CHAPTER 1
Geographical Setting of Uttar Pradesh
CHAPTER I
GEOGRAPHICAL SETTING OF UTTAR PRADESH

A. Physical Setting
a. Administrative set up

The state of Uttar Pradesh forms a part of Ganga plain. It covers an area of 2,40,928 sq. km. According to Census 2001, population of the state was 166.2 million accounting for 16.4 per cent of the country’s population, although the state accounts for only 7.5 per cent of the geographical area of the country. In 2011, the population of the state has reached to 199.6 million (provisional) with the decadal growth rate of 20.09 per cent (Census of India, 2011). Situated in the Ganga plain and drained by a number of rivers, the state has had a long history of human settlement. The fertile plain of Ganga has a very high population density of 689 persons per sq. km, which is more than twice the national average of 324 persons. Garlanded by the rivers Ganga and the Yamuna, the state lies in north-central part of the country. It is a landlocked state, and is bordered by the state of Uttarakhand and the country of Nepal to its north, the state of Bihar in the east, Jharkhand and Chhattisgarh to its southeast, Madhya Pradesh to the south, and Rajasthan and Haryana, and the national capital territory of Delhi to its west. It was created as the United Provinces on 1 April 1937 with the passing of the States Reorganisation Act and it was renamed as Uttar Pradesh on January 26, 1950, when India became a republic. Since then the state is known as Uttar Pradesh (literally, the “Northern State”).

In 1991, the state comprised of 63 districts. On 9th November 2000, nine districts of the erstwhile state were transferred to newly created state of Uttarakhand also known as Uttarakhand (comprising 13 districts of hilly region, as well as the district of Hardwar). The state of Uttar Pradesh now organized into 70 districts, 300 tahsils and 813 development blocks. There are 52,028 village panchayats in the state covering 97,134 inhabited villages. Lucknow is the capital of the state. The remaining of 54 districts of 1991 increased to 70 in 2001 due to emergence of 16 new districts within the state. The districts of Meerut, Moradabad, Farrukhabad, Etawah, Hamirpur, Banda, Allahabad, Deoria, Bahraich and Gonda were bifurcated, and as a result 10 new districts namely, Baghpat, Jyotiba Phule Nagar (J.P.Nagar),
Kanauj, Auraiya, Mahoba, Chitrakoot, Kaushambi, Kushinagar, Shrawasti and Balrampur were formed. Besides, 2 new districts namely, Sant Ravidas Nagar (Bhadohi) (S.R.Nagar) and Chandauli were carved out from the Varanasi district. Remaining of 4 new districts namely, Gautam Buddha Nagar (G.B.Nagar), Hathras, Ambedkar Nagar and Sant Kabir Nagar (S.K.Nagar) were formed by taking area from more than one adjoining districts. District G.B. Nagar was formed in the year 1997 by carving out of entire Dadri tahsil (excluding 5 villages), 6 villages of Hapur tahsil (both belong to Ghaziabad district), 152 villages and 3 towns of Sikandrabad, 104 villages and 3 towns of Khurja tahsil (both from Bulandshahr). Whereas, Hathras district was also created in 1997 by transferring of entire Hathras tahsil, 162 villages, 3 towns of Sikandrabad tahsil of Aligarh district and 134 villages, 2 towns of Sadabad tahsil of district Mathura. Similarly, Ambedkar Nagar district was formed in 1997 by the merger of entire Akbarpur, Jalalpur and Tanda tahsils of Faizabad district and 26 villages of Burhanpur tahsil of Azamgarh district. District S.K.Nagar was also formed in 1997 by transferring the entire Khalilabad tahsil, 131 villages of Basti tahsil of Basti district and 161 villages of Bansil tahsil of Siddharthnagar district. Besides these, some inter-district changes were also occurred during the decade of 1991-2001. At the time of preparation of Census 2001, the state was divided into 70 districts and these districts were grouped into 17 revenue divisions (Census of India, 2001).

b. Structure and relief

Structurally, the state of Uttar Pradesh can be divided into two distinct hypsographical regions:

i. The Ganga plain in the north

The state of Uttar Pradesh is a part of the Ganga Plain which lies between the Himalayas in the north and Deccan Plateau in the south. The Ganga plain forms the most important area from the economic point of view, which stretches across the entire length of the state from west to east. It is characterized by highly fertile alluvial soils, having a flat topology broken by numerous lakes, rivers and ponds. The region is made of alluvium brought by the Himalayan rivers, the Ganga, the Yamuna and the Ramganga and tributaries of these rivers. A vast expanse of alluvium of Tertiary and Quaternary age with a general elevation of about 600 metres above
mean sea level constitutes the plain. Alluvium is a generalized term for unconsolidated sediments consisting of a mixture of sand, silt, boulders and pebbles. The plain forms an elongated belt all along the southern boundary of the Uttarakhand state starting from the base of the hills and continues into the state of Uttar Pradesh. The level surface of the plain commanded and traversed by the glacial-fed perennial rivers of the Himalayas. With the absence of any marked surface irregularities on the plain, rain water sinks into ground, while percolation of water in sub-surface also contributes to maintain water level which can be tapped and offers facility for the construction of canals (Williamson, 1925). The area is very promising from hydrogeological point of view having substantial groundwater resources and forms the major source of agriculture and industrial development (Bhatia, 2010).

