International Journal of Research in Social Sciences
Vol. 10 Issue 05, May 2020
ISSN: 2249-2496 Impact Factor: 7.081
Journal Homepage: http://www.ijmra.us, Email: editorijmie@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal - Included in the International Serial Directories Indexed & Listed at: Ulrich's Periodicals Directory ©, U.S.A., Open J-Gate as well as in Cabell's Directories of Publishing Opportunities, U.S.A

Pattern of Rainfall Distribution in Champaran West : A Geographical Study

Dr. Bablu Kumar
Geography (CBSE NET)
B.R.Ambedkar Bihar
University, Muzaffarpur,
Bihar (India),842001

Introduction

Biting cold, sultry summer, heavy downpour for the short period, longer spell of dryness, spectre old waves and prevalence of loo are the characteristic features of monsoonal climate. For a state like Bihar where prosperity is wedded to agriculture and similarly agriculture is wedded to rain fall. Keeping these peculiarities in mind study of the pattern of rainfall distribution is essential in the context of Bihar in general and west Champaran district in particular.

In summer the climate of the district is hot and dry but winter months are quite cool and pleasant. The Temperature begins falling and coldest in January of the year with mercury falling to about 8^{o} C. The mercury stars shooting upward and May in the hottest Month of the year when the maximum temperature goes up to 45^{0} C. The summer continues till the end of June when the onset of rains brings the much awaited relief and the temperature falls , through the humidity is still high the rise in humidity often makes the heat only more oppressive during the rainy season which last till the end of September.

Temperature condition is almost favorable for the growth of plants throughout the year. But it is availability of water which plays dominating role in brightening economic activities in the region. Hence, study of rainfall distribution is very logical.

Location & Geographical Area

It is Located in the Extreme north western corner in Bihar state in India. Champaran west (West Champaran / Paschimi Champaran) district is located on the global map between 26^{0} 16' and 27^{0} 31' North latitude and 83^{0} 50' and 85 ^{0}18' East longitudes. The district occupies an area of 5,228 square kilometers. It ranks first position from area point of View in Bihar.

It is bounded on the North by the hilly region of Nepal, on the South by Gopalganj district and part of East Champaran district on the West by state of Utter Pradesh and on the East by part of East Champaran district and Nepal . Thus, it is fully land locked District .

Location of Champaran West in map of Bihar

Figure No. 1.1

CHAMPARAN WEST, BIHAR

Figure No. 1.2

Rainfall

For the healthy growth of plants, water is a critical requirement. It is clear that the Champaran west has only 4/10th of its gross cultivated area under irrigation . Even this percentage is not full assured. In such a piquant situation, rainfall is still the main source of water supply both to surface and Sub-surface supply of water for irrigation. The proverb "Indian agriculture is a gamble in monsoon is still relevant.

Any planning for irrigation scheme a thorough knowledge of the rainfall behavior. viz., its intensity , duration, variations, spatial pattern of regional and seasonal distribution, is of paramount significance.

Rainfall Bearing Factors

The spatial distribution and quantity of rainfall received by the area depend on a number of factors. The most important factor is the tie of the Someshwar and Dun ranges in the area and its closeness to the Himalayas. Further, dynamic cooling caused by the movement of the moisture into low pressure Zones and intermingling of cold and warm moisture laden air determines the scope of rainfall also.

The behavior of rainfall in its time-space relation is very whimsical. The area received rainfall more or less throughout the year whatsoever is the amount. The average normal annual rainfall for the district is 1472.6 [2] which is more than the average for the state as well as for the country as a whole. Apparently, this amount is sufficient enough to maintain soil-moisture for the bumper growth of the plants. But variability from normal, early arrival and early departure of rainfall, late arrival and early departure, long spell of dry period intervening high incidence of rainfall, persistence in one part at the cost of other parts and its erratic nature are some of its peculiarities . Which reduce the importance of sufficiency concept of rainfall for the district.

Annual Rainfall:

The average normal annual rainfall for the district is 1472.6 mm. However, this amount varies from year to year. From the perusal of the Table 1.1 it is clear that annual rainfall varies between 1771.5 mm. on 1980 and 1533.22 mm in 2018 over 38 years.

