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FIELD GUIDE

INMID - 04

QUATERNARY GEOLOGY, FLUVIAL GEOMORPHOLOGY, GEOARCHAEOLOGY, AND LANDSCAPE EVOLUTION OF THE MIDDLE GANGA PLAIN: A FIELD-BASED STUDY OF HULASKHERA ARCHAEOLOGICAL SITE AND ADJOINING KARELA LAKE







Dr. Anju Saxena, Dr. Arif H. Ansari and Dr. Suyash Gupta

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Field Guide Book

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Quaternary Geology, Fluvial Geomorphology, Geoarchaeology, and Landscape Evolution of the Middle Ganga Plain: A Field-Based Study of Hulaskhera Archaeological Site and adjoining Karela Lake

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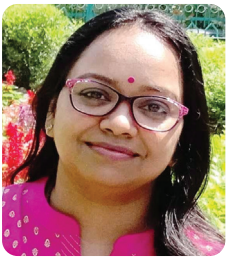
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Table of Contents

1.	Team Leaders	1-2
2.	Abstract	3
3.	Preamble	4-5
4.	Geomorphology of the Lucknow and Surrounding Area	6
5.	Research Problem	7-19
6.	Regional Geology and Stratigraphy	19-22
7.	Literature Review	22-23
8.	Field Transect	24-25
9.	Geoheritage, UNESCO Heritage, Archaeological Sites, Cuisine, and Culture	26-27
10.	Local Conveniences	27-28
11.	Conclusions	29
12.	Acknowledgements	30
13.	Annexure	31-32

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Abstract

The Middle Ganga Plain constitutes one of the most important Quaternary landscapes of the Indian subcontinent, preserving an exceptional record of geological evolution, climatic variability, ecological transformation, and human adaptation. The integrated examination of the Hulaskhera Archaeological Site, and Karela Lake (Jheel), provides a multidisciplinary perspective on the long-term interactions between fluvial processes, environmental change, biodiversity, and cultural development within this dynamic alluvial system.

The Hulaskhera Archaeological Site represents a significant geoarchaeological archive that demonstrates the close association between human settlements and the resource-rich floodplains of the Ganga Basin. Its cultural stratigraphy, archaeological remains, and environmental setting reveal how ancient communities successfully adapted to changing hydrological regimes, exploited fertile alluvial soils, and utilized freshwater resources for sustenance and socio-economic development. The site offers valuable insights into the evolution of human–environment relationships during the Late Holocene and underscores the role of riverine landscapes in fostering cultural growth and the continuity of settlement. Additionally, Karela Jheel, a floodplain wetland formed through fluvial processes associated with the Gomti River system, serves as a key palaeoenvironmental archive for reconstructing Late Pleistocene–Holocene environmental history. Its stratified lacustrine sediments preserve high-resolution records of monsoon variability, hydrological fluctuations, vegetation succession, and anthropogenic activities spanning nearly 17,000 years. Palynological and sedimentological evidence from the lake provides critical information on climatic transitions, forest expansion and decline, and the emergence of agricultural landscapes in the Central Ganga Plain.

Collectively, these two sites illustrate the continuum linking Quaternary geological processes, landscape evolution, ecosystem development, and human civilization. They highlight the importance of integrating geology, geomorphology, palaeoecology, and archaeology to reconstruct past environmental changes and evaluate present-day challenges. The region serves as a natural laboratory for investigating long-term human–environment interactions and offers valuable lessons for sustainable management of wetlands, archaeological heritage, and natural resources in the face of rapid urbanization and climate change.

The preservation and scientific study of these interconnected landscapes are therefore essential not only for advancing knowledge of the Middle Ganga Plain but also for safeguarding its geoheritage, cultural heritage, and ecological integrity for future generations.

Preamble

The Middle Ganga Plain represents one of the most significant geomorphic, geological, ecological, and cultural landscapes of the Indian subcontinent. Occupying a vast stretch of the central Indo-Gangetic foreland basin, this region has evolved through complex interactions among Himalayan tectonics, Quaternary climatic fluctuations, fluvial dynamics, sedimentation processes, and human activities. The plain serves as a natural archive, preserving evidence of environmental changes over hundreds of thousands of years, while simultaneously supporting some of the earliest agricultural societies and urban settlements in South Asia. The study of the Middle Ganga Plain, therefore, provides a unique opportunity to understand the interconnected evolution of landscapes, ecosystems, and human civilisations.

The present landscape of the Middle Ganga Plain owes its origin to the collision between the Indian and Eurasian plates, which initiated the uplift of the Himalayas during the Cenozoic Era. The enormous volumes of sediments generated by Himalayan erosion were transported southward by major river systems and deposited within the foreland basin. During the Quaternary Period (approximately the last 2.58 million years), repeated glacial and interglacial cycles, variations in monsoon intensity, and neotectonic movements significantly influenced river behavior, sediment supply, and floodplain development. Consequently, the region became characterized by extensive alluvial deposits comprising gravel, sand, silt, and clay, forming one of the world's largest and most fertile fluvial plains.

Within this dynamic geological setting, rivers have acted as the principal agents of landscape evolution. The Ganga and its tributaries have continuously reshaped the terrain through erosion, transportation, deposition, channel migration, avulsion, and floodplain aggradation. The resulting geomorphic features include active and abandoned channels, meander scars, oxbow lakes, natural levees, flood basins, backswamps, wetlands, and alluvial terraces. These landforms collectively record the history of river dynamics and climatic variability that have governed environmental conditions throughout the Quaternary. Understanding these geomorphic processes is crucial for reconstructing past environments, assessing contemporary environmental challenges, and developing sustainable strategies for land and water resource management.

The state of Uttar Pradesh occupies a central position within the Middle Ganga Plain and contains numerous sites that illustrate the intricate relationships between geology, geomorphology, ecology, and human history. Among these, the Hulaskhera Archaeological Site and adjoining area provide particularly valuable insights into the evolution of the regional landscape. Although distinct in their character and significance, both locations represent complementary components of the broader Quaternary environmental framework of the Middle Ganga Plain.

