

Chapter - 2

Physical Environment

Kanpur has benefitted from its fertile agricultural hinterland of upper Ganga valley and bundelkhand plateau. Physiographically, the study region lies in Indo-Gangetic plain, particularly in lower part of the upper Ganga plain. The Geological characteristics of this plain are uniform throughout the region because of its uniform formation and rocks structure, due to the plain topography and very minor longitudinal and latitudinal differences the region has almost uniform physical environment. The present chapter deals with a systematic spatio-temporal description and analysis of the aforesaid geomorphologic complex region through the study of such aspects as location, extent and area; general terrain; as well as climatic environment; pedogenic; and floral environment so that a basic stage of geomorphologic knowledge can be set for the study and are presented here in separate sections.

2.1 Location and Extent :

According to 2001 census, municipal area is about 261.50sq.km. In 1961, municipal area was 114.55 sq. miles which has increased to 261.50sq.km. The study region (Kanpur Metropolis) is a Doab of two rivers Ganga and Pandu in upper Ganga plain in the Kanpur district (U.P. in India). The study area extends from 26^o 30 ' E north latitudes and from 80^o 2' E to 80^o 31' E longitudes. The metropolitan region defined by Kanpur Nagar Nigam. It is administratively divided into 6 zones and 110 wards with an average ward population range of 19000 to 26000 (Fig. 1.2, chapter 1).

Population density is 94.06 persons per hectare. The density of core area is much higher than outer area. The area under these two rivers is a doab and G.T. road across the area along the low altitude ridge which forms the watershed boundary of the catchment's area of both the rivers. Therefore, the water of north Kanpur comes in river Ganga and the water of south Kanpur comes in river Pandu. Due to sewage

water of Kanpur south which comes in river Pandu in lower stream this non-perennial river becomes perennial and water of river becomes most polluted.

2.2 Physiographical Characteristics :

The study area is a lower part of upper Ganga plain which constitutes the physiographic sub-division of Ganga-Yamuna doab (area of Kanpur district). A group of curiously exciting topographical characteristics with numerous fascinating landforms of the area is the result of the degradation and aggradational work of the Perennial Ganga and Non-Perennial River Pandu and their tributaries. It has a plain and flat topography marked with casual undulations because of water sheds and subsidiary drainage lines which finally merge with the general trend from north-west to south-east (Fig. 2.1). The height of the area varies from minimum 118.49 m to maximum 136 m. The general slope of the land is from north-west to south-east. The G T Road which passes through middle of the Kanpur Metropolis forms a water divide of the whole area. G T Road constructed along with a ridge of the area which is comparatively higher portion of the study area. The north area of G T Road is drained by river Ganga whereas the Southern part of the area drained by river Pandu.

2.3 Drainage System :

The drainage systems of the study region consist of mainly river Ganga along with its tributaries and various nalas. River Pandu is a Tributary of river Ganga, which plays great role in the drainage system of the area. The drainage system of this region is classified into two groups as follows :

2.3.1 Perennial River Ganga :

The River Ganga flows through sinuous course and forms various river islands. Most of the area under study is drained by river Ganga. In Kanpur urban area the study region is drained by 15 nalas which are artificial and constructed by Kanpur Municipal Corporation. These nalas also drain the industrial and domestic waste water and mix it in the holy river Ganga. The name of these nalas are: (i) KESA Colony Nala, (ii) Roadways Colony Nala, Kheora Nala, (iv) Jageshwar Nala, (v) Jyora Nala, (vi) Nawabganj Nala (vii) Ranighat Nala, (viii) Sisamau Nala,

(ix) Tafco Nala, (x) Parmat Ghat Nala, (xi) Muir Mill Nala, (xii) Police Line Nala, (xiii) Jail Nala, (xiv) Sarsaiya Ghat Nala and (xv) Guptar Ghat Nala.

2.3.2 Non-Perennial River Pandu :

River Pandu is Non-perennial River which drains the area mainly in monsoon season but in the Kanpur it drains a major part of the southern Kanpur metropolis through its various nalas. Here it is notable that due to these drainage conditions, this non-perennial river has been converted into Perennial River.