Table No. 1.1

Year	Rainfall in	Year	Rainfall in
1980	1771.50	2002	1043.13
1983	1491.56	2005	1268.50
1985	1398.58	2010	1316.26
1987	1454.14	2014	1404.25
1990	109.39	2015	1073.12
1993	963.66	2016	1419.90
1995	1072.85	2017	1561.95
1997	1206.85	2018	1533.22
2000	864.16		

Source: (1) District Wise monthly rainfall data , India meteorological Department (IMD).

The mean average rainfall (1980 to 2018) has been computed to the tune of 1421.98 mms. or 142.19 mms. over the period of 38 years. Only eight crop years have received rainfall more than the district average (1472.6).

AVERAGE ANNUAL RAINFALL (1980-2018)

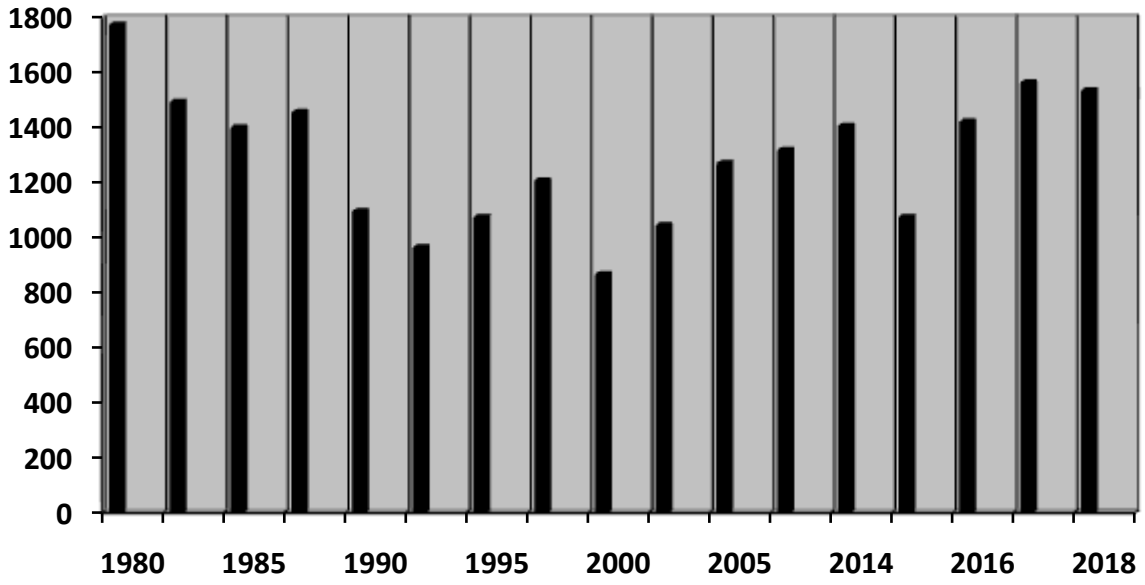

Figure No. 1.3

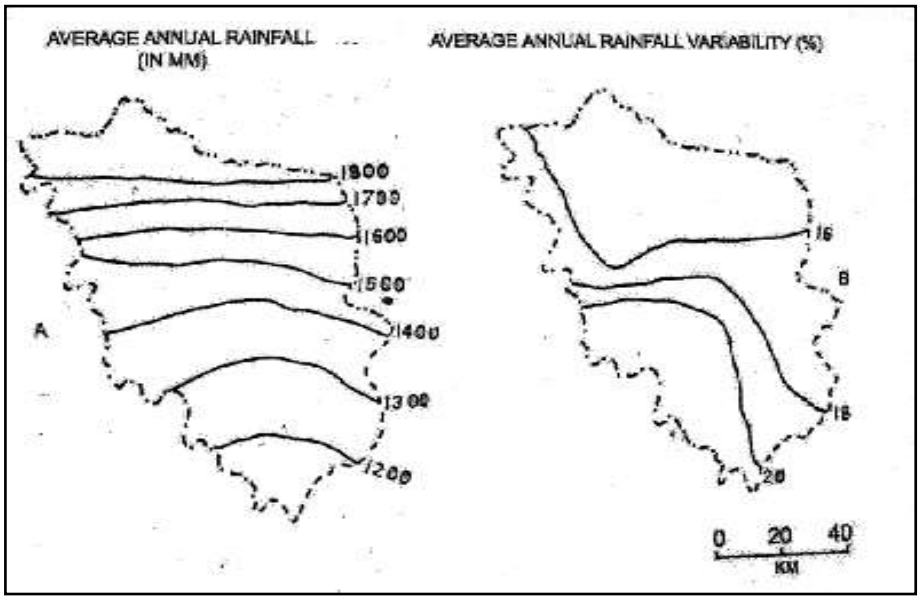

Figure No. 1.4

Annual distribution of rainfall is also uneven. It varies both from north to south and east to west. That isolates follow latitudes especially in the northern part of the district. It tends to deflect towards north in the western sector of the southern part of the district to the south of the river Sikarahana. Two factors are attributed to this anomalous