The Hulaskhera Archaeological Site, situated in the vicinity of Lucknow, is an important cultural and geoarchaeological locality that preserves evidence of human occupation during different phases of prehistoric and early historic development. Archaeological investigations have revealed habitation remains, pottery assemblages, cultural deposits, and material artefacts that shed light on the settlement patterns and subsistence strategies

of ancient communities inhabiting the Ganga Plain. The location of Hulaskhera is not accidental; rather, it reflects the strong influence of geomorphic and environmental factors on the selection of human settlements. Ancient populations were naturally attracted to stable floodplain surfaces, fertile alluvial soils, reliable water sources, and ecologically productive landscapes created by riverine processes. Consequently, the archaeological record preserved at Hulaskhera provides a valuable window into the interactions between humans and their changing environment over time.

From a geoarchaeological perspective, Hulaskhera demonstrates how Quaternary landscape evolution directly influenced cultural development. Variations in river courses, flood frequencies, sedimentation patterns, and climatic conditions would have affected agricultural productivity, resource availability, transportation routes, and settlement sustainability. By integrating geological, geomorphological, and archaeological evidence, researchers can reconstruct the environmental contexts within which ancient societies emerged, adapted, and transformed. Such interdisciplinary investigations contribute significantly to our understanding of human resilience and environmental adaptation in one of the world's most densely populated river basins.

Together, Hulaskhera Archaeological Site and adjoining Karela lake illustrate the dual dimensions of landscape evolution within the Middle Ganga Plain—one reflecting the history of human occupation and cultural adaptation, and the other representing the ecological and geomorphological consequences of fluvial processes. Their combined study offers an integrated perspective on how natural processes have shaped environmental opportunities and constraints for both ecosystems and human societies.

In the context of contemporary environmental challenges, including rapid urbanization, wetland degradation, groundwater depletion, river pollution, and climate change, understanding the Quaternary evolution of the Middle Ganga Plain assumes increasing importance. Historical and geological records provide critical insights into the long-term behavior of river systems and landscape responses to environmental stress. Such knowledge is essential for informed conservation planning, heritage management, disaster mitigation, and sustainable development initiatives.

This field-based exploration of the Middle Ganga Plain, centred on Hulaskhera Archaeological Site, therefore seeks to integrate perspectives from Quaternary geology, fluvial geomorphology, geoarchaeology, palaeoenvironmental reconstruction, and wetland ecology. Through the examination of these sites, participants gain a comprehensive understanding of the processes that have shaped the landscape over geological timescales and continue to influence ecological and cultural systems today. The region thus stands as a living laboratory where the stories of rivers, climate, ecosystems, and human civilizations converge to reveal the dynamic history of the Middle Ganga Plain.

Geomorphology of the Lucknow and Surrounding Area

Lucknow is situated in the Central Alluvial Plain of the Ganga Plain, in the region of Ghaghara-Ganga interfluve. The Lucknow township is located on the banks of the Gomati River. The Gomati River originates in the Terai region of Pilibhit district, flowing generally in a SE direction to meet the Ganga River in Ghazipur district. It is an alluvial-plain river, fed by groundwater and sheet runoff. In the Lucknow area, the Gomati River exhibits distorted meandering, indicating past neotectonic activity. This area exhibits three distinct geomorphic surfaces with their characteristic features, namely, the Upland Terrace Surface (T2) or Upland Interfluve, River Valley Terrace Surface (T1), and Active Flood Plain Surface (T0). The upland interfluve surface is also described as Older Alluvium or Bangar. It shows a high surface with a variety of alluvial features, namely bhur ridges, abandoned channels, lakes, ponds, and patches of alkaline soils. This surface exhibits kilometer-scale undulations, making high grounds and low grounds. It resulted in regions (basins) of centripetal drainage covering several km2. Within each of these basins, a number of large and small ponds and lakes are present. Usually, there is no outflow from such basins. The ponds and lakes are usually associated with raised natural levees and alluvial ridges which are often ancient sites of human settlements. The water bodies were formed in early to middle Holocene and provide a good record of palaeoclimate and palaeovegetation. Deposits of T2-Surface are seen in cliff sections, exposed along the river channels showing many calcrete (kankar) horizons T1-Surface is located within the Gomati River Valley, above the level of annual floods of the river. It may be demarcated into two sublevels, i.e. T1a and T2b. T0-Surface makes the river channel and its active flood plain. The T1-Surface is 5-10m above the T0-Surface, and T2-Surface is about 15-20m above the T1-Surface.

The old Lucknow city is located on the southern side of the Gomati River (Cis-Gomati area), which exhibits mostly higher surface. The planners of the old city of Lucknow made maximum utilization of the landscape in the town development. The main residential areas are located on Upland Terrace Surface (T2) free from annual river floods. The upper part of T1 Surface was developed into parks and gardens with few monuments on raised grounds. The natural drainage was developed, trained and deepened for disposal of effluents as well as excess rainwater. The Bara Imambara is a fine example of using T2 and T1-surfaces to create split levels. The T2-Surface extends in Chowk, Aminabad, Charbagh and Cantonment areas with a general altitude of about 124m above msl. Husainabad, Kaiserbagh and Hazratganj areas are located on degraded T2 and T1-surfaces. Many new settlements in Lucknow namely Niralanagar, Mahanagar, parts of Gomati Nagar (Trans-Gomati area) are located on the T1-Surface. During planning of these new residential areas, no consideration was given to geomorphic features and water outlets. Often natural drainages have been blocked and low areas with small ponds were converted to residential complexes without giving consideration to water movement during monsoon rains. This results in water logging of several residential colonies during heavy rains.

Research Problem

Understanding the interactions among climate change, river dynamics, landscape evolution, ecosystem development, and human societies represents one of the foremost challenges in Earth system science and environmental archaeology today. Across the world, major river basins such as the Nile, Mississippi, Amazon, Yangtze, Danube, Yellow River, Ganga, Yamuna, Ghaghara, Brahmaputra, and Indus preserve valuable archives of environmental change within their floodplains, wetlands, and archaeological sites. Researchers increasingly recognize that riverine landscapes are not merely passive settings for human occupation but dynamic systems that respond to climatic fluctuations, tectonic activity, hydrological variability, and anthropogenic interventions. Therefore, a central global research problem is to determine how environmental changes are recorded in fluvial landscapes and how these changes influence ecological processes and human settlement patterns over long timescales.

During the last few decades, advances in Quaternary geology, geomorphology, palaeoecology, geoarchaeology, and geochronology have greatly improved our understanding of river basin evolution. Nevertheless, significant uncertainties remain regarding the relative influence of climate, tectonics, and human activities on landscape transformation. In many regions of the world, the relationships between river migration, floodplain sedimentation, wetland formation, biodiversity evolution, and cultural development remain incompletely understood. This challenge is particularly important because modern societies continue to depend heavily on river basins for agriculture, water resources, transportation, and ecosystem services. Predicting future environmental responses to climate change requires a robust understanding of how river systems behaved under past climatic conditions.

