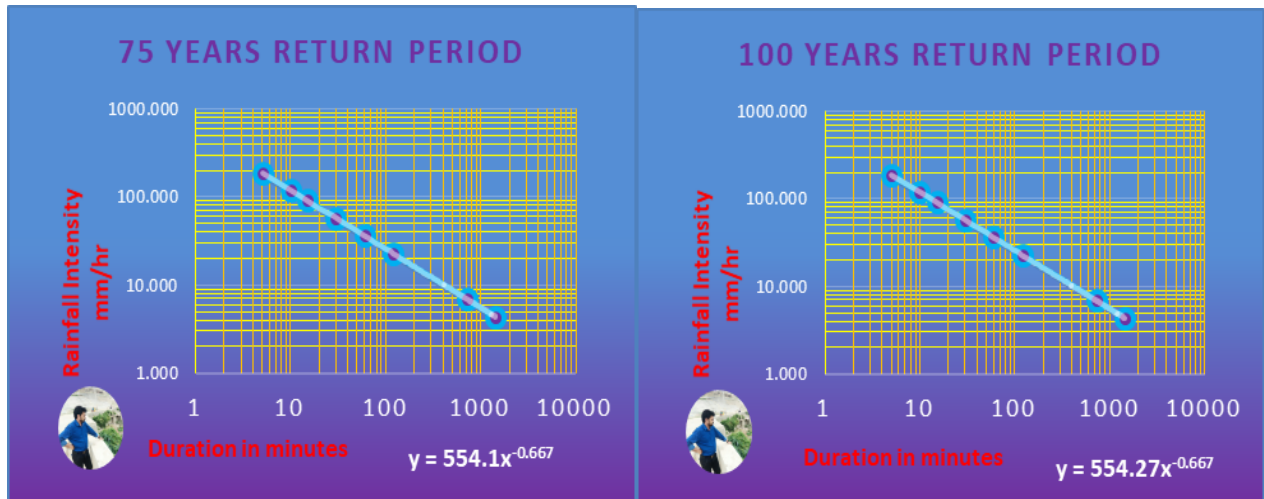


Figure 5 IDF curves for Belagodu Station



Figure 6 IDF curves