distribution pattern. The normal trend of the monsoon rainfall goes on decreasing in the Gangetic plain from east to west and also from north to South.Gaunaha (Bhainsalotan) receives more than 1706.87 mms. of rainfall. Bettiah. Nautan and Sikta and Lauriya receive 1302.66 mm., 1257.33 mm., 1408.72 mm. and 1380.83 mm.,respectively. Narkatiaganj receives 1602.62 mm. of rainfall.

Seasonal Distribution:

Annual intake of rainfall gives broader picture of distributional pattern of rainfall. Seasonal and monthly receipts of rainfall are more meaningful from the point of cultivation. The district experiences the same rhythms of seasonal distribution as experienced by the country. The south-west monsoon season or wet season bears copious rainfall. More than 90% of the total annual intake is received during this season. Hence, prospects of both the Rabi and Kharif crops are delicately balanced with this season. It means that even a slight fluctuation in intake of rainfall causes imminence loss to the standing crops. This anomalous, intake of rainfall is the greatest problem in framing the crop-calendar in the absence of irrigation. Rivers are in spate. Crops are generally damaged either due to lake of moisture or floods. Between the two extremes there is every possibility of damage to crops. To offset it, development of irrigation is must.

Table No. 1.2 Pattern of Mean Seasonal Rainfall
(Period 1980 to 2018 in mm.)

Station	Cold Weather (Nov-Feb.)	Hot Weather (March-May)	We Weather (June-Oct.)	Total
Bettiah	38.82	79.97	1183.88	1302.66
Nautan	35.90	76.45	1144.98	1257.33
Majhaulia	37.21	80.10	1240.42	1357.73
Jogapatti	43.52	74.40	1238.01	1355.93
Sikta	49.32	89.20	1370.20	1408.72
Mainatand	54.43	95.45	1350.49	1500.37
Chanpattia	40.71	99.90	1329.92	1470.53
Narkatiaganj	38.82	98.05	1465.75	1606.62
Gaunaha (Bhainsalotan)	38.32	148.35	1480.20	1706.87
Sidhaw	74.64	96.37	1684.69	1865.70
Ramnagar	36.85	115.46	1425.62	1577.93
Bagaha	38.69	95.60	1327.10	1461.39
Bairia	34.49	76.20	1190.98	1301.67
Madhubani	45.21	79.48	1180.20	1304.89
Thakrahan	42.41	72.21	1234.60	1349.22
Lauriya	38.32	86.41	1256.10	1380.83
Piprasi	36.42	92.30	1490.44	1619.16
Bhitaha	42.24	96.20	1495.44	1633.88
Total District	42.80	91.78	1338.28	1472.86
% of the total Rainfall	2.99	6.39	90.62	100.0

Source: Unpublished District statistical record. The Champaran West, Bettiah.