The entire alluvial plain can be divided into three sub-regions. The first lies in the eastern tract consisting of 14 districts; they are subjected to periodical floods and droughts, classified as scarcity areas. These districts have the highest density of population which gives the lowest per capita land. The other two regions, the central and the western are comparatively better with well-developed irrigation systems. They suffer from the problems of water logging and large-scale water user tracts. The Ganga plain is watered by the Yamuna, the Ganga and its major tributaries, the Ramganga, the Gomati, the Ghaghra and the Gandak. The entire plain made up of alluvium and is very fertile. The chief crops cultivated are rice, wheat, pearl millet, gram, and barley. Sugarcane is the chief cash crop grown in the region.

The alluvium tract which forms one of the three main physiographic divisions of India separates the peninsular from the extra-peninsular region and covers an area estimated to be about 850,000 sq. km. The area is geologically uninteresting, but being a rich agricultural tract is of great importance in human history. It is a synclinal basin formed concomitantly with the elevation of the Himalayas to its north.

According to Eduard Suess, a great Austrian geologist, it is a ‘fore-deep’ formed in front of the resistant mass of the peninsula when the Tethyan sediments were thrust southward and compressed against them. According to a second view by Sir Sydney Burrard (formerly the Surveyor General of India), the plains represent a rift-valley bounded by parallel faults on either side. A third and more recent view with regard to this region is that, it is a ‘sag’ in the crust formed between the northward drifting Indian continent and the comparatively soft sediments accumulated in the Tethyan basin, when the latter were crumpled and lifted up into a
mountain system (Krishnan, 1956).

The exact depth of alluvium has not been ascertained, but recent gravity, magnetic and seismic explorations show that, its thickness varies from less than 1,000 to over 2,000 meters. In width, alluvial plains vary from a maximum of 480 km. in the west to less than 144 km. in the east. The floor is not structurally uniform but is segmented by ridges and hollows due to faulting. Magnetic survey reveals local highs and lows, all of which dip steeply to the north. In 130 borings, the depth from surface to bed-rock was found to range between 90 and 390 meters. The depth of alluvium is at its maximum between Delhi and the Rajmahal Hills, and it is shallow in Rajputana and between Rajmahal and Assam (Wadia, 1919). The deposits covering the Indo-Gangetic basin are composed of gravels, sands and clays with remains of animals and plants. These sands and gravels constitute aquifers. The older alluvium (called bhangar in the Ganga valley) is rather dark coloured and generally rich in concretions and nodules of impure calcium carbonate known as kankar in northern India. The kankar concretions are seen in all shapes and sizes from small grains to lumps as large as the size of human head. The older alluvium was accumulated on slightly elevated terraces, generally above the flood level, the river having cut through it to a lower level. It belonged to Middle to Upper Pleistocene age. The newer alluvium (called khadar) is light coloured and poor in calcareous matter. It contains lenticular beds of sand and gravel and peat beds. It merges with insensible gradations into the recent or deltaic alluvia and assigned to belong with an Upper Pleistocene age (Krishnan, 1956).

ii. The Vindhyan hills and plateau of the south

The southern fringe of Ganga plain is demarcated with the presence of Vindhyan hills and plateau. This region consists of the districts of Jhansi, Jalaun, Hamirpur and Banda (Fig. 1.1). It forms the upper border of central Indian plateau. Low hills and rocky spurs of the Vindhyachal Mountains amidst the jungles of stunted trees give this tract a distinct character. The soils of lowlands consist partly of the Ganga alluvium and partly of the detritus of Deccan trap. These are the mar and kabar soils (a characteristic feature of central India) and the parka and rukar are the deteriorated black soils. The mar is a rich dark coloured friable soil with a large number of minute kankar nodules mixed in its texture. It contains a high proportion of organic matter and characterized with an extraordinarily high moisture retentive
Alluvium
Siwalik system
Vindhyan group
Central Himalayan gneisses
Bihar group
Bundelkhand granite gneisses
Deccan trap

Fig. 1.1

Source: Planning Atlas of Uttar Pradesh, Government of India, UP.
power. The *kabar* is a stiff tenacious soil containing a large percentage of clay and deficient in sand. Because of its hardness, it is difficult to work. The *parua* is a light sandy soil, whereas, *rakar* is stony, generally marked with the presence of large *kankar* nodules. Parts of the districts of Jhansi, Hamirpur and Banda have mixed red and black soils. Under the heavier type of soils, large accumulation of calcium carbonate is seen mixed with the soil. In the light or sandy type of formations, soils are shallow and large size stones are present in them. The soils contain sufficient quantity of potash and lime, but are poor in P₂O₅ and nitrogen. These areas receive a little amount of rainfall and water scarcity is widespread. The amount of rain in this region varies between 80 and 100 cm. Dry farming is practiced over a large area. This sub-region is important for the cultivation of gram, wheat and gram as a mixture, linseed, *til* and *jowar* crops. This sub-region is known as gram producing area, both in terms of quantity and quality. The Betwa and Ken rivers join the Yamuna river from the southwest in this region (Mirchandani, 1971).

c. Drainage

The most holy and sacred rivers of India, the Ganga and Yamuna flow through the state and join at Allahabad. These two rivers along with their numerous tributaries and distributaries form a riverine alluvial land known as the upper and the middle Ganga plain. Other than these two, the Ramganga, Son, Betwa, Gandak, Rapti, Gomti, Ghaghra, Rind etc. are the other important rivers. The state lies within one major basin i.e., ‘the Ganga basin’ which is further divided into sub-basins like the Yamuna, Gomti, Ramganga, Ghaghra-Gandak, Betwa, Son, Tons and Ken.

