Chapter 2 : THE REGION

2.1 National Capital Region (NCR) Delhi

2.2 Constituent area of NCR

National capital region (NCR) constitutes of National Capital Territory Delhi and various parts of three states namely UP, Haryana and Rajasthan. The detailed description is shown in table (2.1):

Table 2-1: NCR Constituent descriptions

<table>
<thead>
<tr>
<th>Sub-Region</th>
<th>Population (2001)</th>
<th>Growth rate (%)</th>
<th>Population Density (Persons/Sq Km)</th>
<th>Area (Sq Km)</th>
<th>Area share to NCR (%)</th>
<th>Population share to NCR (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCT Delhi</td>
<td>13850507</td>
<td>47.02</td>
<td>9340</td>
<td>1483</td>
<td>4.41</td>
<td>37.33</td>
</tr>
<tr>
<td>Haryana</td>
<td>8687050</td>
<td>30.76</td>
<td>648</td>
<td>13413</td>
<td>39.95</td>
<td>23.42</td>
</tr>
<tr>
<td>Rajasthan</td>
<td>2992592</td>
<td>30.31</td>
<td>382</td>
<td>7829</td>
<td>23.32</td>
<td>8.06</td>
</tr>
<tr>
<td>UP</td>
<td>11570117</td>
<td>28.53</td>
<td>1066</td>
<td>10853</td>
<td>32.32</td>
<td>31.19</td>
</tr>
<tr>
<td>NCR</td>
<td>37100266</td>
<td>35.59</td>
<td>1105</td>
<td>33578</td>
<td>100.00</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Source: Census of India 2001

2.2.1 General Profile

The NCR lies between 27° 03’ and 29° 29’ North latitude and 76° 07’ and 78° 29’ East longitude. The physiography of the region is characterized by the presence of the Ganga skirting it as its eastern boundary, the Yamuna traversing north-south forming the boundary between UP and Haryana, and the sand dunes and barren low hills of the Aravalli chain and its outcrops in the west, flat topped prominent & precipitous hills of the Aravalli range enclosing fertile valley and high table lands in the south-west, and the rolling plains dominated by rain fed torrents in the south. The rest of the region is plain with a gentle slope of north-east to south and south-west.
The rock type exposed in the area belongs to Delhi Super-group of Lower Proterozoic age consists of Quartzite of the Alwar group, Phyllite and Slate of the Ajabgarh group.

Figure (2.1) below shows the current administrative division in the NCR.

Figure 2-1 : Administrative division of NCR

Source : Regional plan 2021, NCR

Topographically, the NCR has two major sub-units. The alluvial plains whose monotony is intercepted by isolated hillock or fairly continuous ridges of hard rock and sand dunes.

The major rivers in NCR are the Ganga, the Yamuna, Hindon and Kali, which flows from north to south and a small part of Sahibi, which flows in the south western part. Most of the NCR is also predominantly irrigated through well developed canal network except Alwar and Gurgaon districts, which are irrigated by ground water.
Open wells, shallow tube wells, gravity wells and deep tub wells are abundant in the area covered by the alluvium. Their discharge vary anywhere from 18 to 25 cubic metres per hour for about 2 to 3 meters drawn down in the open wells to about 162 per cubic metres per hour for about 8-12 metres draw down in the deep tub wells.

As far as ground water quality is concerned, there are few fresh water pockets in the north east and south east corners of NCR, otherwise in these area the total dissolved solids (TDS) are more than desirable limits and other quality parameters as within the desirable range. The TDS (nitrate and fluoride) are more than desirable limits in the NCT Delhi area and most part of the north-west and south west part of NCR.

The NCR area lacks in vegetation cover (forest) and mineral resource on the whole. The major mineral deposits of the region are china clay, quartz, silica sand and fire clay.

### 2.2.2 Policy zones and Land use zones

For the regulated and controlled development of the NCR there are four policy zones and four land use zones has been recommended, as discussed below;

**A. Policy zones :**

i) NCT Delhi

ii) Central National Capital Region (CNCR) : The notified controlled areas of the adjoining towns of Ghaziabad-Loni, Noida, Gurgaon-Manesar, Faridabad-Ballabgarh, Bahadurgarh, and Sonepat-Kundli.

iii) Highway Corridor Zone : The controlled area comprising a minimum width of 500 meters, inclusive of green buffer, on either side of the right of way along the National Highway Nos. 1, 2, 8, 10, 24, 58 and 91 converging to Delhi.

iv) Rest of NCR: The area of the NCR outside the designated CNCR and Highway Corridor Zone, comprising both urban and rural areas.

The figure (2.2) below shows policy zones of NCR.
**B. Land use zones:**

(i) Controlled / development / regulated zone

(ii) Highway corridor zone

(iii) Natural conservation zone
(iv) Agricultural (rural) zone outside controlled area / development / regulated zone

Figure 2-3 : NCR Land use zones

Source : Regional plan 2021, NCR

i) Controlled / Development / Regulated Zone : The controlled area zone demarcated in proposed landuse plan is under intense pressure of development. The activities within this zone will have to be effectively controlled and monitored. For this purpose while all a controlled areas declared by the respective State governments from time to time within the preview of their own acts will be deemed as controlled areas/regulated zone. Within controlled areas/regulated zones there will be three sub-zones, whose precise delineation will be undertaken by respective master plan for controlled development.
- Urbanisable Areas (including existing built up/urban areas)
- Agriculture (Rural) Zone within controlled/development regulated areas
- Green buffers

ii) Highway Corridor zone: In order to control the large scale urban development along the important highways in the region, outside the controlled / development / regulated zone, a regulatory zone is provided within which necessary planned development can be undertaken. It includes all major roads and highways within the Haryana sub region: such as:

