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A study of climatic conditions in Punpun basin of Magadh region, Bihar, India

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Abstract
This paper aims at geographical study of climatic conditions in the Punpun basin of Magadh region of Bihar**.** The Punpun basin experiences tropical continental monsoon climate. Nearly 86 per cent of the total rainfall occurs during rainy season i.e. from mid June to September. The mean annual rainfall of the study area is 1168 mm. The mean annual temperature is 24.67°C.

Keywords: climate, drainage basin, season, rainfall, moisture

Introduction

The river Punpun originates from Chotanagpur hills in Hariharganj Block of Palamu district in Jharkhand at an elevation of 442 m and at latitude 24^0 11'N and longitude 84°9'E. The river Punpun flows for most of its portion in north, north-eastern direction and falls into the Ganga near Fatuha, about 25 km downstream of Patna. Its total length is about 235 km. The river receives a substantial portion of discharge from its right bank tributaries. Majority of the tributaries originate from the same range of hills in Palamu, Aurangabad and Gaya districts of Jharkhand and Bihar respectively. The Punpun basin is situated between latitudes 24°6'N and 25°37'N and longitudes 84°0'E and 85°19'E. Spanning over the parts of Palamu and Chatra districts of Jharkhand and Aurangabad, Gaya, Jehanabad, Arwal, Patna and Nalanda districts of Bihar it covers an area of nearly 9025.75 km^2 which is nearly one per cent of the total area of the Ganga sub-basin in the country. The basin covers partially the areas of 8 districts viz. 32.51 per cent of the area of Patna district, 75.20 per cent of Jehanabad and Arwal districts, 52.60 per cent of Gaya district, 82.41 per cent of Aurangabad district, 0.88 per cent of Nalanda district, 6.26 per cent of Palamu district and 6.11 per cent of the area of the district of Hazaribagh (old).

Study area

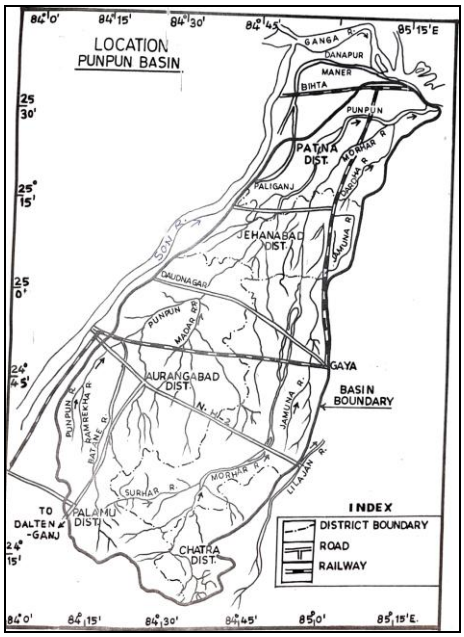

Fig 1: Location of Punpun basin

The study area is a drainage basin. This river basin consists of a number of small tributaries like the Morhar, the Dardha, the Batane, the Madar, the Ramrekha, the Bakri, the Adri, the Neera, the Senane, the Begi, the Khudwa, the Mavaria and the panchanva etc. which join the main river Punpun. The drainage basin is bounded by the Sone basin on the West, the Kiul-Harohar-Phalgu basin on the East, the Ganga basin on the North and the North Koel basin on the South.
The Grand Trunk Road (NH-2) divides the catchment into two parts in such a way that almost all the hilly parts of the basin falls on its south and plain areas on its north. The upper catchment which lies in the districts of Palamu and

Chatra is characterized by low hills mostly covered under forest and the slopes with depression and valleys. The lower part of the catchment are in the districts of Aurangabad, Gaya, Nalanda, Jahanabad, Arval and Patna, is mostly plain or having some uniform mild slope and are being used for cultivation. The elevation of the Punpun basin varies from 442 m above MSL near the origin of the river to about 50 meters above MSL near its outfall into the Ganga. But the highest point of the basin is represented by Bijai Gir (610.0 metres above MSL) which lies in the south-western part of the study area.

The study area is characterized by hills, hillocks, escarpment, plateau surface, channels, channel bars, badlands, winding divides, flood plains, natural levees and slopes of various types. Tors on the hill tops and on the foothills present some other important geomorphic features. The Dome-shaped hills formed due to spheroidal weathering and exfoliation is also very common in the basin. Figure 1 gives a geographical map of Punpun basin.

Climate

Climate of any place or region is the sum total of weather condition for a long period of time. It has played and is playing a very significant role in the evolution of geomorphic features.