One of the major global research themes concerns the reconstruction of human–environment interactions within large alluvial plains. Archaeological evidence increasingly demonstrates that ancient civilizations adapted to changing river courses, flood regimes, droughts, and ecological transformations. However, linking archaeological records directly with geological and palaeoenvironmental archives remains difficult because these datasets are often studied independently. As a result, researchers worldwide are emphasizing integrated landscape approaches that combine archaeology, geomorphology, sedimentology, palaeoecology, and hydrology to reconstruct coupled natural-human systems.

The Indo-Gangetic Plain, and particularly the Middle Ganga Plain, provides an exceptional natural laboratory for addressing these global research challenges. Despite its immense cultural, ecological, and economic significance, the Middle Ganga Plain remains comparatively understudied when compared with river systems such as the Nile, Mississippi, or Yellow River. Several outstanding questions continue to exist regarding the timing and causes of river migration, the influence of monsoon variability on sedimentation, the role of neotectonic activity in landscape development, the evolution of wetlands, and the environmental context of early human settlements.

The field transect encompassing the Hulaskhera Archaeological Site and the Nawabganj Wetland Bird Sanctuary is uniquely positioned to address these issues because it captures multiple dimensions of landscape evolution within a relatively compact geographical area. The transect effectively links geological processes, geomorphic evolution, ecological development, and human occupation within the broader framework of the Middle Ganga Plain.

The Hulaskhera Archaeological Site represents the human dimension of landscape evolution. Situated within the alluvial environment of the Ganga basin, the site preserves evidence of past settlements that developed in response to favourable geomorphic and hydrological conditions. The archaeological remains provide an opportunity to investigate how ancient populations selected settlement locations, exploited floodplain resources, and adapted to environmental changes. Unlike many archaeological sites studied solely from a cultural perspective, Hulaskhera can be examined within its geomorphic setting, enabling the reconstruction of the environmental factors that influenced human occupation and land-use patterns.

Additionally, the Middle Ganga Plain occupies a climatically sensitive position within the Indian Summer Monsoon domain. Variations in monsoon intensity have profoundly influenced river discharge, sediment transport, flood frequency, vegetation dynamics, and wetland hydrology throughout the Quaternary. Consequently, environmental records from Hulaskhera and Nawabganj have the potential to contribute not only to regional studies but also to broader discussions concerning monsoon variability, climate-human interactions, and river basin responses to global climate change.

The field transect therefore addresses a globally relevant scientific problem: understanding how climate, rivers, wetlands, and human societies co-evolve within large alluvial landscapes. By integrating geoarchaeological evidence from Hulaskhera and Karela Lake the transect provides a multidisciplinary framework for investigating long-term environmental change in the Middle Ganga Plain. Such an approach contributes directly to international efforts aimed at understanding landscape resilience, wetland sustainability, cultural adaptation, and environmental management in densely populated river basins worldwide.

Lucknow District (Historical Perspective)

Lucknow, the capital city of Uttar Pradesh is a unique fusion of the cultures and traditions. Although archaeological evidence of PGW sites are reported from 'Teele Wali Masjid' (Mosque on elevated ground) and other sites of the district, the district is famous for its 'Imambara' built during Mughal (Awadh) times. Lucknow was chosen as the seat of the subedar of Awadh, Sadat Khan Burhan-ul-Mulk; when Emperor Akbar divided the whole of India into 12 provinces. Hulaskhera is another important site dating back to 3000 yrs BP.

This district was formerly an element of Kaushal Kingdom. It has been a hub of art, literature and learning. As the anecdotes goes, Lucknow got its name from Lakshmana, the brother of Lord Rama. A mound known as 'Lakshamana Tila' is present close to Gomti River. Subsequent to the collapse of Suryavanshis of Ayodhya, the entire Avadh area was in backwoods. The mainstream populace were religious minded and betrothed themselves in devotion and

adoration. Thus, there was no established headship and the people of Avadh had to admit the hopelessness to ancient rulers such as Magdhans, Kushana, Gurjaras, Pratiharas, Bhars and Pasis. The entire Avadh region was alienated in small parts and ruled by heads of different clans who claimed themselves as Rajputs.

Sheikhs of the region in Salempur are supposed to have come at the close of the 15th century under the headship of Sheikh Abul Husain. The Sheikhs of Bijnor and Pathans of Ramnagar ousted Brahamans and Kayastha who dwelt in the region of the Lakshmana Tila in a small settlement during those days. It is said they built a fort, which was known as Lakhana Qila after the name of its designer who was accountable for designing the organization of the fort. The fort was later on renamed as Machchi Bhawan since Machchi mark (Fish carving) is carved on the main gate. This character was adopted by 'Sarkar' (ruler) of Awadh as state symbol and even today the State government uses this symbol. Subsequently when Sheikh prospered and rose into reputation, a town grew up around the Qila which is presently known as Lucknow city.