The dendritic pattern of drainage follows the general slope of the landform, i.e. from northwest to southeast. With the exception of right bank tributary of the Yamuna, almost all the rivers have their origin in the Himalayas (Fig. 1.2). Other rivers namely, the Son, Betwa, Ken, etc. have their origin in the hills of central India. With the exception of river Ghaghara, these rivers flow in more or less straight courses across the plain and somewhere forming ‘meanders’ and ‘ox-bow’ lakes. The entire land of the state lies in catchment area of river Ganga and its principal tributaries namely, the Yamuna, Ramganga, Sarda, Gomti, Saryu and the Ghaghra.

i. The Ganga

The Ganga originates from Gaumukh in the Gangotri glacier at an elevation
of about 7,010 m. above mean sea level. It enters into the plain at Haridwar. Following the general slope of the land, it flows towards the south and southeast up to Allahabad and then continues towards the east until it passes into the state of Bihar on its onward journey to West Bengal. Its total length is 2,525 km, of which 1,450 km lies in the state of Uttar Pradesh. The Ganga basin covers an area of 8,61,404 sq. km., of which nearly 34.2 per cent lies in the state. Its principal tributaries are the Yamuna on its right and the Ramganga, Gomti and Saryu rivers on the left side. The headwork situated on the Upper Ganga Canal is one of the most important irrigation works in the state and is providing irrigation to 0.7 million hectares (Shafi, 1984).

ii. The Yamuna

Although Yamuna itself is a tributary of the Ganga, it is the second most important river of the state. The Yamuna (which combines the waters of the beheaded Saraswati) has its source at Yamunotri in the Uttarkashi district (now in the state of Uttarakhand). The river passing through Siwaliks enters the western plain at Faizabad and from there it flows roughly parallel to the Ganga for 1,384 km to join it at Allahabad. The Yamuna forms the natural boundary between Uttar Pradesh and Haryana states, and enters the district of Mathura in the north and passes through Agra and Etawah, forming the northern boundary of Jalaun, Hamirpur, Banda districts and the southern boundary of Etawah, Kanpur, Fatehpur and parts of Allahabad, where it joins the Ganga. Its course is 1,376 km long and the entire basin covers an area of 320 thousand sq. km. in Uttar Pradesh. Important tributaries of the river Yamuna are the Chambal, Betwa and Ken which originate from the Deccan plateau. Historically, important places like Delhi, Agra, holy places like Mathura and Allahabad are situated on its bank.

iii. The Ghaghara

The snow-fed Ghaghara has its source near the Gurla Mandhata peak, south of Lake Mansarovar in Tibet. The river flows in a southerly direction parallel to Ganga up to Chapra before joining it. The total catchment area of the river is 1,27,950 sq. km. This river has a high flood frequency and usually shifts its course several times. The river Sarda or the Chauka which forms the boundary between Uttar Pradesh and Nepal is the main tributary which joins it on the right bank. River Saryu is another important tributary of the Ghaghara, on whose bank lies the historical city
of Ayodhya. Two other important tributaries of it are the Rapti and the Gandak.

iv. The Ramganga

River Ramganga rises in the Garhwal district (now in Uttarakhand) at an altitude of 3,110 m. above mean sea level and enters the plain near Kalagarh. It joins the Ganga at Kannauj after traversing a distance of 596 km. The Ramganga basin covers an area of 32,496 sq. km. The Ramganga flows for a total length of about 1,080 km., the upper half of which lies in Nepal and the lower half in Uttar Pradesh. The most important tributaries are the Sarda, the Rapti and the Little Gandak.

v. The Gomti

River Gomati also called Gumti, is the tributary of the Ganga river. It rises near Mainkot, about 3 km east of Pilibhit town in the Pilibhit district of the state at an elevation of 200m and drains the area lying between the Ramganga and the Sarda in the upper reaches and lower down area between the Ganga and the Ghaghara. After flowing through a southerly course for a distance of about 24 km., it joins the Ganga, near Kannauj in the Farrukhabad district. The total length of the river from the source to its outfall into the Ganga is 596 km. and the entire length of it lies in the state. The important tributaries of Gomti are the Khoh, the Gangan, the Aril, the Kosi, the Deoha and the Sai.

vi. The Sarda

It is formed by two streams the Kuthiyankti and Kalapani near the Indo-Tibetan border at an elevation of 5,250 m. The river flows in a southwesterly direction for some distance forming the boundary between India and Nepal. In this reach it receives the Dhauli Ganga, the Khoprang, the Sarju and the Ladhiya on its right and the Chumlia on its left bank. It debouches into the plains after passing through a series of rapids. Entering the plains, the Sarda continues to form the boundary between India and Nepal for a short distance flowing over a boulder bed. Thereafter, it flows in a southeasterly direction through the district of Pilibhit in a tortuous and constantly changing course. One of the most important irrigation systems in Uttar Pradesh, irrigating lands in the Gomti-Ghaghara Doab emanates from this river from Banbassa head works.
vii. The Rapti

It is another tributary of the Ghaghra to join on its left bank. It rises in the lower ranges of Nepal at an elevation of 3,600 m. After traversing a distance of 150 km. within Nepal, it enters the Bahraich district. It then flows in a southeasterly direction through Gonda and Basti and joins the Ghaghra near Berhaj in the district of Gorakhpur. The Rapti also inundates large territory along both the banks. But flooding is beneficial because of the fine silt left behind, which makes the land fertile and productive.

d. Climate

The state of Uttar Pradesh enjoys tropical monsoon climate. It is characterized by a rhythm of seasons which is caused by southwest and northeast monsoons. The pressure reversal takes place regularly twice in a year. At the time of northeast monsoon, winds of continental origin blow generally from west to east, while during the southwest monsoon they are oceanic in origin and blow mostly from east to west. The southwest monsoon usually enters the state by the end of the month of June and parts of the state get most of rainfall from it, while western depressions may bring few showers during the winter months. There are climatic variations in the state due to large extent of area surrounded by hills in the north, a considerable distance from the sea and the relative height above the sea level. The average temperature in the plains varies from 3°C to 4°C in January to 43°C to 45°C in the months of May and June, whereas the rainfall varies from 70 to 160 centimetres and even over in different parts of the state.