2.4 Climate :

The study region has a sub-continental type of sub-tropical monsoon climate with long hot summers, moderate monsoonal rains and a pleasantly cool winter season. Hot summers, pleasant monsoonal showers and cold winters give a peculiar type of seasonality to this region. The winter commences from November onwards, hence, the temperature drops down sharply and low temperature continues up to February, followed by the hot-dry season with strong hot winds. Long scorching summers lead to an accelerated rate of prolonged duration of evaporation resulting in this region, often to come under the water scarcity regions of Uttar Pradesh with the beginning of July, the south-west monsoon sweeps in the study region bringing moderately heavy precipitation and this “muggy” season lasts up to September. The month of October is a transitional period between the hot-wet rainy season and the cold dry winters and constitutes the post-monsoon season. Spatial and temporal distribution of temperature, rainfall, evaporation, humidity, wind-speed etc. determine the nature of atmospheric environmental processes, which help in shaping the morphology of the study region through large scale sculpturing and deposition of materials obtained by involved morphogenetic processes. The climatic condition of the study region is described as follows:

2.4.1 Temperature :

A sub-tropical type of climate of the study region can be recognized by the presence of three distinct seasons viz. the hot-dry summer season from March to June, the hot-wet rainy season from July to October and the cold-dry winter season from November to February. Temperature data of 38 years show (Table No. 2.1)

that the average annual temperature of the study region is 25⁰C. The mean maximum temperature is 31.20⁰C, whereas the mean minimum temperature is 18.83⁰C. The temperature for the winter season begins to fall by mid-November, and January is the coldest month when the mean daily minimum temperature falls down to 7.75⁰C, whereas the mean maximum temperature is 20.67⁰C. Low temperature in January is due to the influence of the occasional temperate cyclonic disturbances coming from the far-off Mediterranean Sea which manage to sweep over the entire north-western portion of the country, bringing along with them cold waves and hailstorms. Due to these cold waves the study region faces lowering the winter temperature to as low as one or two degrees above the freezing point. The lowest January temperature (3.5⁰C in January 2002) was recorded during the last 42 years (1967-2009). The temperature variation of the study region is analyzed in following sub-heads:

Table No. 2. 1
Mean Maximum, Mean Minimum, Highest & Lowest Recorded
Temperature (in ⁰C, 1967-2009)

Months	Temperature (⁰ C)						
	Mean Maximum	Mean Minimum	Average	Highest recorded		Lowest recorded	
				Temp.	Year	Temp.	Year
January	20.67	7.75	14.53	26.73	1995	3.50	2002
February	24.50	10.32	17.89	27.17	1969	8.90	1972
March	30.69	15.10	22.89	34.80	1996	13.00	2002
April	37.29	21.18	29.38	40.39	1999	17.85	1996
May	40.09	25.69	32.87	43.2	1995	22.20	2003
June	38.85	27.77	33.04	44.06	1967	24.70	1996
July	33.50	26.46	29.82	39.35	1967	24.70	2003
August	32.43	25.90	28.60	35.87	1687	23.80	1998 & 1999
September	32.50	24.75	28.19	37.08	1968	22.00	2001
October	32.37	19.53	25.89	39.30	2000	16.60	1972
November	28.37	12.92	20.92	32.93	1997	10.20	2003
December	23.12	8.64	15.99	25.01	1969	5.900	2001
Mean	31.198	18.834	25.001	35.491	-	16.112	-

A rise in temperature is noticed from February which attains its maximum during the month of May and June, when the mean temperature of 40.09⁰C and 38.85⁰C respectively are recorded (Fig. No. 2.2). The highest summer temperature was 44.06⁰C in June 1967. The hot-dry wind known as “Loo” during summers makes the heat more oppressive especially over the alluvium plain which has a poor vegetation cover. With the commencement of the moist south-west monsoons, these hot-dry winds disappear and the lowering of temperature starts with the rains.

2.4.2 Range of Temperature :

Table No. 2.1 shows that the average annual range of temperature of the study region is 12.42⁰C, where monthly range of temperature varies greatly from month to month. The minimum mean monthly range of temperature is 6.52⁰C in August while the maximum is 16.09⁰C recorded in April. The range of temperature is increasing from the month of September (7.87⁰C) to April (16.09⁰C) and starts decreasing from May (10.89⁰C) to August (6.52⁰C). This implies that the range of temperature is high during the winter season (November to February). The eight months from October to May (winter & summer seasons) are associated with the high range of temperature, whereas the four months of rainy season (June to September) are characterized by low range of temperature due to excess humidity in the atmosphere.