The study region experiences tropical continental monsoon climate. More than 86% of the total rainfall occurs during rainy season. The period between middle June to the end of September comes under rainy season. The Punpun basin forms a part of the Gangetic plain and it is situated in the direct path of the tropical depression which is formed in the Bay of Bengal during the monsoon season and travels in north western direction. Most of the precipitation occurs during the monsoon months of June to October. From November to March fine dry weather prevails. Winter is cold and summer is very hot. The mean annual rainfall of the study area is 1168 mm. The mean annual temperature is 24.67°C.

The year can be divided into three main seasons

a. The Summer season (From March to May)
b. The Rainy season (From June to September)
c. The Winter season (From November to March)

The main theme of the study of climate in geomorphology is to study the role of climatic elements notably solar energy and moisture over the geomorphic processes to produce distinctive landforms. Hence, a systematic study of climatic conditions is delineated here.

a. Rainfall

Of all the climatic parameters rainfall is the most important in shaping the landforms of this region. There is little variation of rainfall in the basin. The rainfall is of orographic type. More than 85% of rainfall occurs during south-west monsoon period. Cyclonic rainfall is occasional here. The south west monsoon sets in by mid-June and withdraws by mid-October. July is the rainiest month. During the rainy months the amount of surface-runoff, the amount of sediment load and the magnitude of fluvial erosion are the highest. The rainfall hardly exceeds 50 mm in other months of the year. Some rain occurs during winter by temperate cyclones which come from west. The Table 1 shows the rainfall normal's of the Punpun basin. The Table 2 shows the year Wise monsoon rainfall inside the Punpun river basin and adjacent to it from 1963 to 1990.

Table 1: Rainfall normal of the Punpun basin (in mm)

Month	Rainfall in mm	Month	Rainfall in mm
January	18	July	326
February	25	August	349
March	13	September	194
April	8	October	52
May	22	November	13
June	142	December	6
Annual	1168		

Table 2: Year wise monsoon rainfall inside the Punpun river basin (in mm)

Year	Average rainfall	Year	Average rainfall
1963	877.74	1977	949.13
1964	943.49	1978	1171.33
1965	757.76	1979	652.20
1966	603.02	1980	871.12
1967	1004.37	1981	840.62
1968	803.30	1982	714.62
1969	912.76	1983	766.41
1970	773.26	1984	1005.97
1971	1432.59	1985	1068.65
1972	652.71	1986	951.13
1973	824.63	1987	1275.07
1974	803.93	1988	885.07
1975	759.28	1989	857.50
1976	1043.43	1990	1106.20

The season wise distribution of rainfall of the Punpun basin is delineated in Table 3. From this Table it is obvious that the amount of rainfall varies even in a single season from year to years but the study region gets the heaviest rainfall from June to October.

Table 3: Season wise distribution of rainfall (in mm) in the Punpun Basin

Months	1955	1956	1957	1958
June to October	1149.8	1261.8	672.4	1325.0
November to February	76.0	19.0	76.5	45.1
March to May	22.0	74.0	16.5	15.2

b. Intensity of Rainfall

It is very much helpful in the study of rainfall region. The problem of run-off, soil percolation, evaporation and soil erosion are correlated with the intensity of rainfall. In this region rainfall of high intensities occur during the monsoon period, prior to the break of monsoon a dry spell occurs, due to which in many parts of the basin soils are pulverized and lose cohesion. The rainfall of unusual intensity causes cloud burst floods which are characterized by carrying large volumes of solids and surprisingly little water as runoff. The solid material carried along in cloud burst floods is popularly believed to be derived from stream banks and channels but most of it may in fact be derived from the upland. The rains of unusual Intensity which occur during the monsoon months affect the hill slopes, the uplands and the Valley-slopes considerably. During the period of catastrophic rains linear erosion on slopes co-operates with gravitational processes. Gullies are formed on the slopes and these are in time transported into small erosional valleys. The rains of all intensity cause acceleration of weathering

and processes of denudation in the deforested region. The Intensity of rainfall at any region is calculated by the formula:

$$i = \frac{A}{n}$$

Where A = total rainfall over given period
n = total number of hours of rain or the number of rainy days

c. Humidity

Humidity is the state of atmosphere with respect to the water vapor it contains. Within humidity, relative humidity is of greater importance. It is the ratio between the actual amount of water vapor available in the air and the maximum quantity of water vapor which the air can contain at the same temperature. It is often expressed in percentage.
There is a considerable variation in humidity from season to season. During summer the humidity is much lower than during the other months due to the hot and westerly day winds prevailing in the basin area. As the monsoon season approaches the air becomes charged with moisture and humidity remains steady at 80% to 84% throughout July and August.
In September when fine weather alternates with cloud and rain of the monsoon humidity becomes lower and reaches a minimum of 70% in the month of November. Table 4 shows the month wise average relative humidity for the Punpun basin based on the observations from 1881 to 1940.

