CHAPTER I
INTRODUCTION

The Indo-Gangetic plain plays an important role in the history and archaeology of India. Entire Ganga Plain is divisible into three main units: (i) Upper Ganga Plain, (ii) Middle Ganga Plain, and (iii) Lower Ganga Plain. The Upper Ganga Plain lies between $73^\circ 30' 00''$ E, $25^\circ 15' 00''$ N, covering an area of about 1,49,029 sq. km., which is about 80% of the total area of Uttar Pradesh. The study area is marked by a 300 m. contour which separates it from Garhwal-Kumaons Himalaya, from west of the river Sharda, while the international boundary of India and Nepal marks its northern limits. In the south river Yamuna demarcates its border with Bundelkhand. In the west, boundary of Haryana and Uttar Pradesh demarcates the area. We get detail information pertaining to rivers, soils and other physiographical features of the area under study from the unpublished report of Uttar Pradesh Government entitled, ‘Soils of Uttar Pradesh’, Booklet no. 367.

Map 1.1: Showing study area along with major rivers of north India
PHYSIOGRAPHY

Except for the foothills of the Himalayas in the North, the whole Ganga basin is a plain area. Physiographically, it constitutes a part of the Indo-Gangatic plain, which is largely flat, featureless and is formed of Pleistocene and recent alluvial deposits of the river Ganga and its tributaries. River erosions, change in course of rivers and human activities in recent times have played an important role in shaping the relief of the study area. The Upper Ganga Plain can further be divided into four physiographic unit (Singh, R.L. 1995:131.)

1. The Sub-mountain belt
2. The Ganga-Ghaghra Doab
3. The Ganga-Yamuna Doab
4. The Yamunapar ravine track

Rampur, Pilibhit, Bijnor etc. districts are included in the sub-mountain belt. Present day Lakhimpur, Sitapur, Gonda, Hardoi, Sultanpur district fall in the Ganga-Ghaghra doab. The Ganga-Yamuna doab area, north of Bulandshahr and south of Eta, consist of silty and clayey bangar tracts while the sand ridges alternated by depression in the Bulandshahr, Aligarh etc. render this position in the Doab. The nature of deposits probably owes to the crescentic bends of the two main streams, the Ganga and the Yamuna. Eastern part of Haryana falls in the Yamunapar ravine track.

DRAINAGE

In the present study area, a number of rivers and rivulets join the Ganga and the Yamuna at different places. Some important rivers are discussed below:
Betwa River

The Betwa river is also known as the Vetravati. The Betwa rises in the Vindhya range, north of Hoshangabad in Madhya Pradesh and flows in the direction of north-east Madhya Pradesh and then flows through Orchha to U.P.. Nearly one-half of its course, which is not navigable, runs over the Malwa Plateau before it breaks into the upland. The confluence of the Betwa and the Yamuna rivers takes place in Hamirpur town, Uttar Pradesh. In Sanskrit 'Betwa' is 'Vetravati' which means ‘containing reeds’. This river is mentioned in the epic *Mahabharata*. The capital of Chedi Kingdom was on the banks of this river.
Chambal River

Nine hundred and sixty km. long Chambal river originates from the SingarChouri peak in the northern slopes of the Vindhyan escarpment, which is 15 km. west-south-west of Mhow in Indore District of Madhya Pradesh. It is at an elevation of about 843 m. The river flows first in a northerly direction in Madhya Pradesh for a length of about 346 km. and then in north-easterly direction for a length of 225 km. through Rajasthan. The Chambal flows for another 217 km. between M.P. and Rajasthan and further 145 km. between M.P. and Uttar Pradesh(U.P.). It enters U.P. and flows for about 32 km. before joining the Yamuna River in Etawah district at an elevation of 122 m.

The tributaries of the Chambal include Shipra, ChotiKalisindh, Sivanna, Retam, Ansar, Kalisindh, Banas, Parbati, Seep, Kuwari, Kuno, Alnia, Mej, Chakan, Parwati, Chamla, Gambhir, Lakhunder, Khan, Bangeri, Kedel and Teelar.

Ganga

The Ganga originates from the ice caves at Gaumukh (N 30º55´, E 79º7´) at an elevation of 4100 m. Alaknanda, its main tributary in the mountainous stretch, rises beyond Manna Pass, 8 km. from Badrinath (N 30º44´, E 79º41´) at an altitude of 3123 m. and meets Ganga atDevprayag. The Ganga traverses a distance of 2510 km. from its source to its mouth (Ganga Sagar), draining eleven states of India. The six headstreams of the Ganga are Alakananda, Dhauliganga, Nandakini, Pindar, Mandakini and Bhagirathi. After flowing 250 km., through narrow Himalayan
valley, the Ganga enters the plains at Rishikesh. At Haridwar, a dam diverts some of its waters into the Ganges Canal, which irrigates the Doab region of Uttar Pradesh.

The Ganges follows an 800km. arching course, passing through the cities of Kannauj, Farukhabad and Kanpur. Along the way, it is joined by the Ramganga, which contributes an average annual flow of about 500 m$^3$/s. The Ganga joins the Yamuna at the TriveniSangam at Allahabad, a holy confluence as per Hinduism. At their confluence the Yamuna is larger than the Ganga, contributing about 2,950 m$^3$/s (104,000 cu ft/s), or about 58.5% of the combined flow. (Gupta, Avijit (2007). Major tributaries of Ganga are Bhilangana, Alaknanda, Ramganga, Kali, Yamuna, Gomti, Ghagra, Gandak, Kosi and Sone. River Ganga has also been important historically: many former provincial or imperial capitals (such as Patliputra, Kannauj, Kara, Allahabad, Murshidabad, and Calcutta) have been located on its banks.