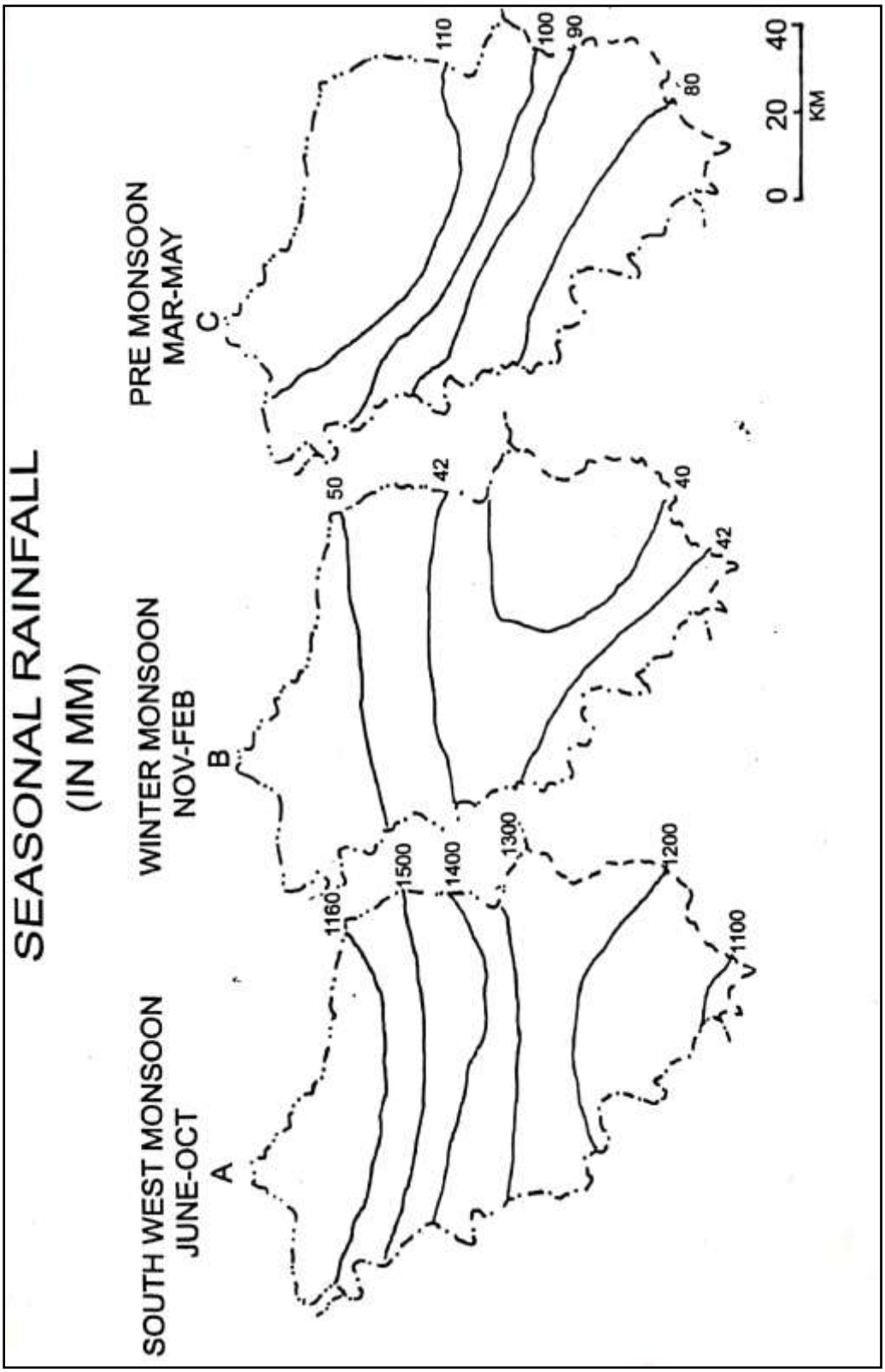
SEASONAL RAINFALL
(IN MM)
SOUTH WEST MONSOON
JUNE-OCT
A
WINTER MONSOON
NOV-FEB
B
PRE MONSOON
MAR-MAY
C
0 20 40
KM
110
100
90
80
50
42
40
42
1160
1500
1400
1300
1200
1100

Figure No. 1.5

The above table 1.2 fig.1.5 and the area under study receives more than 90% of its total rainfall during the wet season (June to October) and 6.39% and 2.99% respectively during the hot weather season and the cold weather season Narkatiaganj, Sidhaw, RamNagar and Gaunaha (Bhainsalotan) receive more rainfall than the average normal annual rainfall computed for the district (during this period alone).

The following facts are notable

i. The value of isohyets drawn on the basis of Table 1.1 decreases from north to south and south-east.
ii. Winter rainfall is the minimum and the amount of rainfall decreases from north-west to south-east as per the path followed by the cold weather depression.
iii. The summer season rainfall is also very scanty but more than the amount of the winter rainfall. During this season the value of isohyets decreases from north-east to south-west.This reversal of trend from the winter conditions is by dint of the impact of Norwester.
iv. Again we see that isohyets are closely spaced towards the north and north-while as spacing of isohyets is relatively far flung in the southern part to the south of the Triveni canal or 1500 isohyets lines.

