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Time series analysis of Rainfall data and its Geo-environmental inferences on Girja Basin, Aurangabad District of Maharashtra, India

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Abstract- An attempt has been made to find the outcomes of rainfall data analysisof groundwater system of Girja Basin, Aurangabad district of Maharashtra, India, which is one of the most important hydrometerological parameter, and which also directs the recharge event. Data analysis of rainfall records for a period of 29 years (1990 to 2018) of Girja basin and geo-environmental inferences on groundwater system have been detailed and exhibited. Mathematical investigation of rainfall data displays a variation range from 341.35 to 1362.6 mm with annual average of 649.28. The 341.35 mm rainfall occurred during 2012 and 1362.6mm rainfall occurred in 2000. Departures and Cumulative departure from the average annual rainfall have been measured. Computed values of statistical parameters indicate a positive trend of rainfall. Estimation of Standard Precipitation Index (SPI) indicates that out of last 29 years, one was extremely wet (SPI 2.0+); two were very wet (SPI 1.5 to 1.99); one moderately wet (SPI 1.0 to 1.49); 22 near normal (SPI 0.99 to -0.99); three moderately dry (SPI -1.0 to -1.49) years, one severely dry (SPI -1.5 to -1.99); and two were extremely dry (SPI-2 and less), Estimations also indicates that post 1996, both severity and occurrence of drought events has increased. Prediction of predictable rainfall trend for 5 years has been envisaged. Geo-environmental inference of rainfall trends on the recharge of groundwater system erstwhile discussed. It is suggested that the climb of rainfall on the precedence beginning need to determine the on-hand water problem by adopting creating of various groundwater recharge structures in the study area.

Keywords: Rainfall Data analysis, Standard Precipitation Index, Geo-environmental inferences, Phulambri area, Aurangabad District.

I. INTRODUCTION

India receives about 75–80% of its annual rainfall during the monsoon season (June–September). Butthe rainfall amount received during monsoon season depicts large variability in time and space. This spatial and temporal variability of Indian summer monsoon rainfall (ISMR) increases the complexity in its prediction on smaller space–time domain, with the aim to achieve improved prediction skill of ISMR on smaller spatial scales, a large number of studies have been done to construct the contiguous regions over Indian landmass. Nicholson [1] has shown that average over a homogeneous region reduces the data volume and takes care of small-scale variability. Also, the averaging helps to enhance the signal variation at larger spatial scales [2]. The climate change is too high for India compared to the global climatic variability. It has further led to the essence of determining whether the trend is increasing or decreasing. The changes in the most important climatological parameter i.e. rainfall, may be responsible for the natural calamities like drought and flood conditions [3], rainfall variability is of spatial and temporal forms and within these variations if by time series analysis no significant trend is obtained then the rainfall is steady, otherwise, it has changed, generally, the study of weather and climatic elements of a region is vital for sustainable development of agriculture and planning. Particularly, rainfall and temperature temporal analyses for trends, fluctuations and periodicities are deemed necessary as such can indirectly furnish with health status of an environment [4,5,6]. Monsoon is the important season of Indian Agriculture; because of 70 percent total cultivated area of the country is under rain fed. The uncertainty of rainfall as well as its uneven distribution during the crop growth period affects the agriculture production adversely. It is described that all possible efforts be made to understand and predict the weather well in advance. So, the farmer can get sufficient time to cope with prevailing situation. As the rainfall and its distribution plays important role in deciding thesuccess or failure of a crop in a given season [7]. Change in climate is a long-term phenomenon and most alarming issues for the entire world, therefore; quantification of climate changes has become preliminary. Identification of temporal trend of hydrometerological variables is important to sustainable management and development of water resources infuture. Rainfall is one of a most important events of the hydrological cycle [8,9]. The rainfall is most important hydrometerological factor that plays a very significant role in their charge of groundwater system. Rainfall is a usually followed expression for the liquid form of precipitation, which contributes in solving the problems related with water bodies [10]. Rainfall is not an accurate loss as well as travel time for the vertical percolation in the permeable formation to several months or years for deep water tables underlying sediments with low vertical permeability [11]. Rainfall infiltration provides most important resource of ground water recharge. The rock formations encountered in upper layers of the earth are commonly measured as the basis for dividing country into different regions for assuming the percentage of rainfall infiltration [12]. Rainfall is the meteorological phenomenon that has the greatest impact on human activities and the most important environmental factor limiting the development of the semi arid regions [13]. Understanding rainfall variability is essential to optimally manage the scarce water resources that areunder continuous stress due to the increasing water demands, increase in population, and the economic development [14]. Hence an attempt has been made to find out the trend of rainfall and its geo-environmental inferences on Girja Basin of Phulambri block in Aurangabad district, Maharashtra.