for Gonibeedu Station

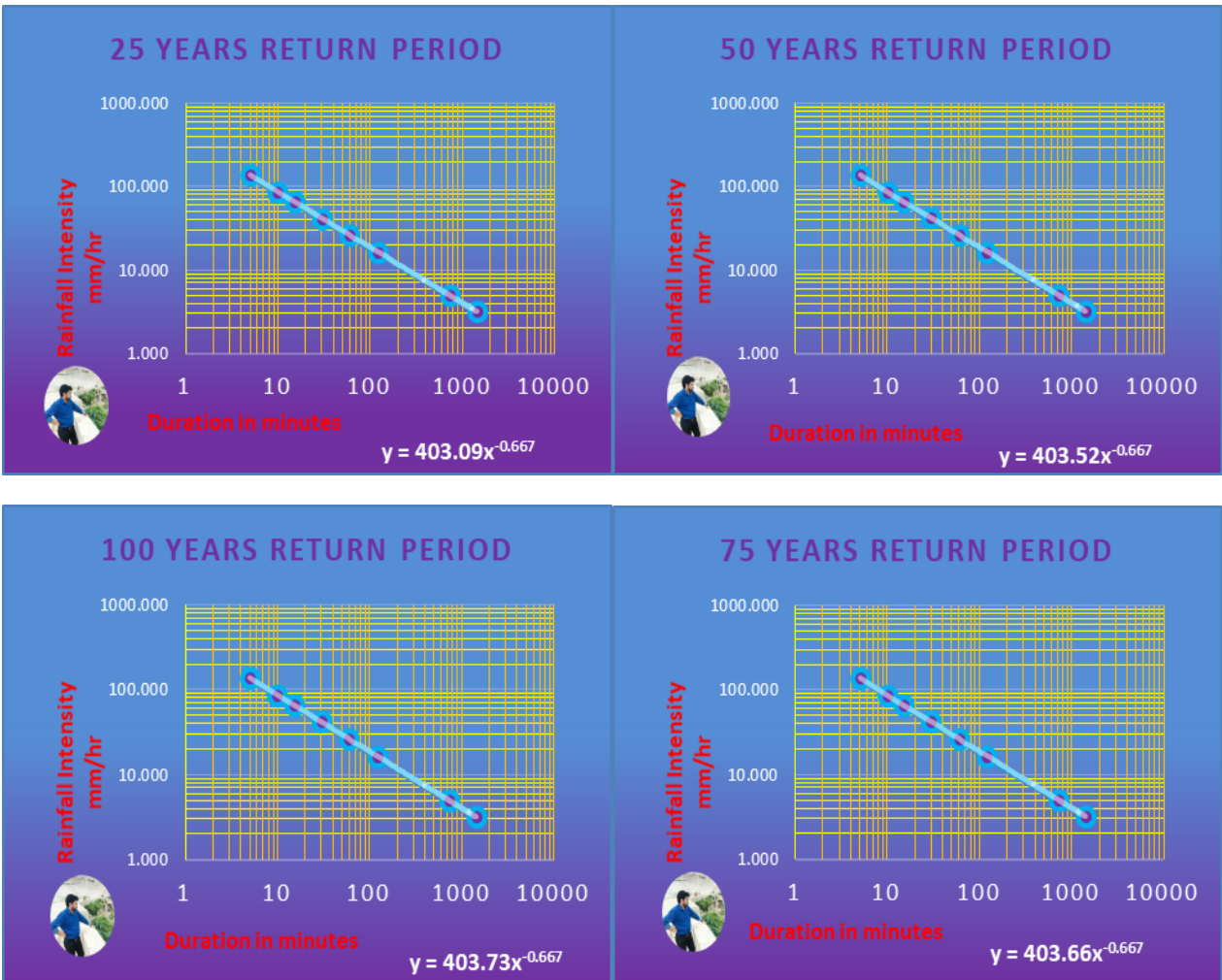
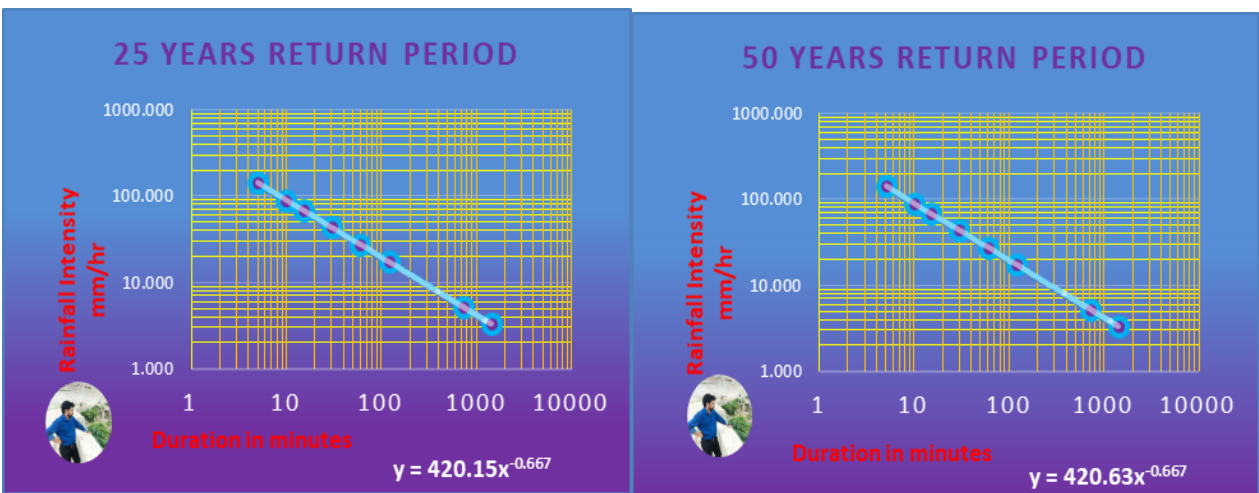