Monthly Distribution

Seasonal distribution is more important than the annual rainfall distribution while as, monthly distribution pattern is more vital than that of the seasonal intake of rainfall. The study of the long spell of dry period can only be possible through the monthly rainfall distribution chart. From the perusal of Table 1.3 it is clear that July receives the maximum rainfall accounting for 30.51% of the total annual intake followed by September, August and June. The mean July intake of rainfall (1980 to 2018) is approximately 327.85 mm . This amount is sufficient enough to maintain soil moisture. But this good sign is marred by erratic incidence of rainfall within days of the month. Majority rainfall of the month is restricted one or two or three days and the rest days remain dried. It is this which creates problem for maintaining proper crop-calendar. November and December months. Witness the beginning of Rabi cultivation.

Table No. 1.3
Monthly & Annual Rainfall (MM)

Month	1980	1985	1990	1993	1995	1997	2000	2002	2005	2010	2014	2015	2016	2017	2018	Total
June	414.43	136.36	87.81	71.87	61.34	218.97	179.57	61.71	119.20	160.76	171.8	139.1	242.7	91.0	144.7	2301.32
\July	**601.29**	**354.08**	**384.89**	**149.74**	**207.12**	**195.87**	**178.88**	**235.20**	**430.76**	**403.53**	**309.7**	**233.8**	**528.9**	**443.2**	521.7	5178.66
August	**494.38**	**269.21**	**215.08**	**261.33**	**415.32**	**313.81**	**180.57**	**303.21**	**320.14**	**326.71**	**431.9**	**386.5**	**89.4**	**937.7**	428.5	5373.76
September	**190.42**	**365.96**	**275.06**	**334.58**	**244.98**	**239.91**	**242.58**	**217.05**	**212.12**	**244.56**	**233.2**	**86.8**	**362.3**	**329.6**	202.6	3781.65
October	**12.41**	**182.40**	**30.08**	**38.75**	**6.65**	**50.04**	**0.68**	**140.20**	**44.30**	**56.73**	**177.0**	**52.4**	**43.4**	**13.3**	3.8	852.14
November	**0.20**	**0.24**	**0.01**	**0.00**	**18.76**	**14.48**	**0.00**	**8.72**	**7.20**	**0.76**	**0.31**	**0.41**	**0.22**	**0.72**	0.62	52.65
December	**7.26**	**18.26**	**2.40**	**0.00**	**8.56**	**12.02**	**1.12**	**1.32**	**5.20**	**5.88**	**2.34**	**4.31**	**6.78**	**6.33**	0.00	81.78
January	**1.06**	**16.76**	**0.19**	**12.21**	**26.50**	**13.45**	**12.83**	**13.74**	**8.53**	**14.63**	**6.0**	**8.6**	**0.0**	**3.7**	0.0	138.2
February	**5.39**	**2.67**	**11.69**	**1.05**	**17.19**	**3.72**	**13.82**	**12.51**	**10.11**	**9.33**	**28.6**	**3.2**	**2.1**	**0.0**	0.0	121.38
March	**13.13**	**1.21**	**6.32**	**9.13**	**13.94**	**5.30**	**8.98**	**7.93**	**13.13**	**10.39**	**6.0**	**49.5**	**4.5**	**95.2**	0.0	244.66
April	**6.57**	**21.58**	**17.31**	**16.29**	**17.30**	**21.96**	**19.07**	**16.77**	**25.31**	**22.72**	**0.0**	**49.2**	**8.2**	**38.0**	93.5	373.78
May	**24.96**	**29.67**	**63.06**	**68.71**	**35.19**	**116.63**	**26.64**	**26.09**	**72.66**	**60.76**	**37.8**	**59.3**	**131.4**	**102.9**	137.8	993.57
Total Annual Rainfall	**1771.5**	**1398.58**	**1093.9**	**963.66**	**1072.85**	**1206.16**	**864.74**	**1043.13**	**1268.5**	**1316.96**	**1404.25**	**1073.12**	**1419.9**	**1561.95**	1533.22	19493.55

Source :- District Wise monthly rainfall data, India meteorological Department (IMD).