The climate of the tarai belt which extends from the districts of Saharanpur to Deoria is humid and hazardous to health due to the humid characteristics. Plain areas in the state generally experience extreme conditions of climate (cold in winter and hot in summer). The southern part of the state is plateau and being stony and barren, it is severely cold in winters and severely hot in summers. About 90 per cent of the total rainfall in the state is received during the rainy season. Therefore, in rest of the year irrigation is necessary for the cultivation of kharif crops in the summer, and for growing of rabi crops in winters and it is also desirable even in the rainy season to counter the effects of short dry spells. From climatological point of view the tropical

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1 Dry spells (or monsoon breaks), which generally are 2-4 weeks of no rainfall during critical stages of plant growth causing partial or complete crop failures, often occur every cropping season.
The monsoon climate has three distinct seasons:

i. The cold weather season (October to February)

ii. The hot weather season (March to mid-June)

iii. The rainy season (Mid-June to September)

i. The cold weather season

The cold season in the state starts from the month of October every year. During the months of October and November, the entire northwestern part of the country including the whole of the Ganga valley remains under the high pressure belt. The prevailing direction of the winds is from west to east, owing to pressure distribution and the influence exerted by the Himalayan relief. The chief climatic characteristics of this season are a fall in temperature and the prevalence of dry and chilly (westerly) winds and clear skies. Occasionally, the western depressions bring rains accompanying with them cold waves of winds and register temperatures below freezing point. Seasonal variations in temperature in parts of the state are well marked. The mean minimum temperature in the month of November at stations Aligarh, Bareilly, Allahabad and Bahraich ranges between 5° and 10° C, but mean maximum temperature ranges between 29° and 33°C. The month of December records a further decrease in day and night temperatures, with the minimum temperature at some places fall below 2°C in the month of January, while the mean maximum temperatures vary between 25° C and 27°C (Fig. 1.3).

An important feature of the cold weather season is the occurrence of frost and hail. Frost is locally known as pala, which usually occurs in the month of January, when rabi crops are immature and they are liable to injury. Hail occasionally may occur and it can damage the plants when they are at the stage of flowering. In these months heavy fog locally known as kohra often occurs at night and lasts until the morning with the sun rise. In the month of February, there is seen a clear sky. By the end of the month of February the temperature begins to increase, but it still remains colder than November. The month of December is quite cold. By the end of December and even first half of January, some western depressions enter in the northern parts of India through Iran, Afghanistan, and Pakistan and move eastward to cover the entire Ganga plains. Snow may occur on high ranges in Himalayas and rain in sub-mountain tracks and the adjoining areas. These depressions create cloudy weather and blowing of cold waves accompanied by light rain in plains of the state.
The amount of rainfall during the winter season does not exceed 10 centimetres. The amount of rain decreases as one goes from west to east (Fig. 1.4). Western part of the state receives 10 to 12.5 cm. of rainfall with the winter cyclones. The amount of rainfall decreases southward from 5 to 7.5 cm. at Jhansi, Jalaun, Hamirpur, Banda and Lalitpur stations, whereas the plains get rainfall from 7.5 to 10 cm. The winter rains though small in amount are of great importance to the rabi season crops grown in the state. This amount of rain is not sufficient for rabi crops, especially for high yielding varieties of wheat which require 4 to 5 irrigation waters. Therefore, the crops grown during the rabi season, greater protection owing to less reliable winter rain. Under these conditions irrigation is a must to carry out successful agricultural operations. Filling the fields with irrigation water also help save the crops from the frost.

ii. The hot weather season

The hot weather season extends over the months of March to first half of June. This season is characterized by rising temperatures and lowering of pressures. Though the temperature starts rising gradually from the months of February, but from early March it starts rising rapidly and continues rising till May and June. In the month of May, the scorching heat becomes intolerable to human beings. The average temperature of the state in this season is recorded from 36°C to 39°C and the minimum to the extent of 21°C to 23°C. At some stations the temperature goes up to 40°C to 46°C for example, Kanpur, Allahabad, Lucknow, Agra and Orai are the stations record high temperatures. Due to nearness of the Tropic of Cancer, the entire Bundelkhand region remains very hot. Northwestern parts of the state also remain hot. The maximum and minimum temperatures in the months of April are recorded 38°C and 21°C respectively. The months of May and June record exceptionally high temperatures, as high as above 44°C for quite few days.

Due to high temperature, a low pressure belt is established in northwestern part of the country which remains very near to the state. Due to high pressure gradient, the strong winds blow to the western parts. The days are characterized by intensive heat, dry air and low relative humidity. Regular phenomena of this season is blowing of hot and dry winds, locally known as lco, and the occurrence of dust and thunderstorms, which are locally known as andhí. The andhí is characterized by
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Annual Temperature


Fig. 1.3
Fig. 1.4
huge cloud of dust which obstructs the visibility in the atmosphere. These storms are caused by the interaction between the dryland winds of the upper strata and the damp sea winds which creeps into the lower strata. These storms are short-lived and frequently end-up with the light showers of rain. Sometimes, they are accompanied by hails and thunderstorms which modify the weather of the area for a short period of time.