NH-1: Delhi to Amritsar

NH-10: Delhi to Rohtak

NH- 71: Rohtak to Jind

NH-8: Delhi to Gurgaon and beyond

NH-2: Delhi to Calcutta

Controlled area of 500 meters from the ROW (right of way) is mandatory. All major roads and state highways such as state highway 10, state highway 20, state highway 22, state highway 24, and state highway 25 have been in restriction of 500 meters of controlled zone. The actual boundaries of the highway corridor zone will be delineated based on the revenue village boundaries by the respective state governments in sub regional plan.

iii) Natural area Conservation Zone : Major natural features identified as environmentally sensitive areas, are the extension of Aravalli ridge in Rajasthan. In NCR, these areas have been demarcated as Natural area conservation zone in the regional plan 2021. Similarly, ground water recharging areas such as water bodies, ox bow lakes, and paleo channels have also been identified. Therefore all the Aravallis within the Haryana state, in addition to the local agricultural zone have to be further detailed out in sub regional plan.
The extension of Aravalli ridge, sanctuaries and other ecologically sensitive areas needs to be conserved with utmost care and afforested with suitable species. The development in this area is to be in accordance with the Environment Act, 1986 from time to time. In view of the very low existing forest cover (4.02%), it is imperative to bring more areas under forest so as to maintain the ecological balance in this region. Accordingly, all wastelands identified in the existing landuse plan and proposed land use plan 2021, ROW of irrigation canals, drains, roads and railway lines are proposed to be brought under forest cover which is proposed to be 10% of the total area of the region.

The areas under water bodies and ground water rechargeable areas will be kept free from any encroachment/ development to allow free flow of water, construction activities for human habitation or for other ancillary purpose thereto not be permitted. Suitable measures are to be taken to maintain the water bodies with the minimum flow or water level. In the flood prone areas / river banks, no construction or habitation activities are to be permitted. Flood protection plan be prepared by the concerned state government / agency.

Detailed conservation plan be prepared for the areas shown in Natural conservation zone in the Landuse Plan 2021 given at the end of discussion. The monuments / man made heritage sites and conservation areas be identified in the master plan / zonal plan of each town and detailed conservation.

iv) Agricultural zone outside controlled / development / regulated areas: Agricultural (Rural) area of NCR has to be regulated by village and block plans to be drawn under district planning process. At the regional level, agricultural zone be designed for primary sector production and as open areas comprising of farmlands, orchards, and pastures etc.

The new employment opportunities in non agriculture sector and consequent concentration of population, the urban expansion would have to be largely made from the agricultural land and other non urban uses. In view of this, following policies have been proposed;
existing cultivated land be conserved for agricultural use as far as possible

efforts be made to increase the production through intensive cultivation by providing irrigation facilities and other necessary infrastructure

measures to be initiated for protection of prime agricultural land and ensure its needless conversion into non agricultural use

Utilization of less and least valuable land for urban expansion / new urban centers / development purposes.

2.3 **Haryana Sub-Region of NCR**

2.3.1 Constituent area of Haryana Sub-Region

Haryana Sub-region is part of National Capital Region around Delhi. The constraints of space and high costs associated with development within NCT Delhi, are causing spill over of economic activities from Delhi which could be absorbed by neighboring states like Haryana, Uttar Pradesh and Rajasthan, in case they are ready to receive them with appropriate physical and social infrastructure support, matching the investors' perception.

The Harayana sub region comprises of the following nine districts, situated on the periphery of Delhi, forming the NCR Sub Region:

**Table 2-2 : Haryana Sub-Region profile**

<table>
<thead>
<tr>
<th>Districts</th>
<th>Area (Sq KM)</th>
<th>Population</th>
<th>Population density (person/Sq Km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panipat</td>
<td>1268</td>
<td>967449</td>
<td>763</td>
</tr>
<tr>
<td>Sonipat</td>
<td>2122</td>
<td>1279175</td>
<td>603</td>
</tr>
<tr>
<td>Rohtak</td>
<td>1745</td>
<td>940128</td>
<td>539</td>
</tr>
<tr>
<td>Jhajjar</td>
<td>1834</td>
<td>880072</td>
<td>480</td>
</tr>
<tr>
<td>Rewari</td>
<td>1594</td>
<td>765351</td>
<td>480</td>
</tr>
</tbody>
</table>
Figure 2-4: Haryana Sub-Region Political map

<table>
<thead>
<tr>
<th>District</th>
<th>Area</th>
<th>Population</th>
<th>Population Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gurgaon</td>
<td>1254</td>
<td>870539</td>
<td>694</td>
</tr>
<tr>
<td>Mewat</td>
<td>1859</td>
<td>993617</td>
<td>534</td>
</tr>
<tr>
<td>Faridabad</td>
<td>743</td>
<td>1365465</td>
<td>1838</td>
</tr>
<tr>
<td>Palwal</td>
<td>1368</td>
<td>829121</td>
<td>606</td>
</tr>
</tbody>
</table>

Districts map of Haryana with parts in NCR
2.3.2 Physiography of the Haryana Sub-Region

Physiography of Haryana Sub-Region is almost plain made up of alluvium of Yamuna river with some pediments of Aravalli. All most all districts of sub-region is having same physiography except those area which are more dominated by Aravalli.

Panipat district is a part of alluvial plain of Yamuna river. It slopes from west to east and water of the area flows towards Yamuna. There are two major physiographic units in the area. The flood plain which is within one mile of the Yamuna river, has light soils and the water table is very near to the surface. This flood plain of the river Yamuna is suitable for rice and sugarcane cultivation. The other unit i.e. older alluvial plain spreading in the western part of the district is inclined towards the south and south-west area. This area is irrigated by tube wells and canals and is a prosperous agricultural area. The district has a perennial river Yamuna, which forms the eastern boundary of the district.