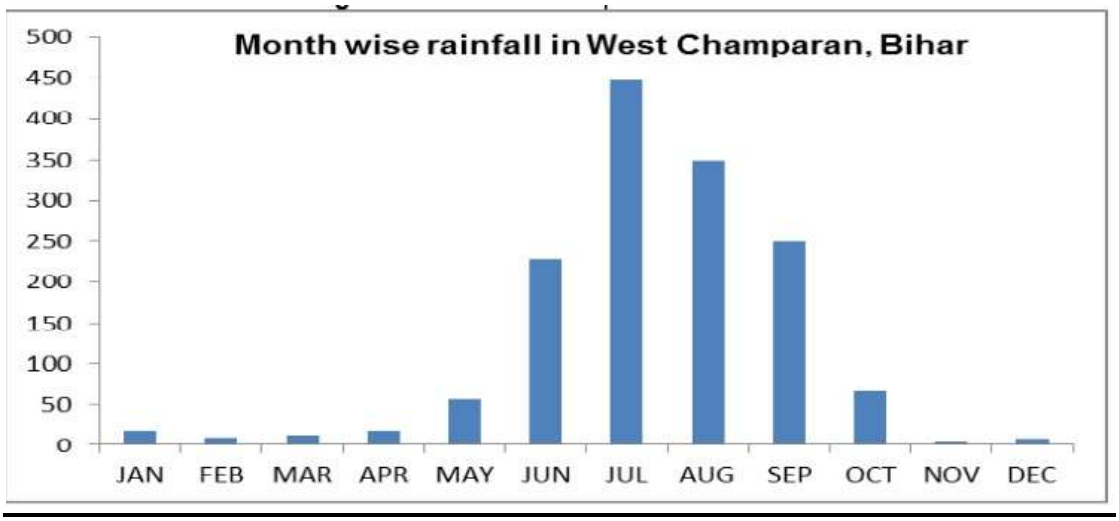

Figure No. 1.6

But these months show great fluctuations in the receipt of rainfall. Even the rainfall incidence in the month of October is not static. Often rainfall fails to provide moisture to the soils. Hence, the region requires maximum irrigation during the growing period of Rabi crops and summer crops. During the months of July, August and September the need of irrigation is occasionally felt. This causes great variations in the utilization of available irrigable water from year to year.

Secondary, Sidhaw, Ramnagar, Bagaha Gaunaha (Bhainsalotam) and Narkatiaganj C.D.B's receive maximum rainfall in the months of June and July. While C.D.B's situated in the southern parts of the Gandak-Sikarahana Doab receive maximum amount of rainfall in the month of August-September . Hence,variability is less in the north in June and July and vice-versa in the southern C.D.B's in August and September. thus northern C.D.B's are suited to Kharif cultivation and southern part is favourable for Rabi crops. The southern parts receive more rainfall in the month of August and September. Late rainfall provides moisture storage for Rabi crops. Above all, moisture storage carried on from the month of June also supplements or fulfill the moisture requirement of the Rabi crops in the south. Thirdly, the northern hilly & piedmont parts of the district have higher location. These parts are less vulnerable to floods in general while as Anchals of Gandak Sikarahana Doals is more prove to floods.

Analysis of the trends of the annual, seasonal and monthly distribution of rainfall over the area throws some light on the actual availability of rainfall. But variations from year to year, from season to season and even within a month turn the wheel in favour of artificial irrigation.

Variability of Rainfall

A very in take significant aspect of rainfall is its variability. It is just a departure of rainfall intake from the normal. It occurs from year to year and also from place to place. K. Parthsasrthy observes "variability as low as 10% from normal is serous in areas of moderate precipitation where the rainfall is just enough for the crop production. This would be so particularly, when it is on the negative side. Dr. W. Stamp's [6] observation "The famine areas are not in the driest parts of the country but those having an intermediate rainfall." The Champaran west falls in medium rainfall range[47,] Blandford[48] Observes "in no single year is rainfall deficient or excessive simultaneously in all parts of India."

Table 1.1 reveal that the area under study does not suffer from lack of rainfall . But its ill-distribution both in space and time poses a great problem in handling the situation arising out of it. It will be evident from the table 1.4 that the variability of the seasonal rainfall is generally greatest in those parts of the district which have the lowest average seasonal precipitation, and is least in those with a high average rainfall.

The Table 1.4 shows that Annual variability increases from north to south and also from east to west. Except Bagaha (15.95) almost all stations have recorded variations beyond 16% (±). The variation takes place between 15.95 and 23.57% recorded by Bagaha and Narkatiaganj respectively.