II. CHARACTERISTICS OF STUDY AREA

This study focuses on the Phulambri block in the northeastern part of the Aurangabad district, the block investigated lies between 75^{o}19’ to 75^{o}39’ E and 20^{o}17’ to 20^{o}02’ N, covers an area of approximately 658.9 km^2 and is bounded by the Lakenwara hills to the south and by the Mhaismal hills to the north. The Girja Basin is the central part of the study area. The average annual rainfall in Phulambri taluka is 649.28 mm. About 83% of annual rainfall is received during June to September. The intact area is enclosed and bounded mainly by basaltic lava flows of the Deccan volcanic province of upper Cretaceous to Eocene age. The major geological units observed are the horizontally disposed basaltic lava flows having two units. This basaltic lava flows are the merely water bearing formations. The weathered and fractured mantles of the traps are forming water table aquifers in the area where ground water arises under phreatic conditions [15,16].

III. RAINFALL DATA ANALYSIS

The total rainfall received in a given period at a location is highly variable from one year to another. The variability depends on the type of climate and the length of the considered period. In general, it can be stated that the drier the climate, the higher the variability of rainfall in time. The same hold for the length of the period: the shorter the period the higher the annual variability of rainfall in that period [17]. The rainfall data are analyzed by using arithmetic and statistical method. In the present work rainfall data in respect of Girja basin area of Phulambri block of Aurangabad district, Maharashtra have been collected for the period of 29-year (1990 to 2018) from the Agricultural Department (Maharain) [18], Maharashtra state and Indian metrological department (IMD) GOI [19]. Rainfall data have been subjected to common procedure of hydrometerological data analysis. The rainfall data of Girja basin area of 29 years (1990 to 2018) have been displayed (Table1, 2 and Figure 1). The Rainfall data indicate a wide range of variation from 341.35 mm to 1362.6 mmwith mean (649.28), median(622.18) standard deviation (217.79), Kurtosis (2.94), Skewness (1.45).

Table.2 Descriptive statistics of study area

Name of parameter	Value
Mean	649.28
Median	622.18
Standard Deviation	217.79
Kurtosis	2.94
Skewness	1.45
Range	1021.25
Minimum	341.35
Maximum	1362.6
Sum	18829.18

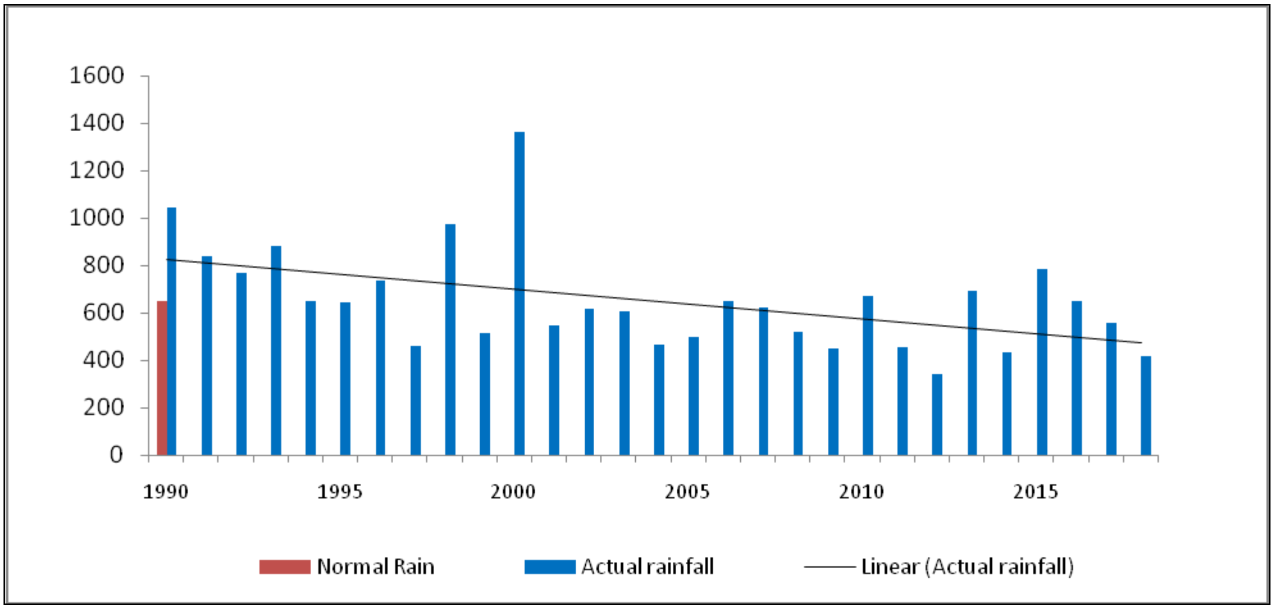

Fig.1. Rainfall of Girja Basin of Phulambri block.

Table 1: Rainfall data of study area, showing departure and cumulative departure from average annual rainfall during period of 1990-2018 and SPI value.