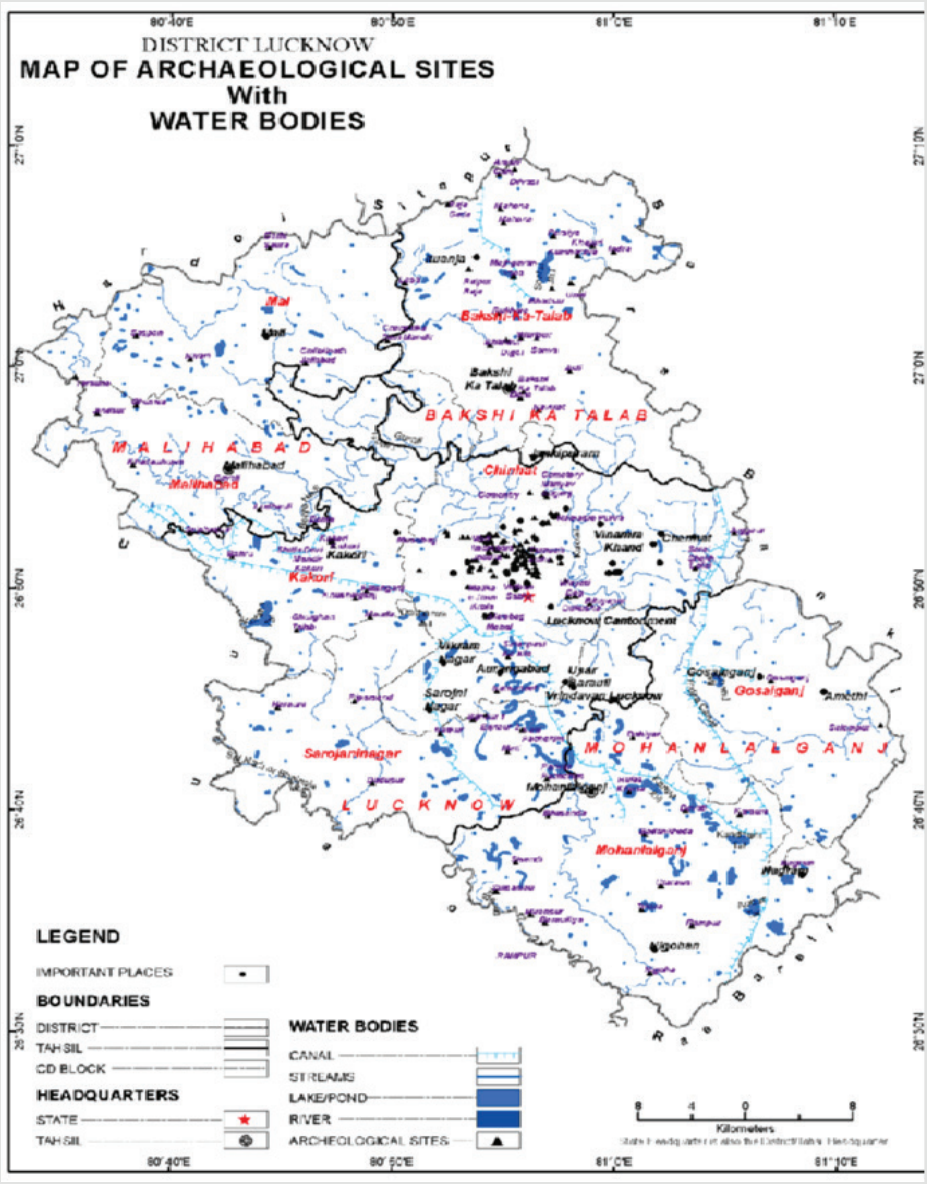
Lucknow remained under the command of Delhi Sultanate for quite some time but it came into public interest at the time of Tughlaq. Afterwards in 1394, Sharqi dynasty of Jaunpur had also ruled this area before it came under the province of Lodi Sultan of Delhi.

Humayun occupied the region in 1526, and afterwards conquered Ibrahim Lodi. Later the area was re-occupied by Afghans but it was a provisional issue and it again came under the ownership of Babar in March, 1528.

In 1539, Sher Shah defeated Humayun and allotted the area to Isa Khan for the safeguarding of law and order in Lucknow and its neighbouring areas. He minted copper and silver coins. Soon after, this area was again in the rule of Mughals. The affluence and the splendour of the district came into more importance during the days of the great Mughal Emperor, Akbar who had fondness for it. He said to have well-known several mohallas to the south of Chowk in the surrounding area of the city. Abul Fazal in his Ain-e-Akbari too has paid bright tributes to the pleasant environs of Lucknow, its enjoyable climate, flowers and fruits. It was then part of Sarkar of Awadh Suba. Throughout the days of Jahangir also, it continued to make firm developments.

Saadat Khan Burhan-ul-Mulk who belonged to the dignified Saiyad family was the creator of Avadh Dynasty; he was awarded the label of Saadat Khan Bahadur in 1720 and afterwards in 1722, selected as Governor of Avadh. With the assistance of Sheikh of Kakori, he had beaten Sheikhzadas, the then rulers of Lucknow. His descendant, Safdarjung predominantly remained in Delhi but prior to his death he came to Avadh and established his capital at Faizabad. Thereafter in 1764, a part of Avadh was lost by Shuja-ud-Daula when he was conquered by Britishers in the battle of Buxer. He was then strained to enter into agreement with East India Company and thus Britishers had started tightening their grasp over the region. Asif-ud-Daula, the fourth Nawab of Avadh consequently switched over his capital from Faizabad to Lucknow. Many superlative buildings were constructed during the days but the impact and rule of Nawabs of Avadh had then started sliding down and eventually, the era of Avadh dynasty came to an end with Nawab Wajib Ali Shah as the last Nawab of Avadh. In 1856 Major General Outram took charge of administration of Avadh. On the other hand, the exclusive traditions that developed with the adaptation of courtesy and generosity during

the period of influence of Nawabs of Avadh has certainly, no match in the history and Lucknow prides itself as the land of this grand legacy.



Map showing water bodies and archaeological sites in Lucknow District.

Human Settlement Evolution, Landscape Dynamics, and Archaeological Heritage of the Middle Ganga Plain

The history of human civilization is intrinsically linked with the evolution of landscapes, climate, vegetation, and water resources. During the last few thousand years, and particularly over the course of the Late Pleistocene–Holocene period (approximately 128 ka BP to the present), human populations expanded across diverse geographical regions of the world, adapting to a wide range of climatic and environmental conditions. This period witnessed profound environmental transformations, including shifts in temperature, precipitation patterns, vegetation cover, river dynamics, and geomorphic processes. Such changes not only influenced the distribution of natural resources but also shaped the development, migration, and sustainability of human settlements. Consequently, understanding the relationship between environmental change and settlement evolution has become a central theme in Quaternary studies, geoarchaeology, and human-environment research.

The Late Pleistocene–Holocene transition was characterized by the termination of the last glacial phase and the establishment of warmer interglacial conditions. Across South Asia, including the Ganga Plain, fluctuations in the strength of the Indian Summer Monsoon significantly affected river discharge, flood frequency, sediment transport, and vegetation dynamics. These environmental changes generated opportunities as well as challenges for human populations. Communities survived and prospered by adapting to changing climatic conditions, exploiting available resources, and modifying their settlement strategies in response to evolving landscapes. As a result, human settlement patterns underwent substantial transformations through time, reflecting the dynamic interaction between natural processes and cultural adaptation.