**Ghaghara**

River Ghaghara, also known as Karnali and is a perennial trans-boundary river originating on the Tibetan plateau near lake Mansarovar. It cuts through the Himalayas in Nepal and joins the Sarda river at Brahmaghat in India. Together they form the Ghaghara river, a major left bank tributary of the Ganga. With a length of 507 km, it is the largest river in Nepal. The total length of the Ghaghara river up to its confluence with the Ganga at Doriganj in Bihar is 1,080 km. It is the largest tributary of the Ganga by volume of water and the second longest tributary of the Ganga by length after Yamuna. In Chinese it is called *K'ung-ch'iaoHo*, in Nepali it is
called Kauriala and Karnali. It is also spelled Gogra, Ghaghra, Ghagra, or Ghāghara.

**Gomti**

The Gomti originates from GomatTaal which is formally known as Fulhaartheel, near MadhoTanda, Pilibhit, India. It extends 900 km. through Uttar Pradesh and meets the Gangariver near villageKaithi in Ghazipur. After 20 km. from its origin, a small river Gaihaee meets it. The river is a thin stream until it reaches MohammadiKheri (about 100 km. from its origin), a tehsil of LakhimpurKheri district, where it is joined by some tributaries like Sukheta, Choha and Andhra Choha. From here the river is well defined. Later other tributaries viz. Kathina at Mailani and Sarayan at a village in Sitapur district joins this river. Another major tributary is the Sai river, which joins near Jaunpur. At the sangam of Gomti and Ganga, the famous MarkandeyMahadeo temple is situated.

**Hindon**

Hindonriver, a tributary of Yamuna river, originates in the Saharanpur district from Upper Shivalik in Lower Himalayan Range. The river is entirely rainfed and has a catchment area of 7,083sq.km. It flows between Ganga and Yamuna rivers, for 400km. throughMuzaffarnagar, Meerut, Baghpat, Ghaziabad districts, Noida and Greater Noida before it joins Yamuna river just outside Delhi. Kali river, which originates in the Doon Valley and travels for about 150 km. passing through Saharanpur, Muzaffarnagar, Meerut and Bagpat districts, merges with
Hindon River, before it merges with the Yamuna river. The Kali river is also highly polluted and adds to the pollution of the Hindon, as it passes through populated and industrial belt of Uttar Pradesh.

**Sharda**

River Sharda originates from the greater Himalayas at Kalapaani at an altitude of 3600 m. in Pithoragarh district of Uttarakhand, where it is known as Kali. The river is named after the Goddess Kali whose temple is situated at Kalapaani near the Lipu-Lekh pass on the border between India and Tibet. In its upper course, this river forms India's continuous eastern boundary with Nepal. After reaching the plains of Uttar Pradesh, the river is known as Sharda. The Kali or Sharda river is the part of the Ganga River system.

**Ken**

The Ken river originates near village Ahirgawan on the north-west slopes of Kaimur range in Jabalpur district and travels a distance of 427 km., before merging with the Yamuna at Chilla village, near Fatehpur in Uttar Pradesh. Ken has an overall drainage basin of 28,058 sq. km. out of which 12,620 sq. km. belong to Sonar river, its largest tributary, whose entire basin lies in Madhya Pradesh. Along its 427 km. course, it receives water from its tributaries such as Bawas, Dewar, Kaith and Baink on the left bank, and Kopra and Bearma of the right. Out of its total length of 427 km. it flows for 292 km. in Madhya Pradesh, 84 km. in Uttar Pradesh, and 51 km. forms the boundary between the two States. Crossing the Bijawar-Panna hills,
the Ken river cuts a 60 km. long, and 150–180 m. deep gorge. Several streams join the Ken in this gorge making waterfalls. The Ken valley separates the Rewa plateau from the Satna plateau.

**Ramganga**

Ramganga west river originates from Doodhatoli ranges in the district of PauriGarhwal, Uttarakhal. The river Ramganga flows to south west from Kumaun Himalaya. It is a tributary of the river Ganges and originates from the high altitude zone of 800-900m. Ramganga flows by the Corbett National Park near Ramnagar of Nainital district from where it descend upon the plains. Bareilly city of Uttar Pradesh is situated on its banks. It has a drainage basin of 30,641 sq.km. (11,831 sq. m.). It joins Ganga near Ibrahimpur, Uttar Pradesh.

**Sarayu**

Sarayu is an important river of U.P. It has ancient significance, finding mentions in the Vedas and the Ramayana. The Sarayu forms a the confluence of the Kamali (or Ghaghara) and Mahakali (or Sharda) in Bahraich district. Mahakali or Sharda forms the Indo-Nepal border. Ayodhya is situated on the banks of river Sarayu.