Sonipat district has almost a plain topography. Physiographically, it may roughly be divided into two units. The Khadar, which lies along the Yamuna in a narrow flood plain ranging from two miles in width, has medium to fine textured soils. The upland plain, which is spread in the west of the Khadar. It is about 20 to 30 feet higher than the Khadar and is 735 feet above mean sea level. It is covered with old alluvium.

Rohtak district is comprised of the vast Indo-Gangetic alluvial plains called older alluvial plain. This older alluvial plain is further divided into sand dunes, plan and depressions. The sediment derived in the old alluvial plain are mostly from the Himalayan rivers having a heterogeneous composition. This landform is formed predominantly by medium to fine textured soils. Since the soils are fertile with good irrigation facilities (canal and tube wells), these have been put into maximum use over a long time. This landform has been further divided into the following subunits:

- **Dunal ridges/Plains**: Dunal ridges, interdunal plains and plains with sandy Aeolian cover dominate the western and south-western part of Rohtak district.

- **Plains**: These occupy mainly the northern, north-eastern and north central parts of the study area, which are characterized by slight to moderate erosion, moderately distinct
parceling and mixed tones due to variable moisture conditions. The soils are mainly free from salt problems except in few small patches.

- **Depressions:** The post-Pleistocene age sediments, which filled the depression areas are mostly derived from the Himalayan rivers from the north. The sediments itself is very deep and fine textured. The majority of the surface drainage is seasonal passing through linear depression areas. This unit occupies the north-eastern and north-central part of Rohtak district.

**Jhajjar** district is comprised of the vast Indo-Gangetic alluvial plains. The main physiographical units of the district are as under:

1. **The upland plain** spreads in the north-eastern part of the district. It slopes towards south. This plain is covered with old alluvium of high productivity. The sandy region is spread in the southern and south-western parts of the district. It comprises of permanent sand dunes, most of them now have been leveled. Sahibi is the only seasonal stream which enters the district from the south-eastern part and flows from the south.

2. **Alluvial Plains:** The sediment derived in the alluvial plain are mostly from the Himalayan rivers having a heterogeneous composition. This landform is formed predominantly by medium to fine textured soils. Since the soils are fertile with good irrigation facilities (canal and tube-wells), these have been put into maximum use over a long time. The alluvial plain again has been subdivided as follows:

   - **Plains:** These occupy mainly the northern, north-eastern and north central parts of the district, which are characterized by slight to moderate erosion, distinct parceling and mixed tones due to variable moisture conditions.

   - **Depressions:** The post-Pleistocene age sediments, which filled the depression areas, are mostly derived from the Himalayan rivers from the north. The sediment itself is very deep and fine textured. The majority of the surface drainage is seasonal passing through linear depression areas. This unit occupies the north-eastern and north-central part of the district.
• **Sand dunes/ Plains:** Dunal ridges, interdunal plains and plains with sandy Aeolian cover dominate the southern and south-western part of the district.

**Rewari** district can be divided into four terrain classes viz. Barren rocky/stony waste/sheet rocky, Sandy plain with sand dunes, Old flood plains and occasional hillocks and Undulating uplands with or without scrub. Generally physical condition of terrain and its evolution is the result of poly-cyclic activities and also affected by the change of climate. The Aravalli consist of organic and volcanic action and presently it is undergoing weathering and denudation. The hills traverse through western part of district roughly in south west to north east direction.

**Gurgaon** district comprise of hills on the one hand and depression on the other, forming irregular and diverse nature of topography. Two ridges (i) the Ferozpur-Jhirka Delhi ridge forms the western boundary and (ii) the Delhi ridge forms the eastern boundary of the district. These hills are the northern continuation of the Aravallis. The north-western part of the district is covered with shifting sand dunes lying in the direction of westerly and south-westerly winds.

**Mewat** district has distinct topographic features with flat alluvial plains over most of the region, long and narrow pediments and local undulations caused by wind blown sands at eh foot hill zones and over much of the plains. The piedmont zone with eroded remnants and weathered rocks separate Rajasthan State and western part of the district from Punnhana and Ferozepur Jhirka on the east.

**Faridabad and Plwal** district has monotonous physiography and has alluvium deposits. The alluvial plains have been divided into two units. Khadar that is the low lying flood plain of newer alluvium and Banger, an upland plain made of older alluvial and is spread towards west. The general slope in the district is towards east. The leveled surface, fertile alluvial soil and facilities for irrigation make the district best suited for intensive cultivation. The district enjoys with perennial river Yamuna, bordering it on the east. The river forms narrow but consistent flood plains There are also few artificial lakes namely Suraj kund, Badhkal, Peacock and Dhauj Lake etc.
2.3.3 Geology of Haryana Sub-Region

Geology is defined as the study of rocks and minerals of the earth with respect to their origin, composition and mode of occurrence. The Haryana State comprises a good assemblage of rocks belonging to age from Pre-cambrian to Quaternary. The state can be divided in three different geological domains:

1) Pre-Cambrian rocks of Aravalli Mountains,

2) Tertiary rocks of Himalayas and

3) Quaternary deposits of Indo-Gangetic Plains.

Out of above mentioned three geological division Haryana sub-region is dominated by Quaternary deposits of Indo-Gangetic plains and Pre-Cambrian rocks of Aravalli mountains.

Panipat: The district has not much geological diversity. It is entirely covered by old and new alluvium deposits of quaternary to recent age, which consist of clay and sand. Consolidated and un-consolidated sands are also found at places in the district.

Sonipat: The districts is almost entirely covered by alluvial deposited of clay, loam, silt and sand brought down by river Yamuna. High grade silica sand left behind by the change in course of the Yamuna river is found in the district.