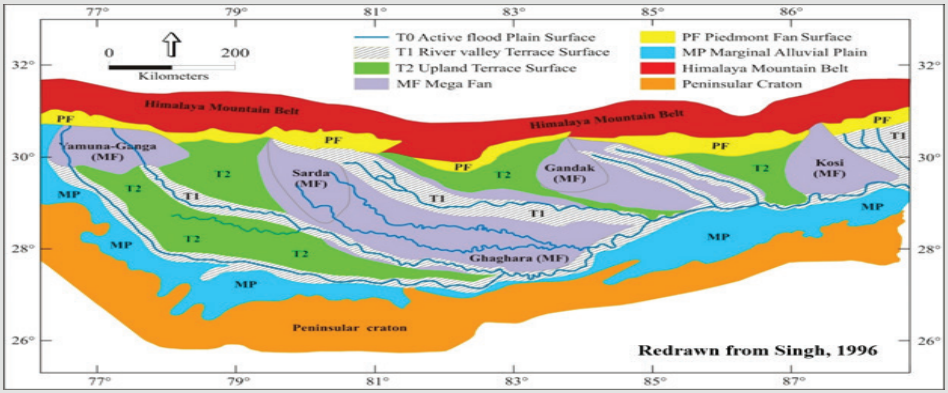
Among the various landscape elements that influenced human settlement, river systems and associated water bodies played the most critical role. Fluvial systems are highly sensitive to climatic variability and tectonic disturbances. Rivers respond to environmental changes through processes such as channel migration, avulsion, incision, aggradation, and abandonment. Variations in sediment supply and water discharge alter channel morphology and create a wide range of alluvial landforms, including levees, flood basins, oxbow lakes, wetlands, meander scars, and abandoned channels. As noted by Singh (2009), these geomorphic responses are manifested throughout the alluvial landscapes of the Ganga Plain and constitute valuable indicators of environmental change. Such landforms not only record the history of river behaviour but also influence the distribution of fertile soils, groundwater resources, vegetation, and habitats that attract human settlement.

The Middle Ganga Plain represents one of the most favourable environments for human habitation in South Asia. The region has supported continuous occupation since prehistoric times owing to its fertile alluvial soils, abundant water resources, favourable climate, and extensive river network. Archaeological investigations reveal that settlements were frequently established in proximity to rivers, lakes, ponds, wetlands, and other freshwater sources. These water bodies provided drinking water, food resources, transportation routes, irrigation opportunities, and ecological stability. Consequently, the evolution of human settlements in the Ganga Plain cannot be understood independently of its hydrological and geomorphological framework.

Historical and geographical studies of settlements within the Ganga Plain reveal a deep and enduring relationship between people and water. Singh (1996) emphasized that it is almost impossible to imagine human settlements without the presence of water bodies that shape and sustain the surrounding landscape. Rivers, ponds, lakes, wetlands, nullahs (rivulet), tanks, and stepwells (baolis) are ubiquitous features throughout the region. These water bodies have not only fulfilled practical needs but have also contributed to cultural identity, religious practices, economic activities, and social organization. Their presence influenced the location and growth of villages, towns, trade centres, and urban settlements throughout history.

The landscape of the Middle Ganga Plain preserves evidence of multiple phases of settlement evolution, each associated with specific environmental and cultural contexts. The region possesses a remarkably long historical and archaeological record that documents changing patterns of human occupation over thousands of years. Archaeological remnants scattered throughout the plain provide valuable insights into the relationship between settlements and their surrounding environments. Tewari (2004) highlighted that numerous archaeological remains preserved within and around the modern urban nucleus of Lucknow represent different phases of historical development. These archaeological records are supported by material evidence such as pottery fragments, structural remains, habitation deposits, artefacts, and cultural layers that collectively reconstruct the historical trajectory of settlement growth and transformation.

In addition to archaeological evidence, palaeoenvironmental proxies such as pollen, phytoliths, diatoms, charcoal, stable isotopes, and sedimentological records provide important information regarding past vegetation, climate, hydrology, and land-use practices (Saxena et al., 2013). Palaeobotanical studies are particularly valuable because they enable researchers to reconstruct the vegetative history of the landscape and assess how environmental changes influenced human activities. Such investigations reveal that the Ganga Plain has experienced substantial ecological transformations during the Holocene, including shifts in forest cover, grassland expansion, agricultural development, and wetland evolution. These changes are closely linked with climatic fluctuations and increasing human intervention.



Geomorphology of Ganga Basin

One of the most significant findings emerging from recent environmental studies is that many of the water bodies around which ancient settlements developed have undergone considerable shrinkage, fragmentation, or disappearance. Watersheds have been repeatedly modified through natural processes as well as anthropogenic activities. Rapid urbanization, agricultural expansion, road construction, drainage modification, groundwater extraction, and other infrastructure developments have altered hydrological networks and transformed the landscape. Consequently, several lakes, ponds, wetlands, and abandoned channels that once played a crucial role in sustaining settlements have either diminished in size or vanished entirely. Understanding these transformations is essential for reconstructing the environmental history of the region and for developing sustainable management strategies for existing water resources.

The archaeological landscape of the Middle Ganga Plain is characterized by a close association between cultural remains and ancient water bodies. Numerous archaeological sites occur near rivers, lakes, ponds, and wetlands, often preserving pottery sherds, antiquities, habitation deposits, and structural remains. Together, these features create a cultural landscape that vividly reflects the periods described in Indian historical and archaeological literature. Such sites provide tangible evidence of how ancient communities selected locations based on environmental advantages and adapted to changing landscapes over time.

A particularly important example is the Hulaskhera Archaeological Site, located in the Lucknow District of Uttar Pradesh. Hulaskhera is one of the most significant archaeological localities in the region and offers valuable insights into the relationship between human settlements and water resources. Archaeological investigations indicate that the settlement was once a well-planned and thriving habitation centre situated on the margins of a lake. The presence of the lake likely provided reliable water supplies, fertile soils, favourable microclimatic conditions, and access to biological resources that supported long-term occupation. Historical and archaeological evidence demonstrates that the settlement flourished in close association with this aquatic environment.

Today, however, the landscape surrounding Hulaskhera has undergone substantial transformation. The lake that once sustained the settlement has become extinct, leaving behind only traces documented through historical records, geomorphic evidence, and archaeological investigations. Although remnants of both the archaeological site and the former lake survive, they now exist within a rapidly changing urban environment. Located approximately 10 km from the expanding metropolitan core of Lucknow, Hulaskhera stands as a testimony to the long-term interactions between humans and their environment. Modern urban expansion, infrastructure development, and land-use changes increasingly threaten the integrity of the archaeological landscape and obscure the environmental context within which the settlement originally evolved.