**Son**

Son river originates near Amarkantak in Madhya Pradesh, just east of headwater of Narmada river, and flows north-northwest through Madhya Pradesh
State before turning sharply eastward, where it encounters with the southwest-northeast-running Kaimur range. The Son parallels the Kaimur hills, flowing east-northeast through Uttar Pradesh, Jharkhand and Bihar State to join the Ganga just above Patna. Geologically, the lower valley of the Son is an extension of the Narmada Valley, and the Kaimur Range an extension of the Vindhya Range.

The Son river is 784 km. (487 m.) long, is one of the largest rivers of India. Its chief tributaries are Rihand and North Koel. Son has a steep gradient (35–55 cm. per km.) with quick run-off and ephemeral regimes, becoming a roaring river with the rain-waters in the catchment area but turning quickly into a fordable stream. Son, being wide and shallow, leaves disconnected pools of water in the remaining part of the year. Channel of the Son is very wide but the flood plain is narrow. It is just 3 to 5 km. wide. In the past, Son has been notorious for changing course, as it is traceable from several old beds near its east bank. In modern times this tendency has been checked with the Anicut at Dehri, and more so now with the Indrapuri Barrage.

**Tamsa**

Tamsa rises in a tank at Tamakund in the Kaimur range at an elevation of 610 m. It flows through the fertile districts of Satna and Rewa. At the edge of the Purwa plateau, the Tamsa and its tributaries form a number of waterfalls. The river receives the Belan in UP and joins the Ganges at Sirsa, about 311 km. downstream of the confluence of the Ganges and Yamuna. The total length of the river is 264 km. It has a total drainage area of 16,860 sq. km.
The Tamsariver while descending through the Rewa plateau and draining northwards makes a vertical falls of 70m. known as Purwa falls. Some of the more notable waterfalls on the tributaries of the Tamsa river, as they come down from the Rewa plateau, are: Chachai Falls (127m.) on the Bihad river, a tributary of the Tamsa; the Keoti falls (98m) on the Mahana river, a tributary of the Tamsa, and Odda Falls (145m.) on the Odda River, a tributary of the Belah river, which itself is a tributary of the Tamsa.

**Yamuna**

Yamuna is the largest tributary river of the Ganga in northern India. Originating from the Yamunotri glacier at a height of 6,387 m. on the south western slopes of Banderpooch peaks in the Lower Himalayas, it travels a total length of 1,376 km. and has a drainage system of 366,223 sq. km. i.e., 40.2% of the entire Ganga Basin.

It passes through, Uttaranchal, Haryana, Uttar Pradesh, Delhi, and meets river Ganga at Allahabad. Tons, happens to be its largest and longest tributary in Uttaranchal. Chambal has its own large basin, followed by Sindh, Betwa and Ken. Yamuna creates highly fertile alluvial plain the Yamuna-Ganga doab region. It has an annual flow of about 10,000 cubic billion meters (hereafter, cbm) and usage of 4,400 cbm (of which irrigation constitutes 96 per cent). Just like the Ganges, the Yamuna too is highly venerated in Hinduism and worshipped as goddess Yamuna, throughout its course. In Hindu mythology, it is the daughter of Sun God, Surya, and
sister of Yama, the God of Death, hence also known as Yami and according to popular legends, bathing in its sacred waters frees one from the torments of death.

**Physical Features**

The Upper Ganga Plain is made up of gently inclined alluvial plains with a gentle slop towards south-east. Its very difficult to define regional divisions in this featureless plain. In most of the area, the only relief seen is buffs, leaves, old and dried channels and existing rivers. In the Ganga-Yamuna doab region bangarland risesuptp 15-60 m. above the adjoining flood plain (khadar). The slop is around 30 cm. per km., that is why in the plain rivers of the study area move very slowly. There are silty or clayey track in the south of Bulandshahr and north of Eta. Sand ridges are visible in the Bulandshahr, Mathura, Aligarh, Eta districts of U.P.

**SOILS**

The soils of area under present study have been classified in seven broad soil groups (Unpublished report, Soils of Uttar Pradesh, Booklet No. 367, Govt of U.P.)

1. Hill soil
2. Bhabar soil
3. Taraisoil
4. Alluvial soil
5. Vindhyan soil
6. Bundelkhand soil
7. Aravali soil
1. Hill Soils

These soil constitute nearly 14 per cent of the total area of U.P. in the northernmost part of the state. It has developed from biotite, schists and phyllitic material under a cool and moist climate. Four soil association types have been recognized in this tract comprising of (i) red loams (ii) brown forest (iii) podsolic and (iv) meadow soil.

At great group level, the hill soils have now been classified as Fragudalfs, Haplustalfs, Dystrochrepts, Eutrochrepts, Haplumbrepts, PalehumultsUstorthents and Argiudolls.

It is brown to greyish brown and dark grey in colour having neutral to slightly acidic soil reaction. Moderately acidic soils occur only at higher elevations where leaching of bases with percolating rain waters is a common occurrence.

2. Bhabar Soil

Immediately adjoining the outer spurs of Himalayas there is a narrow belt of alluvial fan, termed as Bhabar, running from west to east in the foot hill region. This soil, constitutes nearly two per cent of the total area of the U.P. They have developed from the mechanically transported alluvium from the adjoining Siwalik and Himalayan ranges comprising of micaceousandtones and conglomerates inter stratified with boulders along with purple scales and clays. At great group level, these soils have been classified as Ustochrepts, Ustorthents and Haplustolls.
They are coarse gravelly to fine silty, calcareous, dark grey soils, rich in plant nutrients. The nutrients are drained due to the presence of boulders in the substratum leading to acute scarcity of moisture for normal crop growth.