2.4.3 Rainfall :

The amount of rainfall received by any region gives a clear idea of the existing pedogenic and floral environment of that region. The study region of Ganga valley receives a mean annual rainfall of 872.10 mm. Most of the rainfall occurs during wet summer season from the south-west monsoon winds, whereas cyclonic showers during winter season are due to mid-latitude disturbances which affect the north-western parts of the country but sometimes reach as far eastwards as the study region causing thunderstorms and sometimes hail. Table No. 2.3 shows the mean monthly rainfall received during each month of the year from 1967 to 2009, which is shown in Fig. No. 2.3 A.

Table No. 2.3 shows that maximum amount of rainfall are received during the hot-wet months of July, August and September. The average monthly rainfall 247.43 mm, 263.65 mm and 183.38 mm are received during July, August and September respectively. During the last 42 years the maximum (1986.91 mm) rainfall amount was recorded in year 1980, while the minimum (349.3 mm) rainfall was noticed in the year 1974. The actual rainy days in a year are approximately 86 and rests are dry. While analyzing the annual average rainfall, it is noticed that the 21 years out of 42 sample years have less than the annual average rainfall. The temporal variations play a dominant role in the fluctuations of river water discharge.

2.4.4 Seasonal Rainfall :

Major shares (85.76 %) of annual rainfall were received in rainy season, whereas a little only 7.81 % (68.18 mm) and 6.43 % (55.99 mm) rainfall received in summer and in winter season respectively. In view of the seasonal discharge of water the rainy season marks the highest discharge which abruptly decreases in the summer and winter seasons. On account of the trend of variation in amount, it may be mentioned that the nature of rainfall is erratic. Rainfall occurs in drizzles during the winter season while in downpours during the rainy season. The proportion of rainy days to the total days of the season is 1:11 in winter, 1:10 in summer and 1:2 in rainy season as shown in Fig. No 2.3B.

Table No. 2 .2
Seasonal Distribution of Rainfall

Seasons	Number of rainy days.	Total rainfall (in m. m.)	% of the seasonal rainfall.	Intensity of rainfall
Winter	11	55.99	6.43	9.09
Summer	12	68.18	7.81	5.68
Rainy	62	748.22	85.76	12.07
Total	85	872.39	100.00	26.84

2.4.5 Monthly Rainfall :

Table No. 2.3 reveals that there are large variations in the amount of mean monthly rainfall which varies very greatly from 3.82 mm (minimum) in April to 259.29 mm (maximum) in August. The monthly rainfall starts increasing from May (15.32 mm) to August (259.29 mm) and thereafter decreases up to November and again it starts increasing up to February. Further rainfall decreases from February to May in every year.

2.4.6 Intensity of Rainfall :

Table No. 2.2 shows that the total annual average rainfall of 872.10 mm is received in about 85 days therefore the annual intensity of rainfall, therefore, are 10.26 mm per day. The position of seasonal intensity displays variations i.e. 9.09 mm, 5.68 mm and 12.07 mm per day during winter, summer and rainy seasons respectively. The monthly intensity varies from minimum 2.80 mm in April to maximum 13.66 mm in September.

Table No. 2.3
Average Rainfall, Number of Rainy Days and Intensity of Rainfall

Months	Average rainfall mm.	No of rainy day	Intensity of rainfall
January	13.42	2.63	5.10
February	13.98	2.94	4.75
March	05.94	1.74	3.41
April	03.82	1.37	2.80
May	15.32	2.40	6.38
June	72.22	10.04	7.19
July	248.15	18.48	13.43
August	259.29	22.35	11.60
September	183.89	13.46	13.66
October	41.57	5.38	7.73
November	4.56	1.42	3.21
December	9.94	2.79	3.56
Total	872.10	85.00	82.82
Mean	72.67	7.08	6.90

2.5 Vegetation :

The geographical area of forest cover in Kanpur is very low. The vegetation in the study region is only 1% whereas ideally it should be 33% of the land area. The thick open forest is present either in Allen Forest region of Defence areas. To increase the forest cover plantations are done in various ways under the guidance of Forest Department. Currently city has negligible area under forest only one forest area that is Allen forest which originally had 200 hectares, now reduced to 50 hectares only. Interestingly this natural forest patch harbors the Kanpur zoological park (Allen Forest Zoo) The other area called Sanjay Van Banglia has 20 hectares.