Figure 7 IDF curves for Hallimysore Station



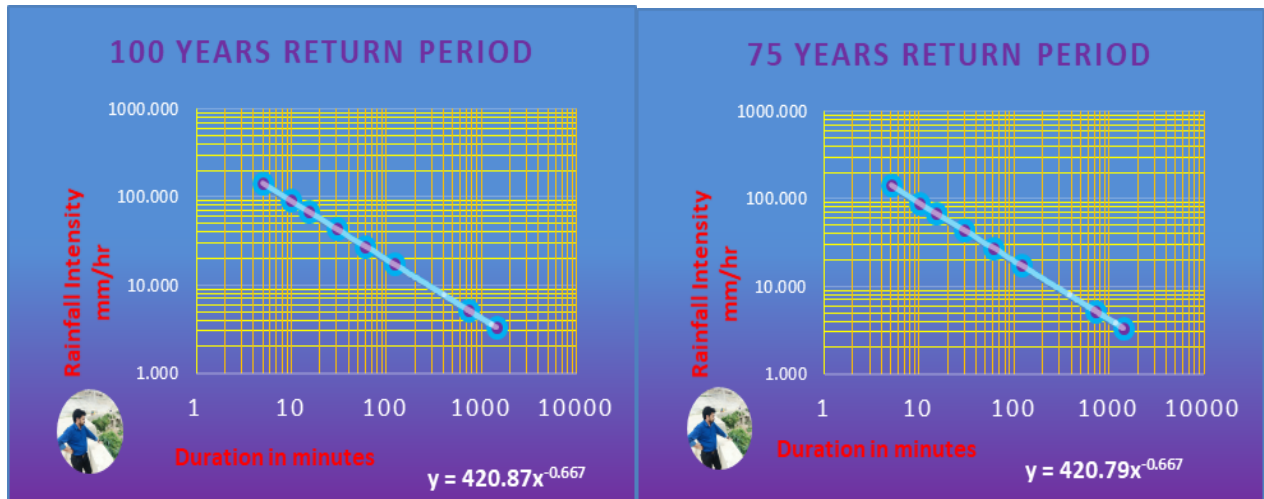


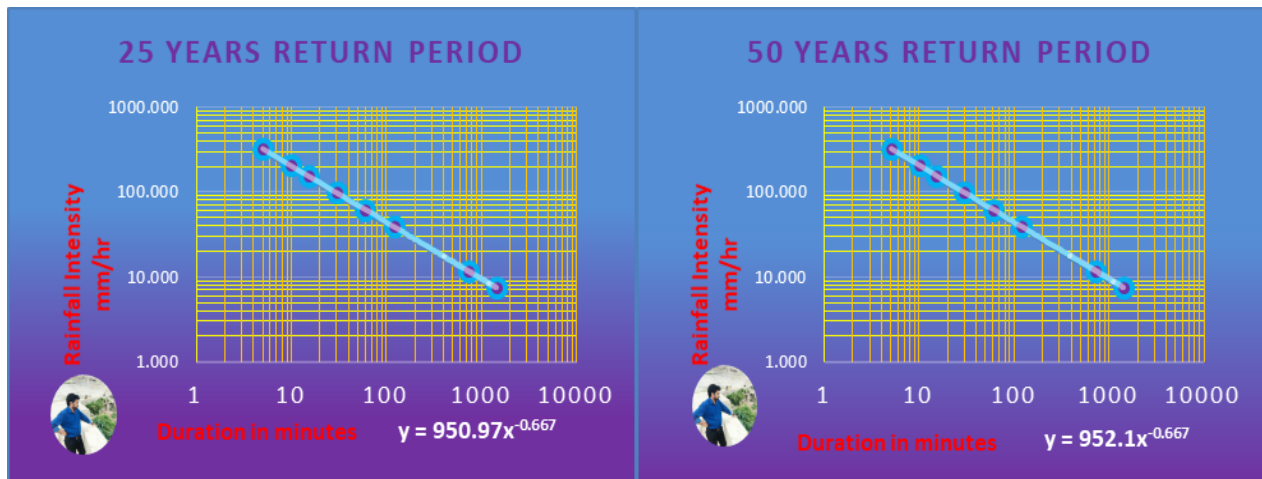
Figure 8 IDF curves for Chikkamangalore Station