3. Tarai Soils

The term tarai means the moist or wet area. Tarai soil is alluvial soil occurring as a narrow belt to the south of Bhabarsoil in the valleys of sub-mountain region of Uttaranchal & Uttar Pradesh stretching from Dehradun to the extreme north-east of these two states.

The tarai belt is divided into two distinct parts, viz.,

a) North-western Tarai extending from Dehradun to LakhimpurKheri and

b) North-eastern Tarai extending from Baharaich to Deoria district up to the easternmost border of the State.


The recognised soil associations in northeastern tarai include:
(i) Gandak recent alluviums - calcium soils with a large reserve of soft-lime, 
(ii) Gandak flat-leached calcium soils with a layer of nodular calci-carbonate (CaCO₃) accumulation and,
(iii) Gandak uplands-degraded calcium soils. The soils of the north-western tarai region have now been classified as Hapludolls, Haplaquolls, Ustorthents and Ustochrepts at the sub-group level.

These are grey to dark grey soil varying in texture from sand to clay loam and have high content of organic matter. Water table is high and the soil remain saturated or fairly moist during the major part of the year.

4. Alluvial Soil

This soil is the most important in this State occupying nearly 61.8 per cent of the total area of Uttar Pradesh. It is excessively deep soil and have developed from the alluvium deposited by the two major rivers of the study area, the Ganga and the Yamuna and their tributaries. The alluvial material deposited by the Ganga and its tributaries is derived from the soft dolomitic rocks of Himalayas and that deposited by the Yamuna and its tributaries owe its origin to the basaltic rock of central Indian hills. The soil is developed on Gangetic alluvium are neutral to moderately alkaline and calcareous especially at lower depth.

Based on topographical features, the soil associations recognized in this soils are (i), *khadirs* or the recent alluviums, (ii). soil of flat land; (iii) upland soil and, (iv) lowland soil.

Texturally, they vary from coarse sands to fine clays. The alluvial soil developed from Yamuna alluvium is quite dissimilar to Gangetic alluvial soil. It is dark to very dark grey, fine textured, calcareous soil showing remarkable swelling
and shrinking on wetting and drying. The alluvium laid down by the river Gandak and Ghaghra in north-eastern part of Uttar Pradesh is highly calcareous. The general slope of the Gangetic plain being from north-west to south-east, the finer fraction increases from western to eastern parts of the State due to gravimetric assorting of soil particles during the course of their deposition. At great group level, this soil further classified as Hapludalfs, Paludalfs, HaplustAfs, Ochraqualfs, Eutrochrepts, Ustochrepts, Ustipsarnment, Psammaquents, Ustifluvents, Ustorthents and Calciorthents. These soils are generally poor in phosphorus (P₂O₅) nitrogen (N) and organic matter.

5. Bundelkhand Soil

This soil lies in the Bundelkhand region of the State constitute nearly 10.9 per cent of the total area of the State. It is developed from Vindhyan rocks abounding in gneiss and granites of the Deccan trap with highly ferruginous beds and often soft lime stone.

This soil can be divided into two broad groups (a) red soil and (b) black soil. These two are again divided into four - soils associations. Four soil association have been recognized in the area which include:

(i). Bundelkhand -coarse grained reddish brown soil
(ii). Bundelkhad -coarse grained grey to greyish brown soil
(iii). Bundelkhand -clay loam black soil and,
(iv). Bundelkhand -fine clayey black soil.
Locally this soil is termed as Rakar, Parwa, Kabar and Mar respectively. The red soil Rakar and Parwa belongs to the order Ultisols, Alfisols and Inceptisols and the black soils are grouped under the great groups, Pellusterts, Chromusterts and Ustochrepts. The Rakar soil is residual slightly acidic, coarse grained, shallow and excessively permeable soils occupying higher elevations. The Parwa soil is alluvial, mildly alkaline, very deep soil with free calcium carbonate (CaCO$_3$) accumulation at lower depths. The black soils Mar and Kabar are very deep soils confined to lowlying land scapes having fine texture and the remarkable property of shrinkage and swelling on wetting and drying.

6. Vindhyan Soil

This soil is lying south of the Ganga in the south-east corner of Uttar Pradesh occupying nearly 5.1 per cent of the total area of the State. It has developed on Vindhyan rocks comprising of Vindhyan and Kaimur sandstones, shales, mixed conglomerates, calcareous and haematitic slates schists, gneiss, carboniferous rocks and to some extent the lime-stones.

Five types of soil association have been recognised in the area and termed as Vindhyan type 1 to type 5. Vindhyan type 1 and 2 occupy the uplands. Vindhyan type 3 lies on flats while Vindhyan type 4 and type 5 rest on the lowlands. The upland soil belong to great groups Haplustults, Rhodostults and Rhodostulf sub. The flat lands and lowland soils generally fall within the great group Haplustalfs, Ochraqualfs, Eutrochrepts, Ustochrepts and Ustitleuvents.
Vindhyan type 1 and 2 are brown to dark brown, coarse textured, shallow to moderately deep, slightly acidic and excessively drained soils. Vindhyan type 3 soils are very deep, yellowish grey, loam to clay loam with somewhat restricted drainage. Vindhyan type 4 and 5 are fine textured grey to dark grey, poorly drained soils underlaid by a calcic horizon.