Total average rainfall in hot weather season is small. It ranges from 100 mm (at the northern stations) to 20 mm (at the stations in the extreme southwest). This rain benefits maize and fodder crops grown in parts of the state. The amount of rain decreases from east to west, due to increasing distance from the sea, as the air gets progressively drier. Gradually, easterly winds are replaced by the west winds, reducing the precipitation due to accompanying storms. Rainfall received during hot weather season gives a temporary relief from the heat and helps in sowing of early rice crop. In the month of June, hot weather season becomes more intensified and continued heat and dryness of air causes unbearable conditions.

iii. The rainy season

Due to excessive heat of summer months, a low pressure is developed in northern parts of India and by the middle of June a complete reversal takes place in the months of air movement. The rainy season in the state normally starts with in the second week of the month of June, when the southwest monsoon enters in the state. Sometimes the onset of monsoon may take place in the last week of July. The Bay of Bengal branch, which enters in the eastern parts of the state through Bihar plains known as 'purba' provides the first rain by the end of June. This is the season of general rains, which is characterized by the arrival of moisture laden oceanic currents from the Bay of Bengal; a fall in temperature is experienced with cool air and rainfall. With the burst of monsoon a complete change in weather is brought about with an immediate fall in temperature and an upward trend in relative humidity. The maximum and minimum temperatures gradually fall from 44°C and 27°C in June to about 30°C and 25°C in the month July. The relative humidity remains over 70 per cent throughout the rainy season. Rainfall days alternate with rainless gaps of a day or two in months of the year as they receive more than 50 per cent of total annual rainfall. The average rainfall amount to 75 cm. and it decreases westward and southwards.
In the months of September, rains normally slacken and the rainless intervals become longer and the day temperature varies. Humidity, however, remains high due to very little movement of air. High humidity and cloudy weather make the heat intolerable. October is the month of retreating monsoon, but mean maximum temperatures remain as high as in September. Rainfall, though scanty is useful for rabi season crops and helpful for the maturity of late rice. Rainfall in the months of June and September is irregular affecting the agricultural practices of kharif and rabi season crops, whereas, continuous rainfall for several days may create flood conditions, which results in sheet and gully erosion and often floods in rivers, destroy the standing crops and bring loss to life and property.

e. Soils

Soil is a vital natural resource and backbone of agriculture. Soils make available food, fodder and fuel for meeting the basic needs of human and animal beings. With increase in human and animal population, the demand for food has also increased. However, the capacity of soil to produce food is limited and limits on production are set by intrinsic characteristics, agro-ecological setting, use and management. This demands systematic appraisal of soil resources with respect to their distribution, characteristic and yield potential, which are very important for developing effective land use systems for augmenting agricultural production on a sustainable basis (FAO, 1993).

The state comprises of two distinct physiographic regions from north to south, which are: (1) the Ganga plain and (2) the Vindhyan hills and plateau. It covers almost three-fourth area of the Ganga plain, which is very deep and gently slopes from northwest to southeast. Elevated areas as now seen of the plain were filled with older alluvium (bhangar), and relatively lower grounds with new alluvium (khadar) along the courses of main rivers and their tributaries. The Vindhyan hills and plateau lies at the southern end of the Ganga plain. It forms part of the foreland of the Deccan tract. Its northern border is formed by the river Yamuna and parts of the Ganga river. A great variety of soil is found in different parts of the state (Fig. 1.5). These may divided into following types:

i. Bhabar soils

Bhabar group of soils forms a narrow belt of alluvial fans which extends from
west to east, immediately adjacent to outer spurs of the Himalayas in the districts of Saharanpur and Bijnor. These soils have developed under a sub-humid and moist climate which becomes dry during summer months. These soils were formed by the alluvium transported from the adjoining Siwalik and Himalayan ranges comprising sand stones in rapid state of weathering and conglomerates interstratified with boulders along with purple shales and clays.

These soils are underlain by small or large sized pebbles and coarse gravel detritus. Dark grey, coarse gravelly to fine silty calcareous *bhabar* soils are rich in plant nutrients but are excessively drained due to occurrence of boulders. Therefore, the cultivation on these soils is hampered by non-availability of the requisite amount of moisture from the soil.

**ii. Tarai soils**

The term ‘*tarai*’ refers to a moist or wet area. The *tarai* region is the sub-montane tract situated along the southern boundary of the Siwalik mountain ranges. The narrow belt of *tarai* soil is situated at the southern side of the *bhabar* soil and extends from the district of Saharanpur in the west to Deoria in the extreme northeast and cover about 5.7 per cent of the total area of the state. These soils are young and virgin as well as rich in humus. This tract can be divided into (i) northwestern *tarai* extending from the districts of Saharanpur to Kheri, and (ii) northeastern *tarai* extending from Bahraich to Deoria (Pathak, 1991). The climate of the *tarai* area is sub-humid which characterises as damp and unhealthy with annual precipitation ranging from 1,000-1,500 mm, a maximum of it occurred during the months of July to September. Soils are saturated during rainy months and remain quite moist during the winter due to high level of underground water. Soils of western and eastern *tarai* are productive and possess essential of plant nutrients, specially the nitrogen which gets depleted within few years of intensive cultivation. These soils are responsive to fertilization and well suited to multiple cropping.

**iii. Alluvial soils**

Alluvial soils which cover nearly 61.2 per cent of the total land area in the state. They occur in the central, eastern, western and southern portions of the state with river Yamuna as its western and southwestern boundary for most of its expanse with the exception of a portion of Agra and Mathura districts, and river Gandak as its
Fig. 1.5

eastern boundary separating it from the state of Bihar. These are very deep and were formed due to the transformation of alluvium deposited by the Ganga and the Yamuna rivers and their tributaries including the Ghagghara and Gandak. These soils vary in fertility characteristics considerably, but they have been developed from mild or strongly calcareous parent material.