Figure 9 IDF curves for Hassan Station



Figure 10 IDF curves for Gorur Station



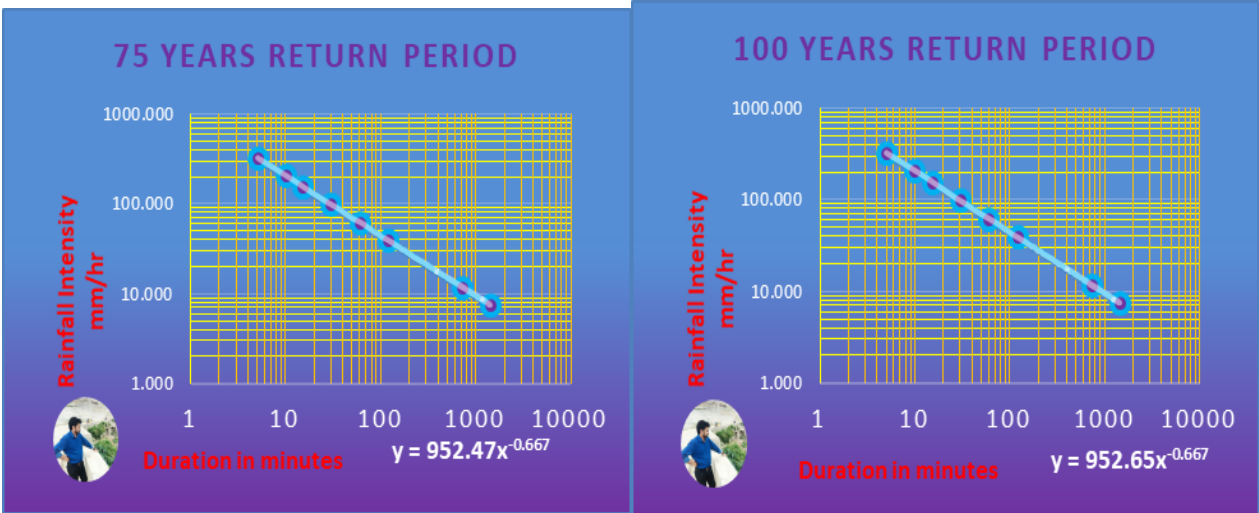


Figure 11 IDF curves for Javali Station

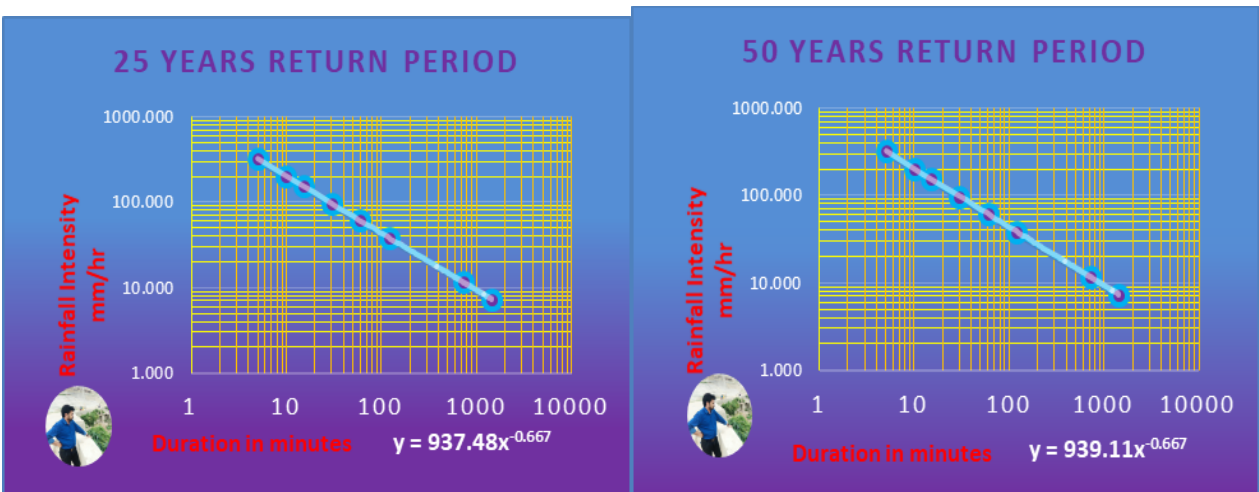