7. Aravali Soil

This soil is lying in the south west corner of Agra district, occupy only 0.21 per cent of the total area of the U.P. It has developed from various formations of Vindhyan sandstones including Kaimur group as the lowest and Bhandar group as the highest member in the outer spurs of central India hills of Bharatpur and Dhaulpur.

This soil is loamy and occasional thin layers of silt in small patches. Locally it is called as Bhur. At great group level, they can be grouped as Psamments and Camborthids (Fig.1.1).

UNDERGROUND WATER

The area under present study is quite rich in ground water resources, both free and confined. The confined water lies between 60-90 m depth, while free water table lies less than 30 m. (Singh R.L. 1995:137). The free water has a deep relation with the relief, geological structure and water channels. Where, there are water channels & water tables which are usually at high level; whereas the area, having thick clay belt, have deep underground water. In the area under present study average
depth of underground water is 5 m. and in areas around river Yamuna, Ganga and Hindon water table is about 3.30 m. below surface.

**GEOLOGY OF THE AREA**

The entire Ganga basin is an active foreland having an east-west elongated shape. The Ganga basin was formed as a result of uplift of Himalaya after the collision of Indian and Asian plates (Dewey and Bird, 1970). The area under present study was formed during the Middle Miocene. During the middle Miocene to middle Pleistocene the northern part of the Ganga plain was uplifted and thrust of the basin shifted southward in response to thrust loading in the orogen. Some scholars like Covey (1986), Singh (1996) used a term “under-filled basin” to the Ganga foreland basin, which represents a topographic low between the thrust belt (Himalaya) and the peripheral bulge. Ganga foreland basin is dominated by transverse river system because the Pliocene is due to erosionally-driven uplift (Burbank, 1992).

The thickness of the alluvium is 6 km. near the foothill zone and decreasing gradually towards the south (Rao, 1973). Geophysical survey carried out in the area shows that metamorphic basement exhibits a number of ridges and basin (Map 1.3). Entire Ganga basin is characterized by three subsurface ridges, i.e. Delhi-Haridawar ridge, Faizabad ridge and Monghyr-Saharsa ridge. There are two depressions viz. Gandak and Sharda deep. The foreland sediments rest on these basement ridges. In the area between the Delhi-Haridawar ridge, the sediments lie over late Proterozoic unmetamophosed sediments, which are the part of the Vindhyan basin in the south
and the Krol basin in the north. East of the Monhgyr-Saharsa ridge the sediments rest on Gondwana rocks.

Map 1.3: Shows subsurface geology and tectonic framework (After Shina et al 2005:225)

Alluvial Stratigraphy

In the Upper Ganga plain, megafan deposit of the rivers consist larger part of the basin. Upper Ganga plain is made up of cone and inter cones (Geddes 1960). The river follow transverse into 150 km. long and 100 km. wide Ganga-Yamuna plain, generating a broad valley. The section of valley rise 15-30 m above Ganga river along cliff lines and extensive gullyning has exposed the area. Modern day Ganga and Yamuna rivers are deeply incised into surface and are not actively depositing sediments on the most parts of megafan. The Ganga megafan deposit can be divided in to four zones (i) gravelly braided streams, (ii) sandy braid plain, (iii) anbranching
channel plain, (iv) meandering channels with broad interfluve area (Shukla et al 2001). The detailed geomorphic mapping done by some scholars like (Sinha et al 2002; Sinha et al 2005) helped in identification of the major geomorphic units such as, major active channel belts, active flood plains, minor active channels, flood plains and slightly dissected plains and highly dissected plains. Figure 1.1 depicts the stratigraphic faces of the Ganga basins.

Fig 1.1: Summarized stratigraphic (after Shina et al 2005)

(C-channel, E= eolian, G=gravel, L= lacustrine)

**FAUNA**

Corresponding to its variegated topography and climate, the area under present study has a wealth of animal life. Its avifauna is among the richest in the
country but due to the growing population, expansion of cultivation, reclamation of jungles and barren lands, wild animals are disappearing very fast. Fauna found in the area under present study is given below:

**Mammals**

Rhesus macaque or Bandar (*Macacamulatta*), Common langur (*Presbytis entellus*), Common Mongoose (*Herpestes edwardsi*), Jackal (*Canisaureus*), Indian fox (*Vulpes bengtalenis*), Stripped hyaena (*Hyenahyaena*), Bheriya (*Canis lupus*), Grey musk-shrew or chuchunder (*Suncus murinus*), Common yellow bat (*Scotophilus heathi*), Tickell’s bat (*Hesperoptenustickelli*), Five stripped palm squirrel or gilheri (*Funambulus pennanti*), Indian porcupine or sahi (*Hystrix indica*), Common house rats (*Rattusrattus*), House mouse (*Mus musculus*), Indian hare (*Lepus nigricollis*), Chinkara or ravine deer (*Gazella gazelle*), Blackbuck (*Antilope cervicapara*), Bluebull or nilgai (*Boselaphustragocamelus*), tiger, leopard, wild bear, sloth bear are the mammals found in the region.