Table No. 1.4
Monthly & Annual Variation in Rainfall (%)

Sl No.	± Station	± June	± July	± August	± September	± Annual
1.	Bettiah	47.25	39.12	35.17	55.51	20.33
2	Lauriya	51.93	52.66	44.60	45.30	20.06
3	Nautan	48.00	30.59	34.98	41.04	20.59
4	Chanpattia	45.31	44.02	39.52	44.21	20.42
5	Majhaulia	47.02	45.62	42.10	47.20	20.59
6	Sikta	43.98	42.82	38.12	43.90	19.41
7	Mainatand	42.92	43.08	39.02	45.10	18.80
8	Gaunaha (Bhainsalotan)	42.15	40.20	36.90	41.55	17.90
9	Sidhaw	40.26	37.80	28.84	37.01	16.81
10	Ramnagar	37.58	44.94	33.85	45.72	16.71
11	Narkatiaganj	45.99	43.10	37.11	39.96	23.57
12	Thakrahan	41.81	42.19	37.55	44.18	21.39
13	Madhubani	41.70	42.05	38.20	44.10	21.52
14	Jogapatti	42.10	42.40	37.15	43.56	22.10
15	Bairia	42.98	42.78	36.90	42.92	20.55
16	Bagaha	43.36	42.49	32.40	45.63	15.95
17	Piprasi	41.22	44.33	35.30	44.20	20.63
18	Bhitaha	42.33	41.44	33.34	42.80	19.98

Source: Unpublished District statistical record. The Champaran West, Bettiah.

Monthly variations of the rainfall during the south. West monsoon period are very important to be considered. Because the prospects of both the Kharif and Rabi cultivations are depends on the normal receipt of the rainfall. In case it fails, it will rain the standing Kharif crops on the one hand and bleak the prospect of Rabi cultivation on the other. Its variability is below 15.5% (which is not found here), precipitation below the normal in a year is not unwelcome. Here precipitation above the normal is not relished, surplus water over tops the river banks and in undated nearly or wide-spread parts of the district. If there is any change either in the normal amount of rainfall or in its timely distribution, there is lock out in Agro-industry. Here, people are so intimately dependent upon the rainfall rhythms that the whole prosperity is tied up with the eccentricities of its seasonal winds.

Table 1.4 reveals that the percentage variation of rainfall is very high almost in all the monsoonal months. Whenever variation is positive, it is a matter of appreciation, if not, a matter of despair. Variations recorded in different monsoon months for different stations swing between 28% and 55% . Nearly 90% C.D.B's have recorded variations

above 40% (except the month of August). This trend is akin to the trend of variations for the whole of the middle Indo-Gangetic plain. The main lowland area shows variations above 40% (±) while as the Sub-montane tract and Tarai register less than 40 % (±) or in between 30 and 40% with one or two exceptions. Hinting over the trend of south-west monsoon rainfall. Leather 18 observes "the relationship between the actual fall and the possible useful fall varies from 99% to 60.6%" This large proportion is enough to cause inundation or drought in the area as the conditions may be. Variation in the month of October is also a matter of great consideration. The district experiences variation between 75% and 100% or sometimes above it in the month of October. The arrival of monsoon may be sometimes too early or too late be one to three weeks than the usual time. Similarly, it may end abruptly with the premature cessation of rains, or fail off well into late October, leaving the ground in a waterlogged condition. Thus, even in years of good monsoon, the rainfall may be sufficiently variable.

Intensity of Rainfall

The average number of rainy days with affective rainfall (25 mm) in the area under study varies from 40 to 60 showing a gradual increase from south to north and west to east. The number of effective rainfall days follows more or less the pattern of the total annual precipitation received in the district as shown in Table 1.2 and 1.5 (stations selected from different segments). Show that the Sidhaw C.D.B registers the highest number of rainy days accounting for sixty days. During the wet season per rainy day bears 27 mm. rainfalls. Gaunaha and Narkatiaganj receive 30.61 and 31.6 mm. rainfall respectively . More or less the same trend is seen at all other stations. It clearly indicates that intensity of rainfall is more in the north and decreases towards south. Further, intensity is high enough during the south-west monsoon period. The rest months of the year have only 10% of its total days and amount per day is for less than the amount received during the south-west monsoon period. Necessity of irrigation is well visualized.