Collectively, these two localities demonstrate the intimate relationship between fluvial geomorphology, wetland evolution, and human settlement in the Central Ganga Plain. Their sedimentary sequences integrate geological, archaeological, and biological evidence, illustrating how climatic oscillations, river dynamics, and ecological changes shaped both the physical landscape and the trajectory of human cultural development. As such, they constitute an exceptional natural laboratory for investigating Quaternary environmental

Karela Jheel (Lake), at Hulaskhera

Karela Jheel and the nearby Hulaskhera Archaeological Site, located southeast of Lucknow in the Middle Ganga Plain of Uttar Pradesh, represent an important example of the interaction between natural landscapes and human settlements. Karela Jheel was once an extensive freshwater lake or wetland occupying a floodplain depression formed through fluvial processes associated with the Gomti River system. Geomorphic studies suggest that the lake developed within an abandoned channel or low-lying flood basin that collected runoff and seasonal floodwaters. The wetland supported rich biodiversity, provided water resources, and created a favourable ecological setting for human habitation. However, due to natural sediment infilling, hydrological changes, agricultural expansion, and urban development, the lake has drastically shrunk and survives today only as a remnant of its former extent.

Together, Karela Jheel and Hulaskhera provide valuable evidence of Late Quaternary landscape evolution, wetland development, and human–environment interactions in the Middle Ganga Plain, highlighting how ancient communities adapted to and utilized dynamic fluvial landscapes.



View of the Karela Lake (Jheel), Hulaskhera

Hulaskhera Archaeological site

The Hulaskhera archaeological site is located on the high ground of the ox-bow lake, the Karela Jheel. It is surrounded by lake except for a narrow pathway, the cutoff point of the meander. The archaeologists deduced that the site was first inhabited around 1000 BC (3000 years ago) by analyzing the artifacts like pottery, coins, terracotta images and brick structures. Gradually a highly evolved civilization flourished here. The civilization reached its zenith between 200BC-200AD. During this period extensive civil engineering works were carried out; high class pottery was produced; art was encouraged and trade carried out. The most important evidence of this period is the gold leaf image of Kartikeya, the God of War (on display at the State Museum, Lucknow).



Some views of archaeological site at Hulaskhera, Lucknow





Glimpses of the Hulaskhera Archaeological site

By 700 AD the civilization declined. There was a marked deterioration in the quality of life of the people. It is said that during this period the water level in the Karela lake increased due to silting. Communication was hampered. By 1000 AD it was curtains for this civilization. We do not know who were the people that lived here or who ruled over them. There was possibly a closely knit community of farmers and artisans. The Karela Jheel that once proved the nemesis for civilization has now almost disappeared. But if Karela Jheel Area as seen by satellite. Hulaskhera is to be discovered by the world, it will only be possible if the Karela jheel is revived. If this happens there will be few places to rival the beauty of Hulashera. Around thirty years ago, the Karela was brimming with water. The archaeological succession at Hulaskhera is as follows: -

Period I	IA Black Slipped Ware, Black and Red Ware, Red War 2A Painted Grey Ware (PGW), besides the above	1000 BC -700 BC
Period II	Northern Black Polished Ware (NBPW)	700 BC - 300BC
Period III	Sunga-Kushana	200 BC - AD 200
Period IV	Gupta & Post Gupta	AD 300 - 700
Period V	Early-Late Medieval	AD 700 - 1300



Location of Karela lake (Jheel) and Hulaskhera Archaeological site

Hulaskhera Archaeological Site: Regional Geology and Stratigraphy

The Hulaskhera Archaeological Site, situated near Mohanlalganj in the Lucknow District of Uttar Pradesh, is one of the most significant archaeological localities in the Central Ganga Plain. The site occupies a strategic position within the fertile alluvial tract of the Middle Ganga Basin and provides valuable insights into the relationship between human settlement, environmental change, and landscape evolution during the Late Holocene.

It represents a significant geoarchaeological locality where human settlement developed in close association with a palaeolake environment. Archaeological excavations have revealed cultural horizons containing pottery assemblages, habitation deposits, structural remains, and anthropogenic sediments embedded within alluvial sequences. The stratigraphic relationship between cultural deposits and surrounding sediments demonstrates how human occupation was influenced by changes in hydrology, vegetation, and geomorphology. The site occupies a slightly elevated floodplain surface, suggesting deliberate settlement selection to maximize access to freshwater resources while minimizing flood hazards. Thus, Hulaskhera provides direct evidence of human adaptation to an evolving alluvial landscape.

Geologically, Hulaskhera is underlain by thick accumulations of Quaternary alluvium deposited by the fluvial systems of the Ganga Plain. These sediments comprise alternating layers of clay, silt, and fine sand that were deposited through repeated episodes of flooding,

overbank sedimentation, and channel migration. The alluvial deposits are generally unconsolidated and exhibit considerable lateral and vertical variability, reflecting changes in river dynamics and monsoonal hydrology. Archaeological excavations have exposed a well-preserved stratigraphic succession containing cultural horizons ranging from the Painted Grey Ware (PGW) culture through the Northern Black Polished Ware (NBPW) period to medieval occupational phases. These stratified deposits provide an important chronological framework for reconstructing settlement history and environmental conditions.

Structural and Geomorphological Setting

The archaeological remains occur on a slightly elevated mound rising above the surrounding floodplain. This elevation is the result of both natural and anthropogenic processes. Initially, the mound developed on a relatively stable fluvial surface created by alluvial deposition. Subsequently, centuries of human habitation, construction activities, refuse accumulation, and rebuilding generated an anthropogenic mound or settlement tell. Although no major tectonic structures are exposed at the site, the geomorphic setting reflects the influence of fluvial processes that shaped the surrounding landscape. Detailed micro-stratigraphic studies reveal multiple habitation levels separated by occupation surfaces, abandonment horizons, and sedimentary layers, indicating repeated phases of settlement expansion and modification.

Palaeontological and Palaeoenvironmental Significance

Unlike classical fossil-bearing localities, Hulaskhera derives its palaeoenvironmental significance primarily from archaeological and biological remains. Excavations have yielded pottery fragments, artefacts, charred plant remains, and faunal assemblages including domesticated cattle, buffalo, sheep, goats, and wild ungulates. These remains provide valuable information regarding subsistence strategies, agricultural practices, animal husbandry, and environmental conditions prevailing during different occupation phases. Such evidence helps reconstruct past vegetation patterns, land-use systems, and human interactions with the surrounding floodplain ecosystem.