The nature of soils in alluvial areas differs widely from district to district. These soils have been broadly classified into different soil associations and nomenclated on the basis of the river family which has contributed to the deposition and development. These soils in general are classified as: (i) Riverine soils or Kadhars and the recent alluvium (ii) Soils of flat lands (iii) Soils of uplands, and (iv) Soils of low lands. Although there are wide variations in soil characteristics from district to district, but the broad zonal features of soil associations remain more or less the same.

The soils belonging to the alluvium of recent accumulation are greyish to ash grey in colour, light textured and calcareous. Flat land soils are neutral to moderately alkaline, calcareous and have an accumulation of lime concretion at varying depths in lower layers of the soil profile. Sub-soil of the profile exhibits marked mottling resulting from the reducing environment prevailing in these soils and due to partial water logging. Soils of the uplands exhibit zonal characters and their profiles show a distinct evidence of maturity. Illuviation of sesquioxides and lime to ‘B’ horizon and accumulation of clay in lower layers is very profoundly exhibited by the soil profiles. These soils are permeable and excessively drained and are neutral to slightly acidic in reaction.

Low land soils are found in depressions within the uplands. They are grey to dark grey in colour, clay loam to clay in texture. Invariably, they have an alluviated horizon of finer clay as well as a layer of calcareous nodules. Ferrogenous mottlings are extensively evidenced in the sub-soils. The soils of the Ganga family differ from each other and of the Yamuna family. With reference to morphological features and agricultural behaviour, they also differ on the basis of their parent materials.

The Ganga alluvium has been formed by quite a wide variety of Himalayan rocks, whereas much of the alluvium of Yamuna owes its origin from the basaltic rocks of central India through which the Yamuna river flows in southwestern parts of the state. The recent alluvium belonging to this family is of black in colour, fine in texture and shows a marked uniformity at all depths. The flat-land soils are loam to
clay loam in texture and profoundly display the profile. Upland soils of the family show an advanced stage of maturity having a zone of calcium carbonate accumulation in lower depths. The soils of this family can be named as ‘tropical chernozems’. With respect to parent material, alluvium found in the northeastern tracts of the state laid down by the rivers Gandak and Ghaghara genetically differs from the soils of Ganga plain. The soils in the Gandak and Ghaghara plains are highly calcareous in nature. A predominating pedogenic processes in this family includes remarkable calcification and decalcification. The bottom soil contains calcium carbonate to the extent of 50 per cent. The flat-lands have a surface horizon devoid of lime with accumulation of calcium carbonate in nodular form in lower horizons. The upland soils are completely devoid of lime, excessively drained and the soil profile exhibits features of the advanced stage of maturity.

Agriculturally, these alluvial soils of the state are highly productive and constitute one of the most fertile formations of the country. These soils respond very well to manuring and have widely adaptable cropping patterns in various agro-climatic regions, also they have immense potential for increased production and it is from these soils that the agricultural production levels can be achieved with the use of high-yielding variety of seeds and adopting improved practices of cultivation.

iv. Bundelkhand soils

The Bundelkhand region of the state lies on the southwest of the river Yamuna. The soils of this tract are entirely different from those of the state as a whole, since they differ geologically from the rest as being non-alluvial in nature. Bundelkhand soils occupy 10.9 per cent area of the state. These soils mainly occur in the districts of Jhansi, Jalaun, Hamirpur and Banda. These soils have developed from the Vindhyan rocks abounding in gneiss and granites of the Deccan trap with highly ferruginous beds and often soft limestone.

Four broad soil associations have been recognized in this area, which differ from each other in respect of colour, texture, parent material, depth and crop adaptability. These are: (i) Bundelkhand coarse grained reddish brown soils, (ii) Bundelkhand coarse grained grey to greyish brown, (iii) Bundelkhand clayey loam black, and (iv) Bundelkhand clayey black soils, which can be distinguished with local names as: *rakar, parwa, kabar* and *mar*.

Bundelkhand soils in general are devoid of moisture and organic matter and,
therefore, can afford only short duration crops. This has been the main reason of backwardness in agricultural development in the region.

v. Vindhyan soils

The soils of Vindhyan region occur in the south of river Ganga in the southern tracts in the districts of Mirzapur, Varanasi and Allahabad, although its area does not exceed more than 5 per cent of the total area of the state. The Vindhyan system of rocks comprises of Vindhyan and Kaimur sandstones, shales, mixed conglomerates, calcareous and haematitic slates, schists, gneisses, carboniferous rocks and to some extent the limestones in weathered form to make up the Vindhyan soils. The soils of the Vindhyan region can broadly be classified in three categories as: (i) Vindhyan uplands, (ii) Vindhyan flats, and (iii) Vindhyan lowlands.

vi. Aravali soils

Aravali soils occupy 0.21 per cent area of the state and occur at the southwest corner of Agra district. Various formations of Vindhyan sandstones (including Kaimur group as the lowest member and Bhander group as the highest member in the outer spurs of Central Indian Hills occurring in Bharatpur and Dholpur districts of the state of Rajasthan) were weathered to form the Aravali soils. The soils are coarse gravel sands or even loamy sands depending on their location and topography. They are locally known as bhur. These soils support scanty sowing of crops and wherever agriculture is practiced, only inferior crops are grown.