**Birds**

Brahminy duck (*Tadorna ferruginea*), Common shelduck (*Tadornatadorna*), Pintail (*Anas acuta*), Mallard (*Anas platyrhynchos*), Wigeon (*Anas Penelope*), Bluewinged teal (*Anas querquedula*), Ferruginous duck (*Aythyafuligula*), Tuffed duck (*Aythafuligula*), Comb duck (*Sakidiornis melanotos melanotos*) are the common birds found in the area under present study. Cotton teal
(Nettapuscoromandianuscoromandianus), Spotbill duck (Anaspoecilorhyncha), Tree duck (Dendrocygnajavanica), Black partridge (Francolinusfrancolinusasiae), Grey partridge (Francolinuspondicerianusinterpositus), Grey quail (Coturnixcoturnixcoturnix), Blue rock pigeon (Columbalivia), Western turtle dove (Streptopeliaorientalismeena), Indian ring dove (Streptopeliadecaoctodecaocto), Indian spotted dove (Streptopeliachinesissuratensis), Pariah kite (Milvusmigrans), King vulture (Torgoscalvus), Tawny eagle (Aquila rapaxvindiana), House crow (Corvussplendens), Indian jungle crow (Corvusmacrorhynchoscluminatus), Indian shikra (Accipiterbadiusdussumieri), Laggar flacon (Falco biarmicus), Redheaded merlin (Falco chicquerachicquera), Eagle owl (Bobo bubo), Mottle wood owl (Strixocellata), Indian house swift (Apusaffinisaffinis), Indian grey shrike (Laniusexcubitorlahtora), Indian baybacked shrike (Laniusvittatusvittatus), King crow (Dicrurusadsimilisalbircutus), Indian pied myna (Sturnuscontracontra), Indian myna (Acridotheresgininianus), Bank myna (Acridotheresgininianus), Northern jungle myna (Acridotheresfuscusfuscus), Northern goldenbacked woodpeckers (Dinopiumbenghalensebenghalense), Koel (Eudynamyscolopaceascolopacea), Indian pied kingfisher (Cerylerudisleucomelantra), Redventedbulbul (Pycnonotuscafer), Indian purple sunbird (Estrildaamendavaaamandava) and Indian small green bee-easter (Meropsphilippinusphilippinus).
**Reptiles**

Common Indian krait (*ElapideBungaruscaeruleus*), *Phoorsa* (*Echiscarinatus*), Indain python (*molurus*), John’s sand boa (*Eryxjohnijohni*), Rat snake (*Ptyasmucusos*), Sand snake (*Psammeghisleithi*), Common lizards (*Haemidactylusbrooki*), Kirla or girgit (*Calotesversicolour*), Sanda (*Uromastixhardwicki*) are the reptiles species found here.

**Amphibians and Water Speices**

Tortoises (*Geoclemmyshamitloni*), Indian bull frog (*RanidaeRanatigrina*), Indian cricket frog (*RanaLimnocharis*), Indian burrowing frog (*Ranabreviceps*), Common toad (*BufonidaeBufomelanostictus*), *Parri* (*Notopterusnotopterus*), *Katla* (*Catlacatla*), *Mrigal* (*Cirrhinusreba*), *Bata* (*Labeobata*), *Siriha* (*Labeogonius*), *Rohu* (*Labeorohita*), *Magur* (*Clariasbatrachus*), *Singhara* (*Mystusseenghala*), *Ghally* (*Ompokbimaculatus*), *Mallee* (*Wallagoattu*) and *Dolla* (*Channapunetatus*) are the amphibians found in the region.

**VEGETATION AND FLORA**

Area under present study is endowed with natural wealth in abundance in terms of vegetation. The diversity of flora and fauna displayed here is due to vast plain area, big and small rivers, diverse of climatic conditions, and different kinds of soil. Three type of forests found in the area under present study, which are discussed below:
**Tropical Moist Deciduous Forests** are found in the moist region of Terai. It grows in regions which record 100 to 150 cm. of rainfall annually, have an average temperature between 26-27°C and have considerable degree of humidity. A special feature of the forests is that deciduous trees of uneven size grow on higher altitude regions. Lower regions have several species interspersed with Bamboo, Climbers, Cand and ever green shrubs. Main trees 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 regions. Trees are mostly deciduous. Since sun-light reaches the ground in abundance, shrubs and grasses also grow here. Large tracts of these forests have been cleared for cultivation. Important trees are *Sal*, *Palas*, *Amaltas*, *Bel*, *Anjeer* etc. *Neem*, *Peepal*, *Sheesham*. *Mango*, *Jamun*, *Babool*, *Imli* (Tamarind) etc. grow along river banks and in other moist regions.

**Tropical Thorny Forests** are mostly found in south-western parts of the State. Such forests are confined to the areas which have low annual rainfall (50-70 cms), mean annual temperature between 25 degreee to 27 degree centegrade and low humidity (less than 47%). Widely scattered thorny trees, mainly, *Babool*, Thorny, legumes and Euphorbias are extensively found here. During rains, short grass also grows here. The trees are generally small here forming open dry forests. Important trees of the region are *Phulai*, *Khair*, *Kokke*, *Dhaman*, *Danjha*, *Neem*, etc. Various types of resin and gum are obtained from these trees. (Upadhyay, Alka et.al, 2011)
Shrubs

Hins (*Capparisseptaria* L. *Carissa spinarum* L.), Castor (*Ricinus Communis*), Panwar (*Cassia tora* L. (ii) *Cassia occidentalis* L.), Babool (*Acacia jacquemontii* Benth), Mallah (*Zizyphusnummularia*), Karir (*Capparisdeciduas*), Khip (*Leptadeniaprotechnica*), Ak (*Calotropisprocera*) are the common shrubs.