Rohtak: The geological structure of the district consists of alluvium (recent), loam (Bhangar and Nadrak), coarse loam (daher and chaeknote). Infect, the district is a part of indo Gangetic alluvial plain ranging from Pleistocene to recent age. Aeolian deposits of sub recent age cap the plains. The sediments comprise of clay, sand and kankar mixed in different proportions. No exposure of hard rocks forming the basement are seen in the area which one as deep as three hundred metres. Geological succession of the area is as under: -

<table>
<thead>
<tr>
<th>Age</th>
<th>System</th>
<th>Formation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pleistocene to recent</td>
<td>Recent to sub recent</td>
<td>Alluvial Aeolian sand</td>
</tr>
</tbody>
</table>

--
Jhajjar : The area forms a part of in Dugan ethic plain ranging from Pleistocene to recent in age. Aeolian deposits of Sub-recent age cap the plains. The sediments comprise of clay, sand and Kankar mixed in different proportions. No exposure of hard rock farming the basement is seen in the area.

Rewari : The purona rocks in Rewari district belongs to Ajabgarh series of Delhi system. The hills have been denuded since ages and hence are with a height ranging from 300m to 425m above mean sea level. The hills are mostly steep, bare and rocky. The hillocks and discontinuous ranges are locally called khols, which are known for mineral bearing rocks. Sandy plains are notable landscape feature in Rewari district which are present in the east of Aravalli hills and are having a scattered pattern of stabilized to partially stabilized sand dunes due to sand deposition from south westerly winds coming from adjacent Rajasthan desert. The previously existing old flood plains have been superimposed by Aeolian plains and sand dunes. These plains are impregnated with sand dunes 1 to 3 meter high above ground and which are mostly stabilized.

Gurgaon : The large part of the district is occupied (i) by scattered isolated strike ridges of old rocks, the relicts of a former Aravalli mountain chain of Pre-Cambrian and (ii) alluvium, sand of recent to sub-recent origin.

Mewat : The large part of the district is occupied (i) by scattered isolated strike ridges of old rocks, the relicts of a former Aravalli mountain chain of Pre-Cambrian and (ii) alluvium, sand of recent to sub-recent origin.

Faridabad and Palwal : The major part of the district is occupied by vaze alluvial plains of recent to sub-recent age, which include older (Banger) and newer (Khadar) alluvial and kankar. The kankar occurs mainly in the northern part and is poor in calcareous matter.

2.3.4 Natural resources

2.3.4.i Water Bodies

Haryana State is a part of two major river basins namely, the Ganga and the Indus. The Ganga river basin occupies the eastern part covering an area of about 30,000 square kilometers whereas the western parts fall under the Indus river basin.
Yamuna is the only perennial river in the Sub-Region, which originates in Tehri district of Uttarakhand. It forms the boundary between Haryana and Uttar Pradesh. The Yamuna sub-basin covers parts of the districts of Panipat, Sonepat, Rohtak, Gurgaon and Faridabad.

The river basin area between Yamuna and Ghaggar drainage basin, which are flat and have no drainage outfall in either of the rivers, forms the Inland drainage basin. The inland drainage basin covers the districts of Rewari, Rohtak and parts of Gurgaon. The Aravalli hill ranges occupying the southern margins of Haryana Sub-Region bring a number of small rainy streams from Rajasthan side into Gurgaon, Jhajjar and Rewari. Among these streams the Sahibi, Krishnawati and Dohan are the major ones. Artificial drains have been constructed in the inland drainage basin to drain the excessive rainwater to the main rivers. In the Sub-Region a number of small ponds or *jhil* exist of which Najafgarh *jhil*, Jhajjar *jhil*, Barkhal *jhil*, Surajkund *jhil* and Sohna *jhil* are the most important.

Canals are the most popular and important source of irrigation in Haryana Sub-Region due to easy supply and regular flow of water to the agriculture fields. In the Inland drainage basin the drains excavated are made to outflow in canals through lift pumps. The canals network is dense in most of the districts except in the districts of Rewari and Gurgaon where there is a general absence of canals. There are four irrigation systems in the State namely Western Yamuna Canal, Bhakra Canal, Agra Canal and Ghaggar Canal. The Bhakra and Western Yamuna Canal system are interlinked and it is difficult separate their command areas. All the districts except Gurgaon and Faridabad fall under their commands. The Bhakra Irrigation System (which receives water from Gobind Sagar Reservoir) and the Western Yamuna Canal system irrigate the major parts of the State. Western Yamuna Canal depends of the water availability in Yamuna river because no dam has been made on the river in the recharge area to tap the water for canal feeding. To cater to the needs of each other both the canal systems have been jointed. Lift irrigation scheme has been developed for the purpose of irrigation with the help of these canals. The districts of Faridabad and Gurgaon fall under Agra canal commands. The topography of the State is such that district of Mahendragarh, Rewari, Bhiwani and part of Jhajjar and Rohtak cannot be brought under gravity canal commands.
2.3.4.ii Minerals

Minerals play an important role in the development of the State’s economy. The various rocks and minerals found in the State according to definitions contained in the Mines & Minerals Act, 1957 under section 3(E), are classified as ‘minor minerals’ and remaining as minerals commonly known as ‘major minerals’. Minor minerals include building stones, gravel, ordinary clay, ordinary sand, boulder, chalcedony pebble, kankar and limestone (used for lime burning), murrum, brick earth, fuller’s earth, bentonite, road metal, rehmatti and shale (used for building materials), salt petre and granite. Minor minerals are the major sources of income because maximum amount of revenue is derived from the auctioning of these minerals. Almost all the industrial rocks and minerals are grouped under major minerals.