Sr.No.	Year	Rainfall (mm)	Departure from average(mm)	Cumulative departure from average rainfall(mm)	SPI
1	1990	1043.9	-394.618	-394.618	3.3
2	1991	840.4	-191.118	-585.736	1.8
3	1992	769.9	-120.618	-706.354	1.5
4	1993	879.9	-230.618	-936.972	1.1
5	1994	647	2.2821	-934.69	0.9
6	1995	642.3	6.9821	-927.708	0.6
7	1996	735	-85.7179	-1013.43	0.6
8	1997	458	191.2821	-822.143	0.4
9	1998	972.3	-323.018	-1145.16	0.2
10	1999	514	135.2821	-1009.88	0.1
11	2000	1362.6	-713.318	-1723.2	0.0
12	2001	547	102.2821	-1620.91	0.0
13	2002	614	35.2821	-1585.63	0.0
14	2003	605.9	43.3821	-1542.25	0.0
15	2004	464.2	185.0821	-1357.17	-0.1
16	2005	497.3	151.9821	-1205.19	-0.2
17	2006	650.5	-1.2179	-1206.4	-0.2
18	2007	622.18	27.1021	-1179.3	-0.4
19	2008	520.96	128.3221	-1050.98	-0.5
20	2009	448.49	200.7921	-850.188	-0.6
21	2010	672.79	-23.5079	-873.696	-0.6
22	2011	454.65	194.6321	-679.064	-0.7

23	2012	341.35	307.9321	-371.132	-0.9
24	2013	689.25	-39.9679	-411.1	-0.9
25	2014	431.01	218.2721	-192.828	-0.9
26	2015	785.8	-136.518	-329.345	-0.9
27	2016	646.2	3.0821	-326.263	-1.0
28	2017	556.5	92.7821	-233.481	-1.1
29	2018	415.8	233.4821	0.0008	-1.4

(A) Arithmetic method:

In mathematic method, average rainfall for the period of months or years is expressed by the arithmetic average of the period of month or year. The variation in rainfall is reflected by a stable average. The rainfall data records for a period of 29 years have been displayed (Table1). The total annual rainfall for a period from 1990 to 2018 have been recorded (table1 and 2), the average of total annual rainfall for the period of 29 years has been calculated as 649.28 mm. The annual total rainfall data have been represented on a graph to observe the trend of variation (Figure 3). It has been observed that minimum value of rainfall has been reported as the 341.35mm during the year of 2012, and maximum rainfall has been noted as 1362.6 during 2000.Graphic pictureshowssignificant variation in the quantity of annual rainfall. Departure and cumulative departure from the average rainfall have been intended and the values are documented (Table 1). The variables are denoted by graphic method, with a view to detect nature of rainfall pattern. The rainfall pattern shows that the rainfall during the years of 1994, 1995, 1996, 1997, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2011, 2012,2014,2016,2017 and 2018show more than the calculated value of average annual rainfall indicating favorable recharge conditions (Fig.3). The years of 1991, 1992,1993,1996, 1998, 2006, 2010, 2013 and 2015 point out low values of rainfallamount than that of the average annual rainfall. It can be envisaged that during these years theirneed have been decline in the recharge of rain water to the groundwater system (Fig.4).

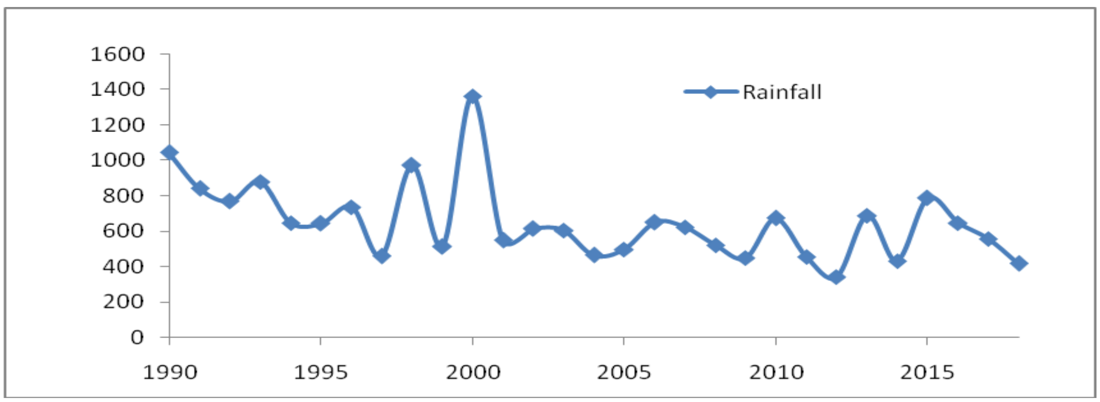

Fig.2 Annual distribution of rainfall data of Phulambri (Girja basin)

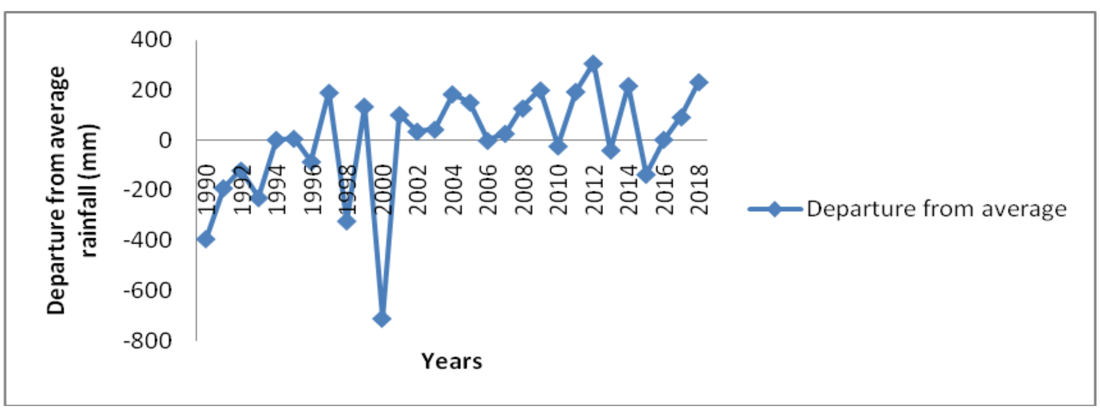

Fig.3 Annual departures from average rainfall data of Phulambri (Girja basin)