Table No. 2.4
Type of Plants and Trees

Type of Plant	Name of Plant	Botanical Names
Trees	Shishem	Dalbergia sissoo
	Mango	Mangifera indica
	Neem	Azadirachata indica
	Papal	Ficus religiosa
	Palash	Butea monosperma
	Bor	Zizyphus jujube
	Babool	Acacia sp.
	Jamun	Syzygium cuminii
	Jack fruit	Artocarpus integrigolius
	Mahua	Madhuca indica
Shrubs	Bamboo	Bamboosa arundinacea
	Cane	Sacharum sp.
	Jharberi	Zizyphus numularia
	Sadabahar	Ipomoca sp.
	Madar	Calotropis procera
	Kans	Saccharum spontaneum
	Munj	Saceharum munja
Grasses & Weeds	Dub	Cynodon dactyulon
	Montha	Cyperus rotundus
	Jangali Palak	Spinacea oleracee
	Senji	Melilotus indica
	Bathua	Chanopodium album
	Kaus	Sacchorum spontanium

Currently these two forest patches serves as the Green lungs for the city. The important floral species of this study region are mentioned in Table No. 2.6 represent some species selected for growing under social forestry and agro forestry. The important species grown in urban areas are Anvla, Babool, Bamboo, Eucalyptus, Kadamb, Popular, Shisham, Sagun and Semal, Mango, Bail, Guava, Jamun, Paper, Banana. School, college, vacant land, green belt area in the city and front of houses are selected for plantation which makes environment clean and pure, enhances cities aesthetics. Nagar Nigam also identifies these places of plantation. In urban areas, for plantation species are selected on OMEGA concept where O stands for Ornamental, M for Middle height, E for Environmentally significant, G for Grazing resistant, A for Pollution and dust and smoke Absorber. In cities medium height plant species are suggested so that the branches do not disturb electricity and telephone lines. OMEGA concept is also called as SHODH which is better understood when split into means – ‘Sho’ means Shobhakari, ‘Dh ’means Absorb dust (dhul) and smoke (dhua).

Plantation of trees along the arterial roads, railway lines and canals are the important strategies of forest department to increase forest cover of the city under social forestry scheme. Some important species recommended for plantation are Neem, Kadamb. Gulmohar, Chilbil, Kaner,Chitwan, Bougainvillaea etc.

2.6 Soil :

The study area is located in central plain region. The main lithological characteristics of the study region is appeared in Fig. No. 2.4. The main soil types are alluvial sandy, alluvial clayey, alluvium and clayey. Soil types are saline and sodic. The soil of the study region is classified into 5 categories as follows.

(A) Typic Ustipsamments: The soil characteristics of this subgroup is deep, excessively well drained, calcareous loamy soils on very gentle slopes with sandy surface and moderate or slight flooding. This soil is found in the both side of Ganga and Pandu alley along with the river islands.

(B) Fluventic Ustochrelts. It is formed comparatively in up lands. The characteristics of this sub soil group are deep, well drained, coarse loamy soils on very gentle slopes with loamy surface and slight erosion.

(C) Typic Ustochrepts: The characteristics of this soil are deep, well drained fine loamy, coarse loamy and fine silt soils in nearly very gentle to level plain with loamy surface and slight erosion. Along with the right bank of Ganga and between the river Pandu most of the area including the urban area of Kanpur Nagar District has this type of soil.

(D) Aquic Ustochrepts: The characteristics of this sub-soil group are deep, imperfectly drained, fine loamy calcareous soils on very gentle slopes with loam surface and slight erosion.

(E) Course soil : Within the course of river Ganga the soil of area particularly of sand bars is mostly sandy. Including varying size (width) of moderate (0.5 - 0.25 mm), fine (0.25 - 0.125 mm) and vary fine (>0.125 mm) sands. These sands include quartz, muscovite, biotic and loom etc.