Haryana sub-region has very little mineral wealth. The region is having mainly brick earth, saltpeter and quartzite. Excellent quality slate is found in the Rewari and Gurgaon districts. Badar sand also called bazri is found in huge quantities in the hilly terrain of Aravallis in Faridabad and Gurgaon district. Siliceous kankar and lime kankar and lime kankar occur in huge quantities in parts of Jhajjar district. Brick earth / ordinary clay suitable for manufacturing of bricks is available in plenty in almost every part of the Salt Petre occurs as thin white incrustations on the surface. Its major occurrences are in Rohtak, Practically inexhaustible deposits of quartzite are found in the state in the Aravalli ranges in the districts of Faridabad, Gurgaon, Rewari Low-grade haematitie and jasperoid haematite occur in Ferozpur-Jhirka area of Gurgaon district.

A number of major minerals, though in minor quantities, are also found in the state. These include aresenopyrite (Alwar quartzites in Gurgaon dist.) china clay (in the feldspathic pegmatite veins in Alwar quartzites in Faridabad and Gurgaon district), felspars (in pegmatites intruding quartzites in Gurgaon dist.), garnet (in garnetiferous mica schist associated with Alwar quartzited in Gurgaon Dist.), graphite (in graphite mica schist occurring in Gurgaon dist.), foundary sand (in abandoned course of Yamuna river in Sonepat dist.), quartz (as intrusive veins with pegmatites in Gurgaon & Faridabad dist.).
Figure 2-5: Mineral map of Haryana Sub-Region

2.3.4.iii Soil of Haryana Sub-Region

Soil constitutes the most precious natural resource of the State. A variety of soils are found in Haryana due to the marked variation in the physiographic and climatic conditions. Soil of the Haryana Sub-Region have been classified and described under the following major soil types:

- **Typic Ustochrepts**: Soil of old alluvial plains
- **Typic Ustipsamments**: Soil of Aravalli plains
- **Typic Ustifluvents**: Soil of recent alluvial plains and flood plains
- **Typic Torripsamments**: Soil of Aeofluvial plains
- **Rock Outcrops**: Aravalli rocky hills

Now district wise details of soil and their characteristics are described below:

**Panipat**: The soils are well drained, Sandy loam to clay loam/silty clay loam in plains and loam to clay loam/ silty/ loose clay loam in relic channels/depressions/basins.

**Sonipat**: The districts comprises of recent flood plains, young meander plains, old meander plains and old alluvial plains. Recent flood plains occur a few Kms. Along the Yamuna river and clearly show fluvial features. The young meander plains show meandering features left by river Yamuna like Palaeochannels, natural levees, point bar complexes, meander cut off and sand bars. The soils are loamy sand to sandy loam on the surface and sandy loam to clay loam in the sub surface. Old meander plains are almost flat with loamy sand to silty clay loam soils. Oldest among all the land forms are old alluvial plains, which cover the major area in the district. These
soils are sand to loamy sand/sandy loam (surface) to silt loam/silty clay loam (sub-surface).

**Rohtak**: The districts mainly comprises of old alluvial plains. The soils are loamy sand to sandy loam on the surface and sandy loam to clay loam in the sub surface. Old meander plains are almost flat with loamy sand to silty clay loam soils. Oldest among all the land forms are old
alluvial plains, which cover the major area in the district. These soils are sand to loamy sand/sandy loam (surface) to silt loam/silty clay loam (sub-surface).

**Jhajjar** : The districts mainly comprises of old alluvial plains and some part of the district comprised of soil of Aravalli plains.

**Rewari** : The soils of the district fall under Entisols and Inceptisols orders. The surface soil texture varies from sand to fine loamy sand. These are excessively drained with slight to moderate soil erosion having high percolation rate. In fluvial low lands the soils are heavier in texture that varies from sandy loam to loam. These soils are well to moderately well drained with slight erosion.

**Gurgaon** : The district comprises of sand dunes, sandy plains, alluvial plains, salt affecter areas, low lands, lakes, hills and pediments. The soil varies from sand to loamy sand in sand dunes and sandy plain areas, sandy loam to clay loam / silty clay loam is alluvial plains, calcareous, loamy sand to loam in salt affected plains, silty load to loam in low lands and calcareous, loamy sand to loam in hills.

**Mewat** : The soils of the area are generally sandy loam to loam. In parts of the low-lying areas, they are clayey and saline. The soils are light and derived from the older and new alluvial layers; the older alluvium is dark-coloured and is generally rich in concretions and nodules of impure calcium carbonate known as “Kankar”. The new alluvium is light coloured and poor in calcareous matter. The soils are generally shallow and low in organic matter.

**Faridabad** : The district comprises of recent Yamuna flood plains, low lying plains, depressions, sand dunes and hills. The texture of the soil is sand to loamy sand in recent Yamuna flood plains, sandy loam in plains, sandy load to clay loam in alluvial plains, sandy loam to loam (surface), clay loam/silty clay (sub-surface) in low lying plains/depressions

Soil types with their agricultural productivity are:

1. **Soils of Aravalli Plains**

   **Location:** In vicinity of the aravalli hills and in the parts of Gurgaon, mewat, Faridabad and Rewari in the sub region.
Characteristics: They are frequently distributed by aeolian activity. The soils of this unit are described under two moisture regimes;

Soil Type: the dominated soils of the aridic zone occur on the sand dunes of the shifting nature. They are sandy, single grain and are alkaline. They are classified as typic torripsamments. The associated sub dominant soils are coarse-loamy typic camborethids. They belong to interdunal areas and are deep, well drained, neutral to slightly alkaline, poor in organic carbon content and fertility.

Cultivation: They are cultivated to Bajara, Gram, Oilseed and Pulses.