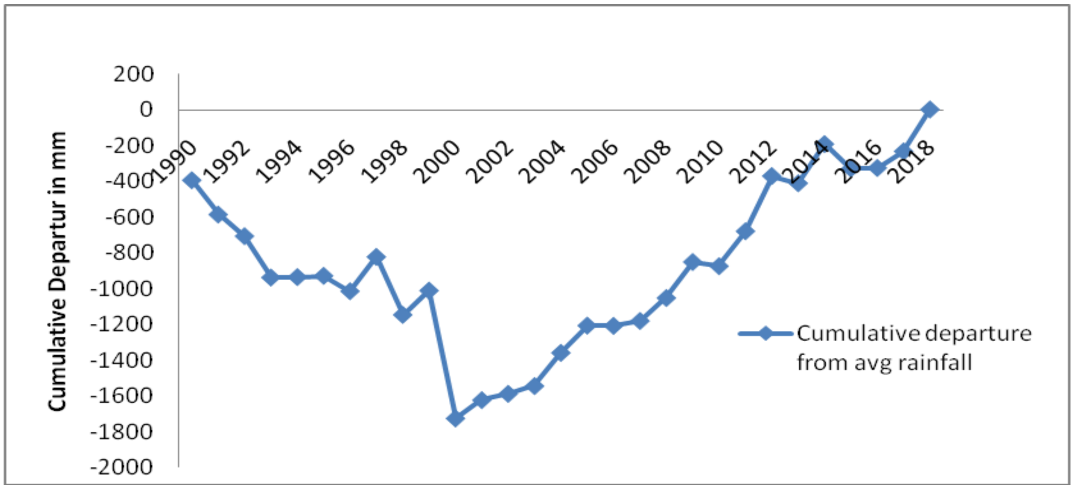

Fig.4 Annual cumulative departures from average rainfall of Girja basin

(B) Relationship between rainfall-rainy events

It was found that almost all the rainfall is received during monsoon, i.e. from months of June to September. Regression analysis between annual rainfall as dependable variable and rainy days as independent variable for Phulambri rain gauge station indicate that quantum of rainfall depends on the number of rainy days (fig.5). The R square value is 0.012. This relationship suggests that a greater number of rainy days usually result in high rainfall and vice-a- versa except year 2000, 1362.6mm rainfall occurs in 12 days. Difference between the mean number of rainy days and amount of rainfall amongst the above normal and below normal rainfall years is 36 (rainy days) and 649mm respectively. This suggest that even a non-occurrence of a single day rainfall significantly affect the amount of the total annual precipitation. Hence it is important to analyze impact of reduction in number of rainy days on rainfall magnitude and drought occurrence.

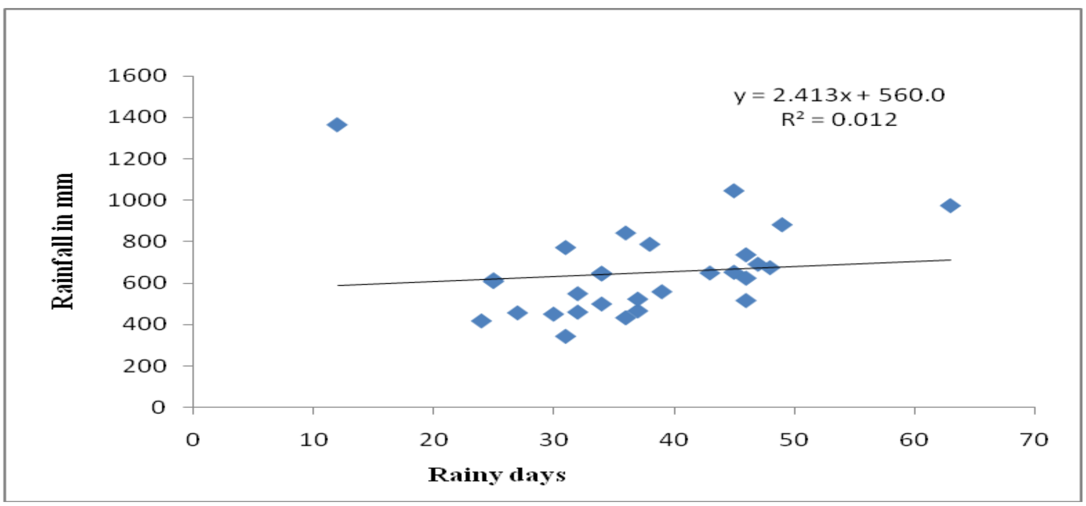

Fig. 5 Relationship between Rainfall and Rainy days (1990-2018)