f. Groundwater sources

According to the estimates, the groundwater resources of the state constitute 76,138 million cubic meters (m.c.m.) of which 48,208 m.c.m. (about 63 per cent) are utilisable. In the districts of Baghpat and Agra, the net drafts were 556 and 980 m.c.m. which were higher than their net potential, therefore, the groundwater use in these districts exceeds to 100 per cent, which sometime reaches to the most critical level. This situation arises because overexploitation of groundwater resources and leads to decrease in groundwater table. In the districts namely, Saharanpur, Budaun, Fatehpur, Muzaffarnagar, Moradabad, G.B.Nagar of doab region groundwater use is well developed which consist of 89.72, 87.33, 86.56, 86.45, 84.98 and 81.89 per cent respectively. The districts which utilize less than 50 per cent of groundwater resources include Banda (48 per cent), Balrampur (46.27), Lucknow (45.2),
Kushinagar (43.17), Lalitpur (41.47), Sonbhadra (41.45), Chitrakoot (41.37), Mirzapur (40.37), Ballia (39.37), Chandauli (39.35), Kheri (39.15), Hamirpur (38.35) and the lowest occurs in Jalaun with 32.82 per cent (Table 1.1).

Table 1.1 Districtwise groundwater availability as on 31.3.2011

<table>
<thead>
<tr>
<th>Districts</th>
<th>Net potential (million cubic meter)</th>
<th>Net draft (all uses) (million cubic meter)</th>
<th>Groundwater utilization (per cent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saharanpur</td>
<td>1715</td>
<td>1539</td>
<td>89.72</td>
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<td>Meerut</td>
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<td>873</td>
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<td>Bulandshahr</td>
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<td>Ghaziabad</td>
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<td>1026</td>
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<td>Mahoba</td>
<td>356</td>
<td>191</td>
<td>53.76</td>
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</tbody>
</table>

(Contd..)
g. Natural vegetation

The state is endowed with rich flora and fauna. It has an amazing variety of some 1,000 woody plants, including 3,000 trees, 400 shrubs and 100 woody climbers. More than 200 species of grasses have been identified in the Gangetic plains along with a rich stock of herbs and valuable medicinal plants. The plains of the state have been rich in natural vegetation which has been removed extensively for
meeting out wide-ranging needs of the people. Only a few patches of natural forests are now seen scattered here and there in the plains. About 7 per cent of the geographical area of Uttar Pradesh was under forest cover during 2001-05. The Himalayan region and the tarai and bhabhar areas consist most of the forests.

The Vindhyian forests consist of mainly the scrubs. In the districts of Jaunpur, Ghazipur and Ballia are free from forest lands, whereas 31 other districts have a lesser area under forest cover.

Near the snow line, there are forests of rhododendrons and Betula utilis (*bhojpatra*). Below them are the forests of silver fir, spruce, deodar, chir and oak. On the foothills and in the tarai-bhabhar area the forests have sal and gigantic haldu trees. Along river courses the *sheesham* grows in abundance. The Vindhyan forests consist of dhak, teak, mahua, salai, chironji and tendu. The hill forests also have a large variety of medicinal herbs. Sal, chir, deodar and sain yield building timber and railway sleepers. Chir also yield resin, the chief source of resin and turpentine. Sisso is mostly used in furniture making, while the khair yields kattha, which is used with betel leaves for chewing. Semal and gutel are used as matchwood and kanju in the plywood industry. Babul provides the principal tanning material in the state. Some of the grasses, such as baib and bamboo are raw materials used in paper industry. *Tendu* leaves are used in making of *bidis* (Indian cigarettes), and cane in baskets and furniture making.

The transitional belt running along the entire length of the state, the tarai and bhabhar areas are rich in forests. The bhabhar tract gives a place to the tarai area, which is covered with tall elephant grasses and thick forests interspersed with marshes and swamps.

Tropical moist deciduous forests are found in the moist region of tarai. They grow in areas which record 100 to 150 cm. of rainfall annually, with an average temperature between 26 and 27°C and have a considerable degree of humidity. A special feature of the forests is that deciduous trees of uneven size grow on higher altitudes. Lower regions have several species interspersed with bamboo, climbers, cand and ever green shrubs. Main trees which grow in *tarai* are: sal, ber, gular, jhingal, palas, mahua, semal, dhak, amla, jamun, etc.

Tropical dry deciduous forests are found in all parts of the plains and usually in central, eastern and western parts. Since sun-light reaches the ground in abundance, shrubs and grasses also grow here. Large tracts of these forests have been
removed making land available for cultivation. Important trees grow here are: sal, palas, amaltas, bel, anjeer etc. Neem, peepal, sheesham, mango, jamun, babool, imli (Tamarind) etc. usually found along river banks.

Tropical thorny forests are mostly found in southwestern parts of the state. Such forests are confined to the areas which have low annual rainfall (50-70 cm.), mean annual temperatures between 25 and 27°C and low humidity (less than 47 percent). Widely scattered thorny trees, mainly, babool and euphorbias are extensively found here. The trees are generally small and form open dry forests. Important trees of the region are phulai, khair, kokke, dhaman, danjha, neem, etc. These trees yield various types of resins and gums.

Herbs obtained from these forests include some medicinal plants, like Rauwolfia serpentina, Viala serpens, podophyllum, hexandrum and Epheera gerardiana.

h. Fauna

The variegated topography and climate of the state is conducive for upkeep of enormous varieties of animal life. Animals depend on forests not only for food but also for their habitat. Its avifauna is among the richest in the country. Animals found in jungles of the state include the tiger, leopard, wild bear, sloth bear, chital, sambhar, jackal, porcupine, jungle cat, hare, squirrel, monitor lizards and fox. These can be seen in all but the highest mountain ranges. The most common birds include the crow, pigeon, dove, jungle fowl, black partridge, house sparrow, peafowl, blue jay, parakeet, kite, mynah, quail, bulbul, kingfisher and woodpecker.