Table 4: Relative Humidity

Months	Humidity in %	Months	Humidity in %
January	66	July	79
February	63	August	82
March	36	September	78
April	25	October	71
May	39	November	66
June	56	December	71

But the humidity chart gives a slightly different picture when it is examined for one particular year. Table 5 shows the data for humidity for 1948:

Table 5: Mean Humidity

Months	Humidity in %	Months	Humidity in %
January	76.6	July	78.0
February	59.0	August	97.0
March	55.0	September	84.5
April	38.5	October	62.0
May	54.0	November	65.5
June	62.5	December	41.0

d. Temperature

Temperature is also an important climatic parameter affecting the geomorphic processes in this region. In this region of increasing moisture and high temperature chemical reactions are great and the relative importance of mechanical fracturing is reduced. Evaporation increases with temperature. In the southern part evaporation is high due to high temperature. If north-westers do not bring rain in any particular year, most of the rivers, tanks and wells dry up causing great problem to human beings. It causes problems for livestock also.

Average temperature and diurnal range of temperature both affect geomorphic processes. Table 6 represents average temperature of this area:

Table 6: Mean Maximum and Mean Minimum Monthly Temperature in °C

Months	Maximum	Minimum	Mean
January	27.2	7.8	17.5
February	30.7	9.3	20.0
March	37.8	14.4	26.1
April	42.9	19.8	31.4
May	44.5	22.5	33.5
June	43.5	23.5	33.5
July	37.8	23.6	30.7
August	35.8	23.6	29.2
September	35.4	23.3	29.4
October	34.7	17.6	26.2
November	31.4	11.5	21.5
December	26.7	6.9	16.8

The average temperature varies from 17.5°C in January to 33.5°C in May. Generally it rises up to 41°C in summer but 44.5°C is not unusual. The temperature curve indicates the rise in fairly high temperature during the summer months. From the maximum it falls immediately with the onset of the monsoon. From Table 6 it is obvious that the basin experiences extremes of temperature. Diurnal range of temperature also affects geomorphic processes. Weathering of the rocks is very much affected. Therefore its study is also important. From Table 7 it is clear that the mean diurnal range of temperature is highest in the month of April, a period of low humidity and of minimum cloudiness. It is quite high during the winter while the lowest range is during the monsoon months. The marked fluctuation of temperature in different seasons affects greatly the operation of weathering processes:

Table 7: Diurnal Range of Temperature

Months	Range of Temperature in °C	Months	Range of Temperature in ^{O}C
January	21.0	July	13.7
February	22.9	August	11.4
March	23.0	September	12.2
April	24.9	October	17.2
May	22.6	November	20.0
June	20.4	December	19.9

e. Winds

It is a region of least wind activity. Both temperature and precipitation being high, the wind action is inhibited in this region. The velocity of wind is higher in the northern part. The velocity of the wind remains usually high from March to September i.e. the period of north-wester and monsoon. During the post-monsoon period some cyclonic depression originating from the Bay of Bengal enter from the east in this basin with tremendous force uprooting a large number of tress and depleting the cohesion of the soil, in those parts where the trees existed. Evaporation increases with the wind velocity. In the southern part where the wind velocity is small due to vegetation cover rate of evaporation is relatively low. A hot wind known as 'Loo' blows from the west from March to May. The work of wind which remains idle in the rest part of the year becomes active during these months. Table 8 depicts the mean wind speed of the study

region in different months:

Table 8: Mean Wind Speed in Km/hr

Months	Wind speed	Months	Wind Speed
January	3.6	July	6.2
February	4.7	August	5.6
March	5.3	September	5.1
April	6.9	October	3.4
May	7.3	November	3.2
June	7.7	December	3.2

f. Special weather Phenomena

Rainfall is sometimes associated with thunder during the rain. Sumner is marked for dust storms and occasional hailstorms. These special weather phenomena have little role in the control of geomorphic processes.

Climate especially through precipitation and temperature-its two important parameters control the hydrology of the study region. As the region experiences high temperature and high rainfall chemical weathering is the dominant process of weathering and mechanical weathering is insignificant. The effect of running water in shaping the land forms is the greatest.

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