Figure 12 IDF curves for Talakavery Station





Figure 13 IDF curves for Sakaleshpura Station



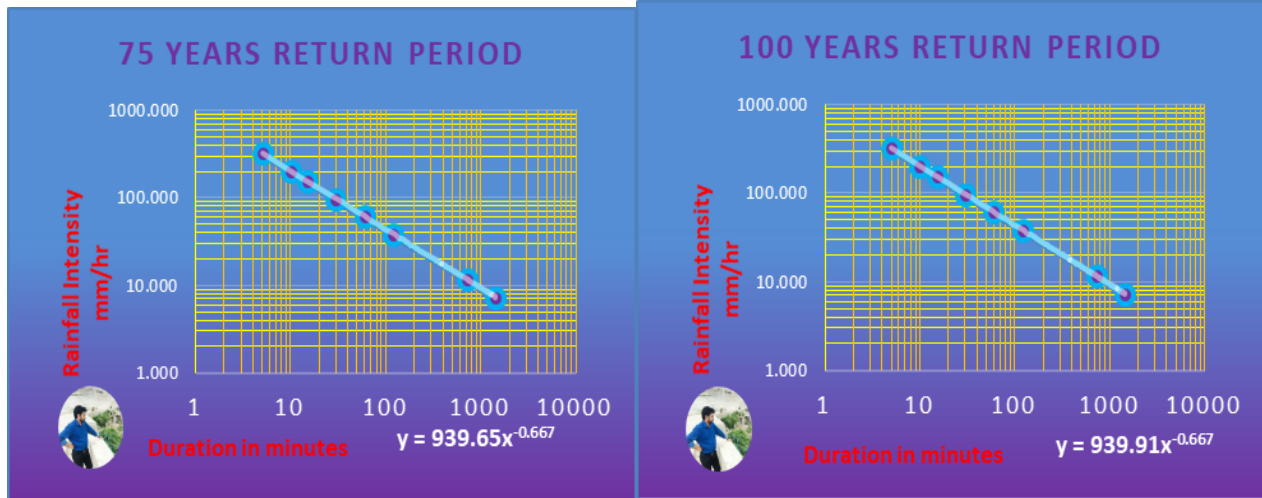


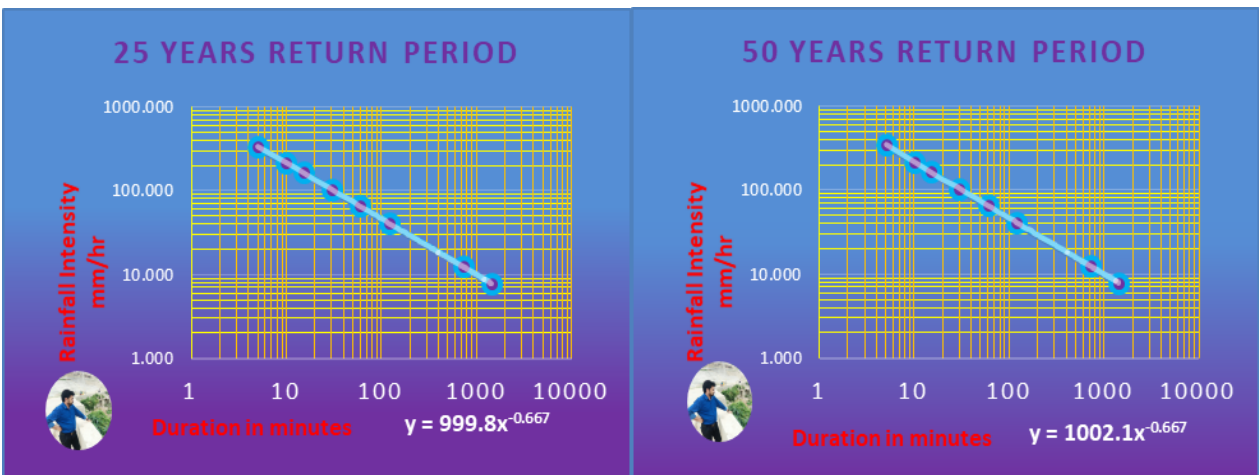
Figure 14 IDF curves for Virajpet Station