Medicinal Plants

The medicinal plants found in the region are *Bansa* (*Adhatodavasida* Nees), *Indirain* (*Citrulluscolocynthis*), *Asgandha* (*Withaniasomnifera*).

CULTIVATED CROPS

The Ganga plains of north India can be called as the ‘agriculture hub’ of India, and its importance can be seen in the fact that more than 70% of the total population depend upon the agriculture. There are mainly two groups of crops in a year, viz. the *rabi* and the *kharif*.

In *rabi* season when the temperature is relatively low the crops grown in this region are wheat, barley, pulses, (gram, peas, *masur*) rabi fodder, *lahi* (mustard), potato and other vegetables. These crops are grown with the help of irrigation because in this region it is the time of retreating monsoon. Wheat is the major *rabi* crop which is grown in largest area because wheat is the staple food of the people of the area under present study. It is followed by the fodder and other vegetables. Rest of the crops are grown in very little portion of cultivated area.
Rice, maize, sugarcane, cotton, jowar, bajra, gawara, paddy, moong, moth, mash, san, arhar, ground nut and kharif fodder are the major crops of kharif season. Rice is the major crop which is cultivated on more than 25% area of the total cultivated area. Among the cash crops sugarcane is the major crop which covers 21.43% of area, while the share of fruits and vegetables lie below 5% of the total cultivated area.

**CLIMATE AND TEMPERATURE**

The climate of area under present study is sub-humid if compared to dry Punjab plains and the humid mid Ganga plains. The annual climate cycle consists of four seasons i.e. summer, winter, autumn and rainy. The mean annual temperature of the study area varies from 11°C to 26°C. The mean temperature during January and February ranges from 13°C to 18°C and May-June from 32°C to 34°C with extremes of 46°C to 56°C.

**Humidity**

The moisture content in the air is maximum in July and August, but the period of its high percentage is generally from July to September. The humidity declines in two phases, first from September to October and second from December to March, while in August the rise in humidity is quite rapid.

**Rainfall and Cloudiness**

Most of the rainfall occurs during the monsoon season from July to September, after which there is almost no rain and the November is the driest month.
of the year. About 74% of annual rainfall occurs during the monsoon in the month of June-July. There is a significant amount of rainfall in the month of June in the form of thundershowers and during the rest of the year there is very little rainfall. In the month of January there is also good rainfall due to the western disturbances from Pakistan. During the monsoon season, the sky is mostly moderate to heavily cloudy. During the rest of the year, the sky is generally clear or lightly cloudy. Cloudy sky prevails for brief spells of the day or two in association with the passing western disturbances in the cold seasons.

**Winds and Dust storms**

Winds are generally slow during the post-monsoon period and winter months. They are strengthened a little during the summer and monsoon months. From April to June winds blow steadily from the west, which are normally hot practically. When the hot season is on the peak, dry winds locally called ‘loot’ blow at high speeds and they are totally dry and hot. Another unpleasant feature of the climate is the dust storms which are very common in the region before monsoon and especially in the south and south-west of the region. In the months of December and January western disturbances strike the area and make rapid decrease in the temperature and occasionally cause rain and is very good for the wheat and mustard crops.
Map 1.4: Showing annual rainfall in the study area

Aims and Objectives of the study

- To carry out exploration in the selected part of the study area.
- To understand the origin, development and expansion of the early farming cultures in the Upper Ganga region.
- To understand the expansion, dispersal, diffusion and migration of the Harappans in Ganga-Yamuna doab.
- To know about the changes in the settlement patterns of various cultures.
- To see inter-regional relations of various cultures.
- To find out relationships, if any, between the Late Harappan culture and OCP culture; Late Harappan Culture and Painted Grey Ware Culture.
- To conduct micro level analysis of ceramics and other artifacts.
To conduct ethnographic and cultural study.

Methodology

- The researchers conducted an extensive village-to-village survey in the region using topographic maps.
- A GPS handset (Garmin, GPS map 60CSx) was used to record and correct the geo-coordinates of the sites.
- Proper sampling of the pottery and other remains from the surface and exposed sections was conducted.
- On the basis of ecological conditions and the detailed analysis of the ancient settlements, different categories of the settlements (like regional centers, villages, industrial centers and camp sites) have been identified. Our main emphasis was locating sites and observing the distribution pattern of the cultural remains in the area. The dating of the sites was determined on the basis of diagnostic ceramic shapes. Estimates of site size was made on the basis of the area across which cultural deposits were found.
- The available published literature and survey reports, including unpublished dissertations, were examined and their data was also included in this study.
Define the Research Problem
(Settlement Pattern of the area under study)

Research Methodology

Review of concept and theories of settlement pattern

Review of the previous work

Carried exploration in the area under study and reconstruction of cultural sequence

Collection of Data
(Published sources and data from explorations)

Analysis of Data
(Analysis of the combined data incorporated with)

Interpretation and Report
(Change in Nature and Distribution of Settlement Pattern of various Cultures in Study Area)

Dissertation

This thesis is divided into several chapters and illustrations in terms of maps, photographs and pottery drawings are provided where ever these were necessary.
Chapter-1: Introduction to Study Area

This chapter is introductory and contains a brief account of geographical background of the region, physical features, drainage, geology, soils, humidity, underground water, hydrographic changes, variety of soil, morphology of study area, tectonic evolution, crops, flora, fauna and petrology of the study area.