(C) Moving Average Curve (Cyclic Pattern)

The moving average curve smoothens out the extreme variations and indicate the trend or cyclic pattern, if any, more clearly. It is also known as the moving mean curve. The procedure to construct the moving average curve is as flows. The moving average curve is super imposed over the original rainfall series, though the variations in the original data are smoothened out to some extent in the moving average curve, no apparent trend (Table 3 Figure 5). The moving average curve is constructed with a moving period of *m* year, where *m* is generally taken to be 3 or 5 years. Let $x_1, x_2, \ldots, x_n$ be the sequence of given annual rainfall in the chronological order. Let y_i denote the ordinate of the moving average curve for the i^{th} year. Then for $m=3$, y_is computed [11, 20].

$$y_i = (x_{i-1} + x_i + x_{i+1}) / 3$$

Table.3. Computations for 3-year moving averages rainfall data of Girja Basin.

Sr.No.	Year	Annual Rainfall	Total for moving average= $(x_{i-1} + x_i + x_{i+1})$	Moving average y_i=Total for moving average / 3
1	1990	1043.9	-	-
2	1991	840.4	2654.2	884.7333333
3	1992	769.9	2490.2	830.0666667
4	1993	879.9	2296.8	765.6
5	1994	647	2169.2	723.0666667
6	1995	642.3	2024.3	674.7666667
7	1996	735	1835.3	611.7666667
8	1997	458	2165.3	721.7666667
9	1998	972.3	1944.3	648.1
10	1999	514	2848.9	949.6333333
11	2000	1362.6	2423.6	807.8666667
12	2001	547	2523.6	841.2
13	2002	614	1766.9	588.9666667
14	2003	605.9	1684.1	561.3666667
15	2004	464.2	1567.4	522.4666667
16	2005	497.3	1612	537.3333333
17	2006	650.5	1769.98	589.9933333
18	2007	622.18	1793.64	597.88
19	2008	520.96	1591.63	530.5433333
20	2009	448.49	1642.24	547.4133333
21	2010	672.79	1575.93	525.31
22	2011	454.65	1468.79	489.5966667
23	2012	341.35	1485.25	495.0833333
24	2013	689.25	1461.61	487.2033333
25	2014	431.01	1906.06	635.3533333
26	2015	785.8	1863.01	621.0033333
27	2016	646.2	1988.5	662.8333333
28	2017	556.5	1618.5	539.5
29	2018	415.8	-	-

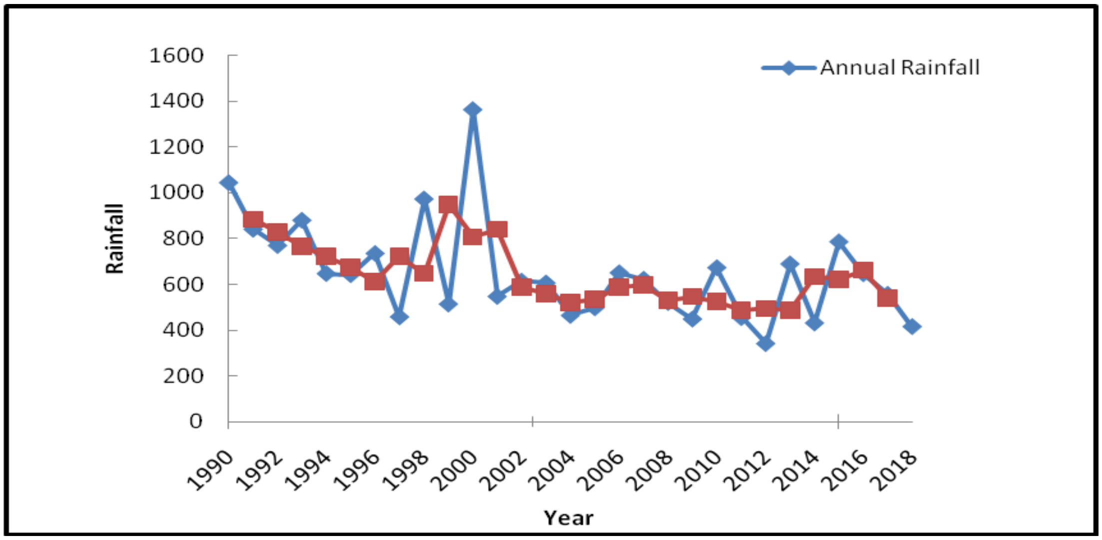

Fig.5.Three year Moving Average curve of Rainfall data of Girja basin

(D) Estimation of Standard Precipitation Index

Standard precipitation index is used to measure the intensity of metrological drought in an area, which takes into account the characteristics of the rainfall such as the inert-annual variability in rainfall in the region. Thus, SPI unlike other criteria used for assessing the intensity of drought, enable us to compare drought intensities spatially between two regions., which experience two different degrees of variation in rainfall, even while having the same magnitude of mean annual rainfall. The reason is in terms of rainfall magnitude, what is normal for one location may be abnormal for another location [21].