Constraints:

- Moderate to severe wind and water erosion
- Poor soil structure
- Poor fertility (Low O.C., low CEC)
- Low water holding capacity

2. Soils of old Alluvial Plains

Location: Soils of this region are spread over parts of Panipat, Sonipat, Rohtak, Jhajjar, Faridabad and Palwal districts.

Characteristics: The dominant and sub dominant soils have been classified as typic ustochrepts and in some areas as udic ustochrepts.

Soil Type: The sub dominated soils are deep, well drained, with or without salinity and /or sodicity problem. Other sub dominated soils are imperfectly drained, fine loamy, calcareous, sodic with high pH and exchangeable sodium percentage. They are classified as nitric ustochrepts and poorly drained fine loamy fluventic ustochrepts.

Cultivation: These soils respond very well to the application of fertilizers and irrigation. Wheat, paddy and sugarcane are the major crops. Excessive use of irrigation water especially of poor quality has created many problems.
Constraints:

- Salinity
- Sodicity
- Poor drainage
- High ground water table

3. Soils of old Alluvial Plains with sand dunes

Location: Soils of this unit are spread over parts of Rohtak, Jhajjar, Gurgaon and Mewat districts. Aeolian sands are deposited by the south western winds from the Rajasthan. Sand dunes at many places have been reclaimed and stabilized.

Characteristics: soils of this unit are described under two moisture regimes: Ustic and Aridic. Majority of the soils ustic moisture regime occur in Rohtak and Jhajjar districts.

Soil Type: Dominated soils of Ustic moisture regime are very deep, somewhat excessive drained, severely to moderately eroded and sandy in texture, classified as typic Ustipsamments.

Cultivation: With adequate soil and water conservation measures they have very good yield potentials for rainfed crops. Adequate application of FYM and fertilizers insplit doses will enhance the productivity of these soils.
Figure 2-7: Soil fertility map of Haryana sub-region

Source: NBSS & LUP in Cooperation with Department of Agriculture, Haryana
Constraints:

- Low Fertility
- Salinity
- Moderate to severe erosine
- Poor retention of moisture in the root zone.

4. Soils of recent Alluvial Plains

Location: Soils of this unit are developed from the alluvial deposits along the bank of the Yamuna and its tributaries in parts of Panipat, Sonipat, Faridabad and some part of Rewari. They are occasionally subject to moderate flooding during heavy rains.

Characteristics: The dominating soil in recent flood plains of the Yamuna is coarse-loamy and sandy. They are classified as coarse-loamy, calcareous as well as non-calcareous typic Ustifluvents and coarse-loamy and fine-loamy, fluventic Ustochrepts.

Soil Type: sub-soil water of good quality facilities intensive farming. Conservation measures and application of recommended doses of FYM and fertilizers are some of the suggestive measures.

Cultivation: They are cultivated for wheat and paddy in the low lying areas while bajra and gram are cultivated on levees.

Constraints:

- Moderate seasonal flooding
- Shallow groundwater table
- Slight to moderate erosion
- Low to medium fertility
5. Soils of Fluvio-aeolian Plains

**Location:** Soils of this unit are located in Rewari and western part of Rohtak District. They are occasionally subject to moderate flooding during heavy rains.

**Characteristics:** The soils of this unit are of Aeolian nature modified by fluvial activity of river Sahibi. The annual rainfall ranges between 300-500 mm. The soil of this unit under two moisture regimes:

**Soil Type:** Domestic soils are very deep, excessive drained, slightly alkaline, sandy and calcareous, occurring on gentle sloping plains. These soils are the Ustic moisture regime as typic Torripsamments. Subdominant soils in Ustic moisture regime are well drained, coarse-loamy, calcareous, typic Ustifluvents and fine loamy typic Ustochrepts.

**Constraints:**

- Poor soil structure
- Poor Fertility
- Moderate wind erosion
- Low water holding capacity

2.3.4.iv **Ground water**

Ground water is an important resource for meeting the water requirements for irrigation, domestic and industrial uses. Ground water is annually replenishable resource but its availability is non-uniform in space and time. In Haryana sub-region ground water occurs in alluvium as well as in hard rocks. In alluvium, sand, silt, kankar and gravel beds constitute potential water bearing zones whereas in hard rocks weathered/fracture quartzites and cavernous limestones constitute potential aquifers. Ground water at shallow depths occurs under unconfined conditions, whereas at deeper levels confined/conditions prevail.
a) Ground water status

In the Sub-Region the ground water is extensively used for irrigation and domestic purpose. Due to tremendous increase in the requirement of ground water for agriculture, industries and by newly developed urban areas, the water levels have shown a continuous declining trend in a number of districts. On the contrary, the excessive use of canal water for agricultural purpose coupled with unfavorable geological conditions, lack of natural surface drainage and poor quality of ground water, the less utilized ground water have risen towards the ground causing water logging conditions in some districts. The quality of ground water in Haryana Sub-Region has changed significantly during past decades due to industrialization, urbanization and agricultural growth.

If we see the ground water depth in various district of the Sub-Region since 1974 to 2009, we find that there is drastic fall in ground water level mainly in the district of Gurgaon, Rewari and Panipat. In the Sub-Region since 1974 to 1995 there was minor decrease in ground water level and between 1995 to 1997 water level has increased but after that till 2009 there is continuous decline in the ground water level. So, mainly since 1997 the water depth of the Sub-Region has increased tremendously. It can be easily understood through following, figure 2.8 and table.2.3.