Figure 15 IDF curves for Salagame Station



Figure 16 IDF curves for Shantigrama Station



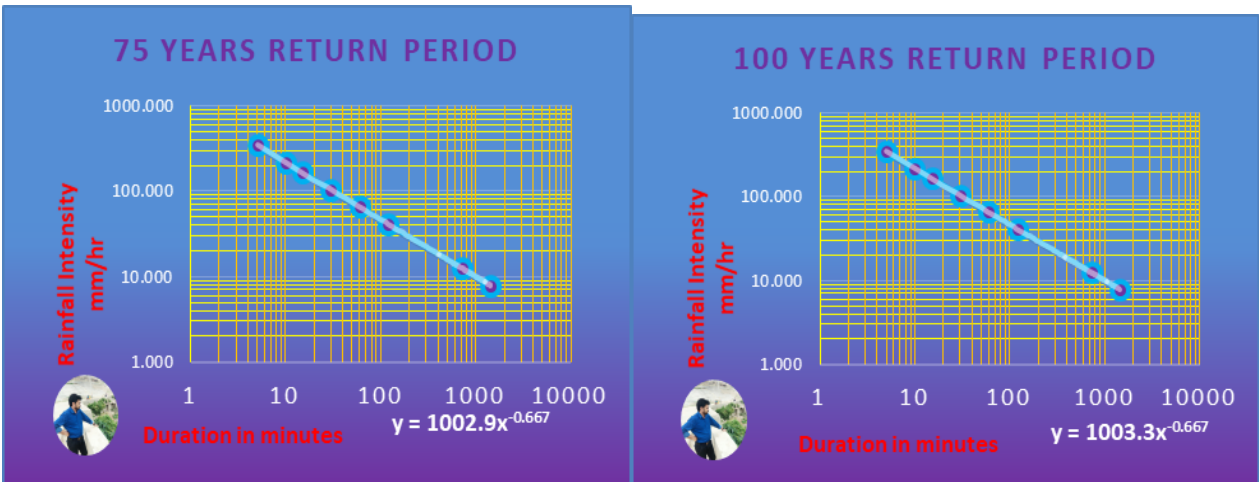


Figure 17 IDF curves for Poonampet Station



Figure 18 IDF curves for Siddapura Station

Table 22: IDF equations for all the raingauge stations in the study

Station Name	IDF Equation $Y=aX^{-0.667}$ where Y is intensity of rainfall, X is the time interval and a is constant						
	Value of constant 'a' for different a return period						
	2years	5years	10years	25years	50years	75years	100years
Arehalli	631.9	652.5	658.6	662.0	663.1	663.4	663.6
Arkalgud	415.5	428.4	432.1	434.2	434.9	435.1	435.3
Basavapatna	392.4	403.8	407.1	409.0	409.6	409.8	409.9
Balagodu	524.8	543.9	549.6	552.7	553.8	554.1	554.3
Belur	467.8	483.8	488.6	491.2	492.1	492.4	492.5
Bettadapura	384.1	395.1	398.3	400.1	400.7	400.9	401.0
Bilur	1057.2	1098.3	1110.7	1117.5	1119.8	1120.5	1120.8
Channenhally	429.8	444.3	448.6	451.0	451.8	452.1	452.2
Chikkamangalore	407.0	416.0	418.7	420.2	420.6	420.8	420.9
Doddabemmati	309.5	316.6	318.7	319.8	320.2	320.3	320.4
Galibeedu	1031.1	1034.6	1061.5	1065.3	1066.6	1067.0	1067.1
Gonibeedu	731.8	757.0	764.5	768.6	770.0	770.4	770.6
Gorur	412.5	423.4	426.5	428.3	428.9	429.1	429.2
Hagare	404.9	417.0	420.6	422.6	423.2	423.4	423.5
Halekote	409.1	424.6	429.2	431.8	432.6	432.9	433.0
Hallibailu	932.4	953.7	960.0	963.5	964.6	965.0	965.2
Hallimysore	391.3	399.4	401.8	403.1	403.5	403.7	403.7
Harangi	429.0	443.1	447.3	449.6	450.4	450.6	450.7
Hassan	456.5	469.1	472.8	474.9	475.5	475.7	475.8
Hosakere	1376.6	1408.6	1418.0	1423.2	1424.9	1425.5	1425.8
Hunsur	421.4	434.9	438.8	441.1	441.8	442.0	442.1
Javali	920.0	941.3	942.5	951.0	952.1	952.5	952.7
Kenchamma hoskote	584.5	600.6	605.3	607.9	608.8	609.1	609.2
Krishnarajpet	427.0	436.7	439.5	441.1	441.6	441.8	441.9
Kushalnagar	378.6	387.7	396.3	391.8	392.3	392.4	392.5
Malalur	306.3	313.1	315.3	316.5	316.9	317.0	317.0
Mallipatna	417.3	425.7	428.1	429.4	429.9	430.0	430.1
Melkote	528.0	544.5	549.4	552.1	553.0	553.3	553.4
Naladi	1748.8	1804.9	1821.3	1830.6	1833.6	1834.6	1835.1
Nuggehally	490.8	509.8	515.4	518.6	519.6	519.9	520.1
Periyapatna	394.0	403.8	406.6	408.2	408.7	408.9	409.0
Poonampet	936.4	979.8	992.6	999.8	1002.1	1002.9	1003.3
Sakleshpura	746.1	769.0	775.7	779.5	780.7	781.1	781.3
Salagame	421.3	435.5	439.7	442.0	442.8	443.1	443.2
Shantebachahalli	529.3	556.3	564.3	568.9	570.3	570.8	571.1
Shantigrama	376.2	388.1	391.7	393.7	394.3	394.5	394.6
Shravanabelagola	508.2	528.4	534.3	537.7	538.8	539.1	539.3
Siddapura	594.9	612.8	618.0	621.0	621.9	622.2	622.4