Mathematically the SPI is estimated on the basis of the cumulative probability of occurrence of a given rainfall at a station. Based on the historical rainfall data, an analyst can then tell what is the probability of the rainfall being less than or equal to a certain amount. Thus, the probability of rainfall being less than or equal to an amount much smaller than the average will be also be lower (0.2,0.1, 0.01 et depending on the amount). Therefore, if a particular rainfall event gives a low probability on the cumulative probabilities function, then this is indicative of a likely drought event. Alternatively, a rainfall event which gives a high probability on the cumulative probabilities function is an abnormally wet event. Some of the advantages which can be derived from the SPI are as follows. Plotting a time series of the years against SPI gives a good indication of the drought history of a particular station. In order to estimates the SPI values for different rainfalls, the mean value and standard deviation of the rainfall record is to be first estimated. Then the deviation of the annual rainfall from the mean value is estimated and expressed in terms of number of standard deviations by diving by the SD value.

Table.4. classifications of Rainfall events as per SPI values

SPI Values	**classifications**	**Year**
2.0 +	Extremely wet	2000
1.5 to 1.99	Very wet	1990, 1998
1.0 to 1.49	Moderately wet	1993
-0.99 to 0.99	Near normal	1991, 2015, 1992, 1996, 2013, 2010, 2006, 1994, 2016, 1995, 2007, 2002, 2003, 2017, 2001, 2008, 1999, 2005, 2004, 1997, 2011, 2009
-1.0 to -1.49	Moderately dry	2014, 2018, 2012
-1.5 to -1.99	Severely dry	Nil
-2 and less	Extremely dry	Nil

The standardized precipitation index (SPI) was estimated to determine that rarity of a drought in Girja basin based on 29 years (1990-2018) rainfall data available from Phulambri rain gauge station. SPI values suggest that out of last 29 years,1 was extremely wet (SPI 2.0+); 2 were very wet (SPI 1.5 to 1.99); 1 moderately wet (SPI 1.0 to 1.49); 22 near normal (SPI 0.99 to -0.99); 3 moderately dry (SPI -1.0 to -1.49) years (Table,3 and Fig.6).1 severely dry (SPI -1.5 to -1.99); and 2 were extremely dry (SPI-2 and less), however, no severely dry (SPI -1.5 to -1.99); and extremely dry (SPI-2 and less) was recorded. Estimations also indicates that post 1996, both severity and occurrence of drought events has increased. (Table,3 and Fig.6).

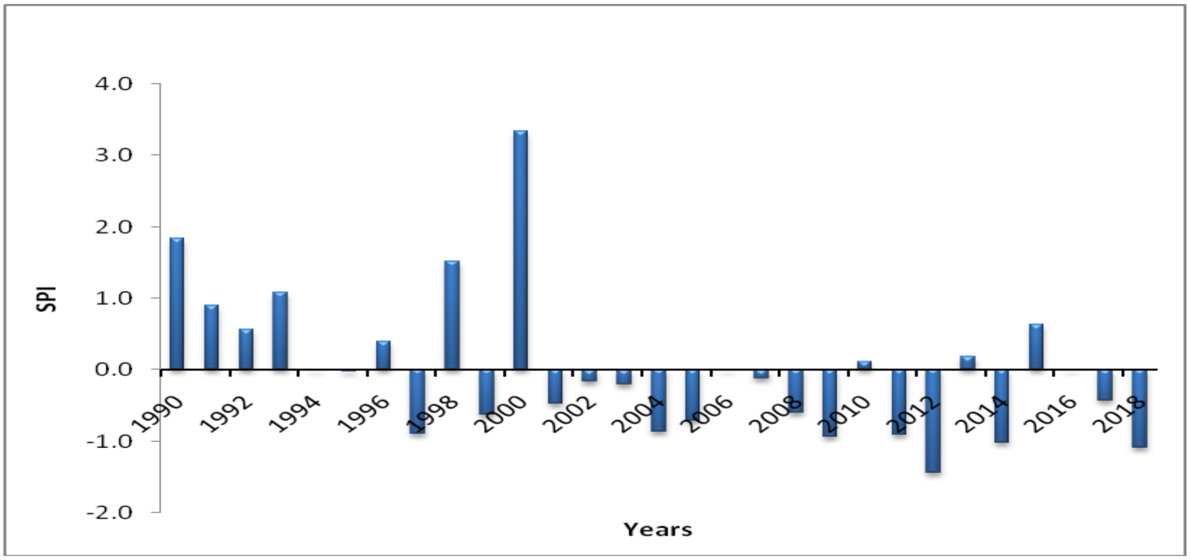

Fig. 7 Rainfall events as per SPI values (1990 to 2018) of Girja Basin

(E) Time Series Analysis

The time series analysis delivers important information about the trend of a series of observation it supports: (1) To measure the deviation from the trend and (2) Provides information on the nature of trend. Hence, this analysis permits us to prediction the forth coming behavior of trend [10,11,22]. The method of least square fit of straight line has been implemented for the trend analysis of the performance of annual rainfall. The straight-line equation can be represented as:

Where, $y = a + bx + cx^2$

y = Trend value of dependent variable

x = Independent variable

a,b and c = unknown

To create a best fit straight line, the value of a, b and c must be determined from the observed data this is done by solving of three normal equation.