Quaternary Geological Significance

From a Quaternary geological perspective, Hulaskhera represents a Late Holocene settlement established within the dynamic alluvial environment of the Central Ganga Plain. The site demonstrates how ancient communities adapted to fertile floodplain soils, abundant water resources, and favourable ecological conditions created by riverine processes. The archaeological stratigraphy, combined with alluvial sediment records, provides a unique archive for investigating human–environment interactions, climatic variability, and landscape evolution during the Late Quaternary. Consequently, Hulaskhera serves as an important link between geology, archaeology, and environmental history in the Middle Ganga Basin.

Karela Jheel (Wetland Lake): Geology, Palaeoecology and Quaternary Significance

Adjacent to Hulaskhera, Karela Jheel represents the remnant of a former floodplain lake that originated through fluvial processes such as channel abandonment, avulsion, or flood-basin

formation. It is located within the Gomti River floodplain. The lake sediments comprise finely laminated silts, clays, and organic-rich layers that act as repositories of palaeoenvironmental information. Pollen, phytoliths, diatoms, charcoal fragments, and geochemical indicators preserved within these sediments enable reconstruction of past vegetation patterns, hydrological fluctuations, and climatic conditions. Such palaeobotanical and palaeoecological records indicate significant environmental transformations associated with Holocene monsoon variability and increasing anthropogenic influence on the landscape. Detailed geological, palynological, and sedimentological investigations have demonstrated that Karela Jheel preserves a continuous record of environmental and climatic changes spanning the Late Pleistocene and Holocene periods. The lake sediments provide valuable evidence of monsoon variability, vegetation succession, human activities, and landscape evolution over the last ~17,000 years, making it an important natural laboratory for Quaternary research in the Ganga Basin.

Regional Geology and Stratigraphy

Karela Jheel occurs within the extensive alluvial tract of the Central Ganga Plain, a part of the Indo-Gangetic Foreland Basin. The basin is filled with thick Quaternary sediments derived primarily from the erosion of the Himalayan mountain system and transported by major river networks. The regional stratigraphy consists of alternating sequences of sand, silt, clay, and organic-rich deposits that reflect repeated cycles of river migration, flooding, and floodplain development.

Geomorphologically, Karela Jheel is interpreted as a shallow oxbow-type lake or abandoned floodplain depression formed as a consequence of channel migration and cut-off processes within the Gomti River system. Such features are common throughout the Ganga Plain where meandering rivers continuously modify their courses through erosion and deposition. Following abandonment, the isolated channel segment evolved into a lake and subsequently accumulated lacustrine sediments.

Sediment coring from Karela Jheel has revealed approximately 2.6 m thick stratified lacustrine deposits, providing a continuous sedimentary archive extending back to approximately 17,000 calibrated years BP. The sediments comprise finely laminated clays, silts, and organic-rich horizons deposited under relatively low-energy conditions. Variations in grain size, organic content, and sediment colour reflect changing hydrological regimes, vegetation cover, and climatic conditions through time.

Structural Characteristics

From a structural geological perspective, Karela Jheel lies within a relatively stable alluvial environment and exhibits no evidence of significant tectonic deformation. Unlike tectonic basins where sediment accumulation is controlled by faulting or crustal subsidence, the evolution of Karela Jheel is primarily governed by fluvial and climatic processes. The sediment profile exhibits distinct stratification characterized by alternating layers of clay,

silt, and organic matter. These layers record environmental oscillations associated with changes in monsoon intensity, water depth, sediment influx, and biological productivity. Fine laminations indicate prolonged periods of quiet lacustrine deposition, while occasional coarser layers suggest episodes of increased runoff and sediment transport. The well-preserved stratigraphy enables high-resolution reconstruction of palaeoenvironmental conditions and provides a chronological framework for understanding regional landscape evolution.

Palynology and Palaeoecological Reconstruction

One of the most important scientific contributions of Karela Jheel derives from its exceptionally preserved pollen record. Palynological analyses of sediment cores have yielded abundant pollen grains representing a wide range of arboreal, shrub, herbaceous, and cultivated taxa. These pollen assemblages serve as proxies for reconstructing past vegetation patterns and environmental conditions.

The pollen record includes taxa such as Holoptelea, Oroxylum, Madhuca indica, Acacia, and Cerealia, among numerous others. Together, these taxa document significant ecological transitions that occurred during the Late Pleistocene and Holocene. During the period between approximately 14,000 and 12,500 years BP, pollen assemblages indicate the predominance of open grassland and savanna-like vegetation. High frequencies of herbaceous taxa suggest relatively dry climatic conditions associated with the terminal stages of the Last Glacial Period. Reduced monsoon intensity likely limited forest development and promoted the expansion of grass-dominated landscapes across the region.

Subsequent climatic amelioration during the Early Holocene resulted in increased monsoon rainfall and the gradual expansion of woodland and forest communities. The appearance and increasing abundance of arboreal taxa such as Holoptelea and Oroxylum indicate the development of more humid conditions and enhanced vegetation cover. These changes correspond to the strengthening of the Indian Summer Monsoon following deglaciation.

By the Middle Holocene, the landscape became increasingly characterized by mixed deciduous forests interspersed with wetland vegetation. The presence of Madhuca indica, a species associated with moist tropical environments, reflects favourable climatic conditions and enhanced ecological productivity. Simultaneously, aquatic and marsh vegetation expanded around the lake margins, indicating higher water levels and sustained wetland development.

Quaternary Geology and Monsoon Variability

The sedimentary and palynological records from Karela Jheel provide a detailed reconstruction of Late Quaternary climatic variability in the Central Ganga Plain. The lake archive demonstrates that monsoon fluctuations exerted a primary control on hydrology, vegetation dynamics, and sedimentation patterns throughout the region.

A particularly significant phase occurred between approximately 4800 and 2000 years BP, when palynological evidence indicates widespread forest expansion and increased biomass productivity. This interval corresponds to a relatively humid climatic phase characterized by

strengthened monsoon circulation. Enhanced rainfall promoted the development of dense woodland vegetation, sustained lake levels, and increased organic matter accumulation within the basin.