Chapter-2: Field Survey

This chapter includes the field work conducted by the researcher. It also comprises of previous work, cultural sequence and terminology used for various cultures and names and description of the archaeological settlements discovered/located during the course of explorations. Each site is discussed with special reference to its location with correct geo co-ordinates, size of the site, cultural sequence it yielded, its local name and distance and direction from the village. The Table showing distribution of explored sites of various cultures

<table>
<thead>
<tr>
<th>S.No</th>
<th>Culture</th>
<th>No. of Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Late Harappan</td>
<td>51</td>
</tr>
<tr>
<td>2</td>
<td>OCP</td>
<td>17</td>
</tr>
<tr>
<td>3</td>
<td>PGW</td>
<td>22</td>
</tr>
<tr>
<td>4</td>
<td>NBPW</td>
<td>8</td>
</tr>
<tr>
<td>5</td>
<td>Historical</td>
<td>126</td>
</tr>
<tr>
<td>6</td>
<td>Medieval</td>
<td>45</td>
</tr>
</tbody>
</table>
Chapter -3: Harappan Civilization

Chapter-3 is devoted to highlight the remains of Harappan Culture in the chosen study area. In the area under the present study was first occupied by the Harappans who belong to the late phase of the Mature Harappan culture. However, bulks of the sites have yielded the remains of Late Harappan culture. The area attracted attention of the archaeologist who placed a number of sites, with Harappan affinities on the archaeological map of India. Some of the sites were subject to the excavations also inorder to get information about the culture. There are four important excavated sites viz. Hulas, Alamgirpur, Sanauli, Bargoan. The details of these excavations are discussed briefly in the chapter along with other explored sites. In this chapter following aspects are studied or included, Introduction, Excavated
Chapter-4: Ochre Colour Pottery and Copper Hoard Tools

Chapter 4 contains a detailed study of Ochre Colour Pottery and Copper Hoard Tools. The excavations conducted at Hastinapur brought to light hitherto unknown culture named tentatively as Ochre Coloured Pottery Culture. In this chapter our emphasis is on this very culture. The explored and excavated sites were subject to close scrutiny and on the basis of the results various aspects of this culture were studied under the following heads. Introduction, Excavated sites, Explored sites, Settlement pattern, Food Economy, Material Culture, Dwellings, Chronology, Relation with Late Harappans, Pottery

Chapter-5: Painted Grey Ware Culture

Painted Grey ware is the theme of this chapter. Painted Grey Ware culture which played important role in the history of this region in particular and in India in general, is the crux of this chapter. Till now the cultures were basically rural based without any urban trait. This culture for the first time evolved itself in such a direction so as to move towards urbanization. The various aspects of this culture and its march towards urbanization is studied in this chapter under the following heads. Introduction, Excavated sites, Explored sites, Settlement pattern Food Economy, Material Culture, Dwellings, Chronology, Late Harappan and Painted Grey Ware overlap, Pottery.
Chapter-6: Northern Black Polished Ware Culture

Chapter 6 is devoted to Northern Black Polished Ware Culture. The footprints of the Painted Grey Ware culture were followed by the next culture named after the diagnostic pottery which is found specifically in the Ganga Valley. The emergence of urban traits fully developed in this phase, with the help of iron technology. The use of iron led to the clearance of the jungle paving way for agriculture land which in turn was ploughed with the help iron share. The surplus generated led to the prosperity and the deluxe ware in the form of NBPW is the testimony of this. This march of the society of that period is documented and studied under the following heads. Introduction, Excavated sites, Explored sites, Settlement pattern, Food Economy, Material Culture, Coins, Dwellings, Fortifications, Chronology, Pottery,

Chapter-7: Conclusion

The researcher not only gave the exact geo-co-ordinates of explored sites but also tried to give exact size of the settlements. The researcher has explored hundreds of sites in the study area and it was noticed that most of the archaeological sites are either converted into the agriculture fields or the soil is removed from here for making roads, canals and domestic structures. The situation is very grim because in a few years it will be very difficult for the archaeologist to get any site for excavations. Hence, the present study has its own importance as the sites are now recorded for posterity which may not exist in future. Here, this researcher would like refer to the site Sanauli. The researcher visited the site after excavation at that time most of the
portion was intact. When the researcher visited the site in November 2010 and 2011, most of the site was removed by the villagers to use soil for bricks manufacturing and heap of human bones and fragment pottery was dumped at number of places. But still some sites viz. Kurdi, Ishpur Till, Bamnoli, Barnava-1, Bhura-3, and Asara-2, have rich archaeological potentialities and if excavated at an early date they can throw welcome light on the history and culture of the region. Otherwise like other sites these important sites are doomed to vanish without any trace and the future generations shall be deprived of vast archaeological heritage.

Plate 1.1 Fertile plains of study area
Plate 1.2 Reserve forest of study area

Plate 1.3 River Yamuna
Plate 1.4 River Hindon

Plate 1.5 River Krishni
Plate 1.6 Katha Nala

Plate 1.7 Sangam of Hindon and Krishni river