Srimangala	981.8	1014.0	1023.5	1028.7	1030.4	1031.0	1031.3
Sukravarashante	867.1	886.7	892.4	895.6	896.7	897.0	897.2
Talakavery	1624.0	1670.2	1683.7	1691.4	1693.8	1694.6	1695.0
Virajpet	892.8	923.4	932.4	937.5	939.1	939.7	939.9
Yelawala	433.5	445.1	448.4	450.3	451.0	451.2	451.3

#### IV. CONCLUSIONS

The present work shows a methodology for the Development of the IDF curves from daily rainfall data. In particular, to obtain durations shorter than 24 hours, Log-Normal distribution model of disaggregation was applied to the historical data available for forty three raingauge stations present in the study area. Table 22 shows the equations that can be applied to different raingauge station for different return period. In these equations the value of constant 'a' is maximum for Naladi station and minimum for Malalur raingauge station, Rainfall intensity is directly dependent on these value and time. There is always a shortage of short-duration rainfall data as it requires automatic rain gauges to record such data. On the contrary, daily rainfall values are

generally available due to the use of cheap manual instruments. These IDF equations will help to estimate the rainfall intensity for any specific return period in a short time and more easily. The results computed can be utilized for developing surface drain network for recharging ground water.

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#### AUTHORS PROFILE

**Mohammed Badiuddin Parvez** Is a life member of Indian Water Resources Society, ASCE Born in Karnataka, India. Obtained his BE in Civil Engineering in the year 2009-2013 from UVCE, Banagalore and M.E with specialization in Water Resources Engineering during 2013-2015 from UVCE, Bangalore University and Pursuing Ph.D from Bangalore University. And has 3 years of teaching experience. Till date, has presented and published several technical papers in many National and International seminars, Journals and conferences.



**M Inayathulla** Is a life member of Environmental and Water Resources Engineering (EWRI), ASCE, WWI, ASTEE, ASFPM. Born in Karnataka, Obtained his BE in Civil Engineering in the year 1987-1991 from UBDT, Davanagere and M.E with specialization on Water Resources Engineering during 1992-1994 from UVCE, Bangalore University and got Doctorate from Bangalore University in the year 1990-1995. Presently working as Professor at UVCE, Bangalore University, India. And has more than 25 years of teaching experience. Till date, has presented and published several technical papers in many National and International seminars and conferences