Figure 2-8 : District wise Ground water depth
Table 2-3: Ground water depth since 1974 to 2009

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In the Sub-Region, only Rohtak and Jhajjar has shown improvement in the ground water status since 1974. In Rohtak and Jhajjar district ground water table in 1974 was at the depth of 6.64 meter and 6.34 meter respectively where as it has improved to 4.19 meter and 5.2 meter respectively in 2009. There are three districts namely Gurgaon, Rewari and Panipat which has lower ground water table than the Sub-Region average and shown drastic decline in ground water table depth. In 1974, Gurgaon, Rewari and Panipat had ground water table at the depth of 6.64 m, 11.75 m and 4.56 m respectively and it has gone down to 23.61 m, 21.91 m and 14.09 m respectively in 2009. Faridabad is also showing great decline in water table since 2003.

In the Sub-Region Gurgaon and Rewari is worst in terms of availability of ground water. In the above table districts marked by red color are showing drastic fall of ground water table, yellow colored districts are not in a critical stage but on the verge of decline in terms of ground water and those which are marked by green color are having good condition or improvement in ground water depth.

b) Ground water quality

Industrial effluents, sewage water, fertilizers, pesticides and insecticides cause a number of pollutants to enter into surface and ground water, thereby deteriorating water resources of the region. The Sub-Region has been divided into three quality zones based on the electrical
conductivity (EC) values of ground water as: fresh water with EC value <2000 micro mhos/cm, marginal water with EC value 2000-6000 micro mhos/cm and saline water with EC value of more than 6000 micro mhos/cm and six combination zones based on the occurrence of ground water quality zone with respect to depth.

On the basis of above criteria if we see the ground water quality of the sub region then we find that these zones are distributed in patches in all over the region.

**Fresh ground water:**

Fresh ground water occurrences are more in the shallow aquifers as compared to deep aquifers whereas water salinity becomes prominent with the increase in depth of water bearing zones. Fresh water zones are found in the southeastern parts of Rewari district. In these districts the presence of Aravalli hills, which acts as a ground water recharge zone and absence of canal irrigation has rendered the ground water quality as fresh.

**Marginal Ground Water:**

Marginal ground water is generally located around the zones of fresh water. Major zones of marginal ground water are found in majority of areas of Rewari district, western part of Gurgaon and central parts of Faridabad districts.

**Saline Ground Water:**

Saline ground water occurs mainly in the northern parts of Jhajjar district and at number of places in Rohtak. Some areas occur in central parts of Gurgaon and Faridabad districts. This is aggravated due extensive canal network adding surface water to saline ground water and non-exploitation of ground water due to its saline quality. This has resulted in rise in water table and water logging. The salinity in the south-western and south-eastern parts of the Faridabad and Gurgaon district respectively can be explained in terms of desiccation of water in these flat and semi arid plains coupled with under exploitation of ground water.

The shallow marginal-deep fresh zones are found associated with fresh water zones as seen in the districts of Rewari and Gurgaon, Deep Saline Zones are generally associated with saline zone.
These zones cover majority of areas is Sonipat, Jhajjar district and southwestern and southeastern parts of Faridabad and Gurgaon districts.

Mapping of Ground Water zone as per their suitability for domestic, irrigation and industrial uses is highly desirable for proper management of ground water resources and to safeguard human being from consumption of poor quality ground water. To check further deterioration

Figure 2-9 : Ground water quality of Haryana Sub-Region

Source : Resource atlas of Haryana, Science & Tech. Dpt., Haryana,

of quality of ground water in the State regular monitoring of their chemical quality is necessary.
2.3.4.v Flora and Fauna

The forests confer manifold ecological benefits on the State economy. They have great bearing on ground water occurrence, soil erosion, floods and environment. They supply a variety of raw material to many industries. Forests are source of revenue to the Government and provide employment to a large number of people. The forests in Haryana are classified under Reserved Forests, Protected forests, unclassed forests, closed U/S 38 of IFA (Indian Forest Act) and Areas closed U/S 4 & 5 of LPA (Land Preservation Act). Major reserved and protected forest areas in Haryana state are mainly confined to the Himalayan ranges in Panchkula and Yamunanagar districts. Small reserved forests are found at a number of places in the districts of Yamunanagar, Kaithal, Ambala, Jind and Hisar. Majority of forests in the State belong to subtropical dry deciduous category whereas subtropical thorny forests are found only in the Aravalli hills in the southern parts of the State.

Hence in the NCR part of Haryana Sub-Region, it is having very little forest cover. Only in the district of Gurgaon, Rewari, Mewat and Faridabad reserve forest of the region exist. Few patches of forest are also in Rohtak, Jhajjar and Sonipat.

Table 2-4: Division/District Wise Forest Area (in Ha) for the Year 2007-2008

<table>
<thead>
<tr>
<th>District/state</th>
<th>Reserved forests</th>
<th>Protected forests</th>
<th>Protected forests total</th>
<th>Un-classed forests</th>
<th>Forests u/s 38 of IFA 1927</th>
<th>Forests u/s 4&amp;5 of LPA 1900</th>
<th>Grand total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Compact Road Rail Canal Bandh</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Panipat</td>
<td>0.00 15.81 967.9 295 2734.47 89.49 4102.67 0 72 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sonipat</td>
<td>0.00 0 1851.16 331.58 4573.02 316.84 7074.60 284.4 0 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7359</td>
</tr>
<tr>
<td>Gurgaon</td>
<td>214.89 144.68 1010.26 142 200.83 90.50 1588.27 22.66 0 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7381.55</td>
</tr>
<tr>
<td>Mewat</td>
<td>16.19 0.37 1203 0 821.68 136.27 2161.32 39.66 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1856.70 4073.87</td>
</tr>
<tr>
<td>Faridabad</td>
<td>314.24 37.78 925.14 0 903.48 29.59 1895.99 92.38 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3548.47 5851.08</td>
</tr>
<tr>
<td>Rewari</td>
<td>514.04 0 1678.46 269.9 1471.57 117.51 3537.14 55.04 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4106.22</td>
</tr>
<tr>
<td>Rohtak</td>
<td>0.00 41.20 1335.26 505.5 1917.99 198 3997.95 375.40 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>221</td>
</tr>
<tr>
<td>Jhajjar</td>
<td>0.00 491.00 1294.16 146.57 1852.19 42.42 3826.34 45.04 31</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Haryana Sub-Region</td>
<td>1059.36 730.84 10265.34 1690.55 14475.23 1020.62 28184.28 914.58 350.37</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5934.53 36443.12</td>
</tr>
</tbody>
</table>