Certain animals are found in special habitats. The elephants are confined to tarai and the foothills. The chinkara and the sandgrouse prefer to live in dry climate, and are natives of the Vindhyan forests. The musk deer and the brown bear are found in the higher Himalayas. Among the game birds resident of the state are the snipe, comb duck, grey duck, cotton teal and whistling teal.

Several species of wildlife have become extinct in the state. Among them are the lions of the Ganga plain and rhinoceros of the tarai. The fate of many species has become uncertain, including the tigers, black bucks, musk deer, swamp deer, bustards, pink-headed ducks, chits and mural pheasants and four-homed antelopes. Although a determined enforcement of laws against poaching and hunting has yielded some results, the wildlife population today in the state is alarmingly low.
To preserve its wild life, the state has established Dudhwa National Park in Kheri district and 12 game sanctuaries, the Corbett Park, which is a major tourist attraction.

B. Socio-economic Setting

a. Population

Population of the state has become more than double since 1951 putting tremendous pressure on resources and infrastructure. As per 2001 Census, the population accounted for 166.19 million persons of which 87.56 million were males, and 78.63 million females as against 132.06 million persons with 70.39 million males and 61.66 million female in 1991, showing a net increase of 34.136 millions. The state of Uttar Pradesh is the most populous state of India. The Allahabad district is most populous with a population of 4.94 million persons followed by Kanpur Nagar (4.13 million), Azamgarh (3.95 million), Jaunpur (3.91 million) and Gorakhpur (3.78 million). Mahoba with a population of 0.70 million, however, is the least populous district of the state.

All India level decadal growth during 1991-2001 was 21.5 per cent, whereas the growth rate in respect of the state of Uttar Pradesh was 4.3 per cent higher than that of the national level. This rate was 25.4 per cent during 1971-81 and 25.6 per cent during 1981-91, which slightly increased to 25.8 per cent during 1991-2001. The growth rates of rural-urban components of population for the state were 24.06 and 32.88 per cent during the same periods, respectively. It implies that rural population growth rate was slightly lower than the overall growth rate (25.80 per cent) by 1.74 per cent, whereas the urban population growth rate was higher by 7.08 per cent.

Demography of the state is marked with an adverse sex ratio, high fertility and mortality rates, a high proportion of children and a slow process of demographic change. The sex-ratio as measured is the number of females per thousand males. According to 2001 Census, there is predominance of males over females, having a sex-ratio of 898 (904 for rural and 879 urban areas). The corresponding figures for 1991 were 876 (879 and 864 respectively). The proportion of children below 7 years of age constituted 19.03 per cent of the total population, which was significantly higher than the national average of 15.9 per cent. The highest figure was recorded for Chitrakoot (23.5 per cent) and lowest for Kanpur Nagar (17.2 per cent).
b. Literacy

Literacy is an important indicator of socio-economic characteristics of the country. It has a direct bearing on the expansion of technology. A person who has attained 7 years and above who can both read and write with understanding in any language is considered to be as literate. The state of Uttar Pradesh does not show much better position in education. According to 2001 Census, the literacy was merely 57.36 per cent. Showing some signs of improvement, the state assumed literacy rate of 69.72 per cent, inching closer to the national average (74.04 per cent) in Census 2011 (Times of India, 2011). The literacy rate was higher in urban areas in comparison to rural areas, which was 70.61 per cent versus 53.68 per cent. Male literacy rate in total, rural and urban areas of the state were 70.23, 68.01 and 78.13 per cent respectively, which were higher than the corresponding rates of female literacy, accounting for 42.97, 37.74 and 62.05 per cent respectively. It is observed that Kanpur Nagar ranked at top with 77.63 per cent in overall literacy rate, whereas it was lowest in Shrawasti with 34.25 per cent. In rural areas of the state, the district of Auraiya recorded the highest literacy rate (69.54 per cent) and Balrampur (32.09 per cent) was at the bottom. Following the same trend, the district of Sonbhadra tops in the literacy rate among the districts in the urban areas with 83.58 per cent. The district of Kanpur Nagar achieved the highest record in male literacy with 91.39 per cent and female literacy 79.76 per cent in comparison to other districts of the state.

c. Occupational structure

The term ‘occupation’ connotes the exact function of work that an individual performs in a sector. The Census of India has followed the UNO system of categorizing different occupations under 9 major heads. These categories are conventionally grouped into three major groups as: primary, secondary and tertiary. Primary group of occupation includes: (i) cultivation, (ii) agricultural labourers, (iii) livestock, forestry, fishing hunting and plantations, orchards and allied activities, and (iv) mining and quarrying; a secondary group of occupation comprises: (va) household industry, (vb) other than household industry and (vi) constructional work; and tertiary group of occupation comprises of: (vii) trade and commerce, (viii) transport, storage and communications, and (ix) services.
Occupational structure of the state reflects the preponderance of agrarian economy. However, about 66 per cent workforce of the state was engaged in agricultural activities (Census, 2001). Out of total workers, 41.1 per cent were cultivators and 24.8 per cent agricultural labourers. Other workers constituted about 28.5 per cent. If we compare sex-wise contribution, males occupied the highest share of 42.7 per cent as cultivators, whereas number of female was higher to work as agricultural labourers and in household industry workers (39.6 and 8.3 per cent, respectively) as against number of male workers of 20.1 and 4.7 per cent (Fig. 1.6).
References