$\sum y = na + b\sum x + c\sum x^2$..................(1)

$\sum xy = a\sum x + b\sum x^2 + c\sum x^3$ ....(2)

$\sum x^2 y = a\sum x^2 + b\sum x^3 + c\sum x^4$................(3)

The values of the different elements in the above equation have been determined by considering y asvariable (annual rainfall) and x as constant (year).

The values are taken from table 6 is as follows,

n =29, $\sum x = 0, \sum y = 18829, \sum x^2 = 2030$

$\sum x\, y = -25215, \sum x^3 = 0, \sum x^2 y = 1387014.14, \sum x^4$ =255374

Substituting these values in normal equation 1, 2 and 3, we get the values of a, b and c as follows,

18829= 29a + 2030c .... (4)

-25215 = 2030b,

b = -12.4212 .... (5)

387014.14 = 2030 a +255374 c............... (6)

2030c = 18829-29a

1387014.14 = 2030a + 255374 [18829-29a] / 2030.

1387014.14 – 2368688.2 = 2030a – 3648.2 a

-981674.06 = -1618.2a

a = 606.6457

2030c = 18829- 29 (606.6457)

c = 0.609

Solving equations (4), (5) and (6) the value of a, b & c are obtained as follows,

a =*606.6457*, *b* = *-12.4212*, *c* = *0.609*
Hence, the equation for straight line is becomes

$$y = a + bx + cx^2$$

y = 606.6457 + (-12.4212) x + 0.609 (x^2) .... (7)

With the help of equation (7) the trend values have been calculated. The future forecast of rainfall amount for period of 5 years. i.e. from 2019 to 2023 has been made. The calculation of expected rainfall for coming years is made as per the following method. Forecasting of expected future trend of rainfall 2019 to 2013 is as follows,

$$Y = a + bx + cx^2$$

Y_{2019}= 606.6457+ (-12.4212) x 19+0.609 x $(19)^2$ = 590.494
Y_{2020}= 606.6457+ (-12.4212) x20+0.609 x $(20)^2$ = 601.821
Y_{2021}= 606.6457+ (-12.4212) x 21+0.609 x $(21)^2$ = 614.369
Y_{2022}= 606.6457+ (-12.4212) x 22+0.609 x $(22)^2$ = 628.135
Y_{2023}= 606.6457+ (-12.4212) x 23+0.609 x $(23)^2$ = 643.119

Table 5: Estimated trends values of future expected rainfall (2019 to 2023)

Sr. No.	Year of Forecast	Expected rainfall (mm)
1	2019	590.494
2	2020	601.821
3	2021	614.369
4	2022	628.135
5	2023	643.119

The probable value of the expected rainfall for the future period, i.e. 2019 to 2023, indicates increasing trend of values with consider to the calculated average annual rainfall. It is criticized that suitable measure should be adopted to increase the rainfall quantity in the upcoming years with an outlook to gain continued rainfall to be in command of the running down of groundwater store.

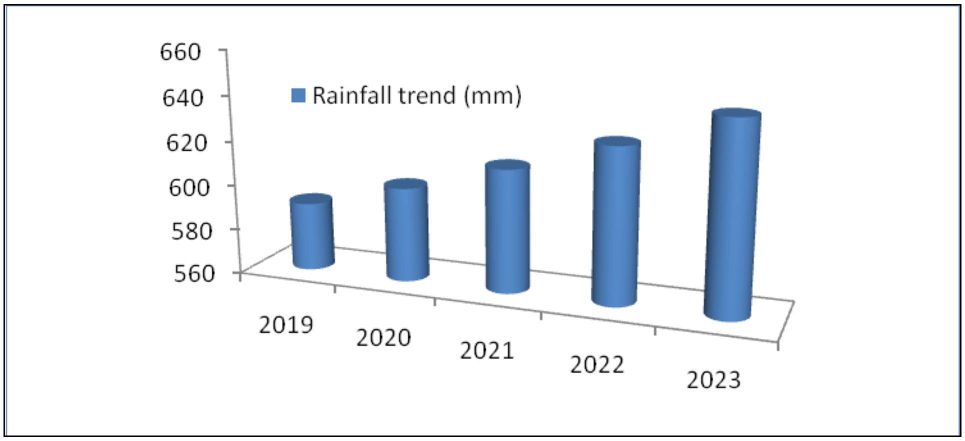

Fig.8. Forecasting of expected future trend of rainfall from 2019 to 2013.