Source: Forest department, Haryana,
Figure 2-10: Forest area map with National parks and Wild life sanctuary

Forest area details of the Sub-Region

Legend
- Towns
- Rail
- NH
- SH
- Water body
  - Lake
  - Pond
  - River
- Forest Boundary (Toposheet)
- District Boundary
- MCH
c- Wild life Sanctuary
- National Park

Forest area as per Toposheet of 50K: 53.67 Sq KM
0.4% of Sub-Region

Forest area as per Forest department excluding forest along road, rail, canal & bund: 99.9 Sq KM
9.67% of Sub-Region

Source: SOI Toposheet 1:50000 scale; Resource atlas of Haryana-2004
Wildlife constitutes an integral part of the forests. Development of wildlife to a greater extent relies on the type of forests, their density and climate of the region. In Haryana State there are 9 wildlife sanctuaries and 2 national parks out of which there are 3 wildlife sanctuaries and 1 national park in the Haryana Sub-Region covering an area of 1742.55 acres and 359.51 acres respectively consisting of the rate species of birds, black bucks, chital, barking dears, red jungle fowls and leopards etc. The location, spatial extent and wild animals found in these parks and sanctuaries are given in table:

Table 2-5 : National parks and wild life centuary details

<table>
<thead>
<tr>
<th>National Park/Wildlife Sanctuary</th>
<th>Tehsil/District</th>
<th>Important Wild Animals Found</th>
<th>Area (in acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sultanpur National Park</td>
<td>Gurgaon</td>
<td>Water birds</td>
<td>359.51</td>
</tr>
<tr>
<td>Bhindawas Wildlife Sanctuary</td>
<td>Jhajjar</td>
<td>Water birds, Black buck, Blue bull</td>
<td>1016.94</td>
</tr>
<tr>
<td>Nahar Wildlife Sanctuary</td>
<td>Kosli/Rewari</td>
<td>Black buck, Blue bull, Black and brown partridges</td>
<td>522.25</td>
</tr>
<tr>
<td>Khaparwas Wildlife Sanctuary</td>
<td>Jhajjar</td>
<td>Water birds</td>
<td>204.36</td>
</tr>
</tbody>
</table>


These wildlife sanctuaries are under the control of Chief Wildlife Warden of Ministry of Environment and Forest Gov. of India and National Parks are under the control of The DG Forest MOEF Gov. of India. No development within the sanctuaries and national parks can be under taken without the consent of the controlling authority. In addition, it is desirable to exercise development control so that no development which can directly or indirectly affect the sanctuaries and the national park. It is desirable to leave 5 Km buffer zone from the sanctuary and national park border. Since Sultanpur national park is in close proximity to Gurgaon urban area and proposed expansions it is necessary to exercise control to ensure environmentally compatible land use.

2.3.5 Agriculture

Haryana Sub-Region being a part of fertile Indo-Gangetic Plains, the agriculture practice forms the main landuse of the region. There are two main cropping seasons, namely Kharif and Rabi. Majority of the area is utilized for agriculture during Rabi and Kharif (double crop) season due to better irrigation facilities in the region; major kharif crops include rice, jowar, bajra, gaur, maize, cotton, sugarcane, groundnut and pulses. Rabi crops include wheat, barley, gram rapeseed/mustard and pulses. The short period available between mid-May and July is
sometimes also used for raising a third crop particularly in the areas where assured irrigation is available for watering the crop during the dry season.

Figure 2-11: Map showing Cropping Pattern in Haryana Sub-Region

Source: Agriculture department, Haryana, 2008
Northern portion of the region is characterized by good agricultural area due to fertile alluvial soils, marginal to food quality of ground water, network of irrigation, canals, tube wells and relatively better natural drainage. On the contrary southern part like Gurgaon and Rewari, due to lack of rainfall, poor irrigation facilities, poor Ground water quality coupled with desertic terrain with and dunes, result in relatively less cultivation during Kharif season.

2.3.6 Agro-Ecological Zones of Haryana Sub-Region

Based on the soil, physiography, bioclimate and length of growing period, the State has been divided into 8 agro-ecological zones (NBSS & LUP, 1989). Out of those eight zones our sub region falls under zone-2, zone-3 and zone-4.

**Zone 2:** These zones cover maximum area of the State extending over parts of Sirsa, Fatehabad, Hisar, Bhiwani and Jhajjar districts. The geomorphology of the region comprises of aeofluvial plain, having hot and dry climate. The annual rainfall varies from 300-450mm with growing period of 60-90 days.

**Zone 3:** This zone covers southern parts of the State covering districts of Mahendragarh, Rewari and Gurgaon. The topography of the region is represented by rugged hilly terrain of Aravalli ranges. The climate is hot and semi-arid with annual rainfall of about 350-500mm and growing period of less than 90-120 days.

**Zone 4:** This zone extends over parts of central and eastern Haryana covering districts of Karnal, Kaithal, Panipat, Jind, Rohtak, Sonipat and Faridabad. Topography of the region belongs to alluvial plain with Yamuna alluvial plain covering majority of the areas along the eastern parts of the State. The climate is hot and semi-arid with annual rainfall of 450-600mm and growing period of less than 90-120 days.
Figure 2-12: Agro-Ecological zones of Haryana Sub-Region