Table No.1. 5

Number of Rainy Days

Sl.No.	Stations	S.W. Monsoon Rain in mm.	Average Annual Rain in mm.	% contribution of S.W. Monsoon	Number of rainy days.
1	Vainsalotan	1684.69	1865.70	90.30	60
2	Bagaha	1327.10	1461.39	90.83	57
3	Gaunaha	1480.20	1637.07	90.38	58
4	Bettiah	1148.88	1257.67	91.33	42
5	Narkatiaganj	1465.75	1516.78	96.57	53
6	Thakrahan	1234.60	1349.22	91.55	43
7	Sikta	1270.20	1398.72	91.52	44

Source: Unpublished Statistics, Available at Dist. Head quarter.

Some of the important results can be summarized as

I. Bihar gets more than 1256 mm of its annual rainfall.
II. West Champaran district gets more than 85.61% of its annual rainfall in the south west monsoon.
III. The highest rainfall (35% of south west monsoon rainfall), is receive in July month, 30% (of south west monsoon rainfall), is received in August month , followed by September 20% of the south west monsoon rainfall.
IV. The highest mean southwest monsoon rainfall (1865.70mm) is observed in Vainsalotan and lowest mean southwest monsoon rainfall (1257.67mm) in Bettiah.
V. The southwest monsoon season rainfall shows a significant decreasing trend, where as monthly rainfall and annual rainfall do not show any significant increasing / decreasing trend.
VI. In the southwest monsoon season, maximum number of rainy days (~60 days) is observed in Vainsalotan and minimum number of rainy day (~42days) in Bettiah.
VII. The maximum number of dry days during the southwest monsoon season (~305 days) is observed in Vainsalotan and minimum number of dry day (~323days) in Bettiah.
VIII. A significant increasing trend for the number of rainy days in south-west monsoon in Bettiah, Bagaha, Gaunaha, Vainsalotan.
IX. A significant increasing trend for the number of dry days n west champaran is Bettiah .Thakrahan, Dhanaha , Sikta, Narkatiaganj Bagaha, Gaunaha ,Narkatiyaganj, Vainsalotan.

Conclusion

From above description it is clear that this district receives more rainfall than the average Computed for Bihar and India. In the analysis we have considered Monsoon months, the south west monsoon season and annual scale. The spatial scale has been considered from state to district for the study of mean rainfall, and stations are considered for the study of intensities of rainfall. The analysis brought many Significant features of rainfall pattern and can be used for water agricultural managements. But seasonality and variability in the incidence of rainfall is not conductive for agriculture. Hence , artificial watering through Trihut, Tribni and Done canals will bring great change in agricultural landscape of the district.

References

1. Mukharjee, R.K. Problems of Modern India.
2. Bihar Through Figures: Annual Wealth & Crop Reports. Directorate of Statistics, Government of Bihar. Patna.
3. Memoria, C.B. Geography of India, Shivalal Agrawal & Company. Educational Publishers . Agra. 3, p. 217.
4. Geology Department of Patna University. Findings Reports of the Survey work. The Indian Nation, 1987.

5. Based on Unpublished Statistical Record. Irrigation Department Office of Superintendent engineer.
6. Parthasarthy, K : Monsoons of the World 1938, pp. 185-194.
7. Stamp. L.D.: Asia. A Regional and economic Geography, 1962, p. 198.
8. Techno-economic Survey of Bihar, N.C.E.A.R., New Delhi.
9. Clark, K.J.T., "The Vicissitudes of the Summer Rainfall of the Indo-Gangetic Plain and the Assam Valley". Vol. 17, 1932, p. 286.
10. Clerk, K.G.T. Op. cit., p. 289
11. Leather, Memoris Dept. of Agriculture , India, Indian Chemical series, vol. 1 No. 8, p. 161.
12. Chakarvarti. a.K. : Floods in Himalayan Rivers of Ganga Plain: Causes and Controls Geographical Review of India. Vol. 21, December 1959. pp. 34-35.
13. Guhathakurta P and Rajeevan M , 2008 " Trends in rainfall patern over India" International J. of Climatology,28:1453-1469
14. Guhathakurta P, Sreejith O P and Menon P A, 2011 " Impact of climate changes on extreme rainfall events and flood risk in India " ,J. Earth System Science. 120,No. 3,359-373.

* * * * *