Table 6: Time series analysis of rainfall data of Girja basin of Phulambri area

Sr.No.	Year	*t=x*	Rainfall *y*	x^2	*xy*	x^3	x^2y	x^4
1	1990	-14	1043.9	196	-14614.6	-2744	204604.4	38416
2	1991	-13	840.4	169	-10925.2	-2197	142027.6	28561
3	1992	-12	769.9	144	-9238.8	-1728	110865.6	20736
4	1993	-11	879.9	121	-9678.9	-1331	106467.9	14641
5	1994	-10	647	100	-6470	-1000	64700	10000
6	1995	-9	642.3	81	-5780.7	-729	52026.3	6561
7	1996	-8	735	64	-5880	-512	47040	4096

8	1997	-7	458	49	-3206	-343	22442	2401
9	1998	-6	972.3	36	-5833.8	-216	35002.8	1296
10	1999	-5	514	25	-2570	-125	12850	625
11	2000	-4	1362.6	16	-5450.4	-64	21801.6	256
12	2001	-3	547	9	-1641	-27	4923	81
13	2002	-2	614	4	-1228	-8	2456	16
14	2003	-1	605.9	1	-605.9	-1	605.9	1
15	2004	0	464.2	0	0	0	0	0
16	2005	1	497.3	1	497.3	1	497.3	1
17	2006	2	650.5	4	1301	8	2602	16
18	2007	3	622.18	9	1866.54	27	5599.62	81
19	2008	4	520.96	16	2083.84	64	8335.36	256
20	2009	5	448.49	25	2242.45	125	11212.25	625
21	2010	6	672.79	36	4036.74	216	24220.44	1296
22	2011	7	454.65	49	3182.55	343	22277.85	2401
23	2012	8	341.35	64	2730.8	512	21846.4	4096
24	2013	9	689.25	81	6203.25	729	55829.25	6561
25	2014	10	431.01	100	4310.1	1000	43101	10000
26	2015	11	785.8	121	8643.8	1331	95081.8	14641
27	2016	12	646.2	144	7754.4	1728	93052.8	20736
28	2017	13	556.5	169	7234.5	2197	94048.5	28561
29	2018	14	415.8	196	5821.2	2744	81496.8	38416

(Where n =29, $\sum x = 0, \sum y = 18829, \sum x^2 = 2030$, $\sum x\,y = -25215, \sum x^3 = 0, \sum x^2 y 1387014.14$, $\sum x^4$ =255374)

IV. GEO-ENVIRONMENTAL INFERENCE OF RAINFALL

Rainfall is a major source for groundwater recharge. The response of groundwater level to rainfall is divided into quick and slow parts; Rainfall effects on the groundwater-level variation include the relatively quick and slow responses [23]. Precipitated water that reaches at the surface ground may be partially discharge into streams as surface run off or partially infiltrate into the ground. The latter further percolates into groundwater aquifers, eventually emerging in springs, seeping into streams to form surface run off, or storing in subsurface. The soil stores infiltrated water to become soil moisture, and then it recharges to groundwater level if the soil is saturated. Nevertheless, it releases slowly as subsurface flow to enter the stream as baseflow during rain less period [24,25]. This may also result from deeper percolation, evapotranspiration, or artificial discharge. The analysis of rainfall data of study area, draw attention to a somewhat fine vary of deviation representing mutually the positive and negative trends that influence the recharge of the groundwater basin. The present leaning of over use and inadequate rainfall is causing depletion in groundwater levels. Groundwater levels may demonstrate seasonal variation due to rainfall. Drought extending over a period of several years, contribute to declining water levels. The rapid depletion of groundwater levels causes scarcity and even resulting into drought situation in a particular area [10,26]. The occurrence of drought and heavy precipitation are the most important climatic extremes having both short and long-term impacts on the groundwater availability. These impacts include changes in groundwater recharge resulting from the erratic behavior of the annual and seasonal distribution of precipitation and temperature; changes in evapotranspiration resulting from changes in vegetation; and possible increased demands for groundwater as a backup source of water supply [27]. However, the link between climate variability and the groundwater response is more complicated than that with the surface water regime. Its dynamics is rather a stable system, and responds slowly with a time lag to climate variability. Further, the diverse aquifer characteristics respond differently to the surface stresses [28,29]. The investigation of rainfall data shows a significant variation in the quantity of rainfall and its circulation. On top of the intact, it can be present recap that the areas have observed several of positive rainfall year's causative to the increase of groundwater basin. The completion of suitable measure is probable to endow with therapy in reduce the speedily budding situation of groundwater level depletion ensuing in the drought circumstance in study area. The ever-increasing quantity and frequencies of rainfall episodes would augment recharge event and assist in the pledge of the crisis of sustained water supply in the study area. The farmers and the people sitting on the scarcity of heat and water are eagerly awaiting the rains.

If the monsoon rainfall is good, then there will be the positive result as follows,

- The economic growth would be good
- The farmers will get a great relief.
- Water scarcity in rural areas will minimize.
- If good rain occurs, the product will be good and farmers will benefit from small traders.
- Possibility of reducing pandemic
- If the rain is good, then the bank and the financial sector will also be benefited.
- Expected to increase the demand for necessary equipment, goods and fertilizers from farmers.

V. CONCLUSION

The study has given an explanation of mathematical and statistical analyses of rainfall data for 29 years (1990 to 2018). Time series has made possible in forecasting of projected rainfall data for 2023. The upcoming tendency or trends of rainfall is positive and would confer to recharge the ground water system and trim down the problem of water supply for the duration of non-rainy days especially in non-monsoon period. It is suggested that the basic step ladder have to be carry out on peak main concern to agree to preparation for the intensification of rainfall sum and frequencies, and execution of proposal for ever-increasing the persistent water make available by pleasing to the eye recharge condition of groundwater system that would make available counteractive measures to conflict the wide spread water supply catastrophe in study area.

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