The humid conditions of the Middle Holocene are reflected in high concentrations of arboreal pollen, increased aquatic vegetation, and organic-rich sediment layers. Such evidence suggests that the Central Ganga Plain experienced favourable environmental conditions capable of supporting diverse ecosystems and expanding human populations. After approximately 2000 years BP, however, the palaeoenvironmental record indicates a gradual decline in forest cover and an increase in anthropogenic indicators. Reduced frequencies of arboreal pollen accompanied by increasing herbaceous and cultivated taxa suggest progressive landscape modification. This transition likely reflects a combination of climatic drying and intensified human activities, including agriculture, forest clearance, and settlement expansion.

Evidence of Early Agriculture and Human Impact

One of the most remarkable aspects of the Karela Jheel record is the occurrence of Cerealia pollen, which provides direct evidence for agricultural activity in the region. The appearance and subsequent increase of cereal pollen indicate the establishment and expansion of cultivation practices during the Holocene.

The palaeoecological record demonstrates that human communities increasingly transformed natural vegetation through land clearance, cultivation, grazing, and resource exploitation. These anthropogenic influences became particularly pronounced during the Late Holocene when settlements expanded across the fertile floodplains of the Gomti Basin. The proximity of Karela Jheel to the Hulaskhera Archaeological Site further strengthens the interpretation that environmental changes and human activities were closely interconnected.

Significance for Quaternary Research

Karela Jheel represents one of the few high-resolution lacustrine archives available from the Middle Ganga Plain. Its continuous sedimentary sequence preserves a detailed record of environmental transformations spanning the Late Pleistocene–Holocene transition, the Holocene Climatic Optimum, and subsequent phases of human-induced landscape modification.

The integration of sedimentological, palynological, and chronological evidence demonstrates that the lake records major shifts in monsoon intensity, vegetation succession, wetland evolution, and agricultural development. Consequently, Karela Jheel serves as a critical archive for understanding the complex interactions among climate change, hydrological processes, ecosystem dynamics, and human societies in northern India.

In summary, Karela Jheel is not merely a floodplain wetland but a valuable Quaternary archive documenting nearly 17,000 years of environmental history. Its stratified lacustrine deposits provide compelling evidence of monsoon-driven climatic variability, forest expansion and decline, wetland evolution, and the emergence of agricultural landscapes, making it an

indispensable site for palaeoenvironmental and geoarchaeological investigations in the Central Ganga Plain.

Literature Review in the Middle Ganga Plain: Hulaskhera Archaeological

The Middle Ganga Plain (MGP) has attracted considerable scientific attention owing to its significance in Quaternary geology, fluvial geomorphology, archaeology, palaeoecology, and human settlement studies. Research conducted over the last few decades has demonstrated that the region preserves a rich archive of environmental and cultural evolution spanning the Late Pleistocene and Holocene. Studies by Singh (1996, 2009), Tewari (2004), Gibling et al. (2005), Sinha et al. (2005), Srivastava et al. (2017), Rajoriya et al. (2026) and numerous palaeoenvironmental investigations have highlighted the role of monsoon variability, river migration, sedimentation, and human adaptation in shaping the landscape of the Ganga Basin.

Geomorphological and sedimentological studies have focused primarily on the evolution of the Ganga and its tributaries, emphasizing the influence of climatic fluctuations and neotectonic activity on channel migration, floodplain development, and sediment accumulation. Research has revealed that the Middle Ganga Plain experienced repeated phases of aggradation and incision during the Quaternary, controlled largely by monsoon-driven hydrological changes. These studies have established the importance of abandoned channels, oxbow lakes, wetlands, and floodplain depressions as archives of environmental change.

Significant progress has also been made in the field of palaeoenvironmental reconstruction. Palynological and palaeobotanical investigations from lakes and wetlands of the Ganga Plain, particularly from Karela Jheel, have provided valuable records of vegetation history and monsoon variability during the last ~17,000 years. Pollen studies indicate transitions from Late Pleistocene grassland-dominated landscapes to Early and Mid- Holocene Forest expansion, followed by increasing anthropogenic influence during the Late Holocene. The occurrence of cereal pollen and anthropogenic indicators has provided evidence for the development of agriculture and land-use modifications in the region.

Archaeological investigations at Hulaskhera have revealed cultural sequences ranging from the Painted Grey Ware (PGW) to Northern Black Polished Ware (NBPW) periods and later historical occupations. Excavation reports and archaeological studies indicate that the site was strategically located near a palaeolake environment, reflecting the close relationship between settlement distribution and water availability. These findings support broader interpretations of human adaptation to floodplain environments in the Middle Ganga Basin.

Despite substantial progress, several important issues remain unresolved. First, there is a lack of integrated studies combining archaeology, geomorphology, sedimentology, and palaeoecology across the Hulaskhera–Karela Jheel. Most investigations have been conducted independently, limiting our understanding of coupled human–environment interactions. Second, high-resolution chronological frameworks based on radiocarbon dating and other geochronological techniques are still insufficient for many sedimentary and archaeological sequences. Third, the influence of neotectonic activity on floodplain evolution and settlement distribution remains poorly constrained. Fourth, the long-term impacts of human activities on wetland hydrology, biodiversity, and sedimentation require further investigation.

Finally, rapid urbanization around Lucknow, agricultural intensification, groundwater extraction, and wetland degradation pose serious threats to these archives. Future research should adopt a multidisciplinary approach integrating geospatial analysis, sedimentology, palynology, geoarchaeology, isotopic studies, and ecological monitoring. Such studies would significantly improve our understanding of Quaternary environmental change, monsoon dynamics, wetland evolution, and cultural adaptation within the Middle Ganga Plain and contribute to sustainable heritage and ecosystem management.

Field Transect

The Hulaskhera Archaeological Site is situated within the Middle Ganga Plain of Uttar Pradesh, India, a region characterized by extensive alluvial sedimentation, low-relief topography, and dynamic fluvial processes associated with the Ganga River system. Hulaskhera is located on the southeastern outskirts of Lucknow and represents an important archaeological locality preserving evidence of human occupation from the Neolithic to historical periods.

Geomorphologically, the site occur within the active alluvial tract of the Middle Ganga Plain, characterized by meander belts, oxbow lakes, flood basins, natural levees, and backswamp environments. The landscape has evolved under the influence of monsoon-controlled river discharge, avulsion, and periodic flooding. Hulaskhera occupies a slightly elevated floodplain surface suitable for long-term human settlement.

Sedimentologically, the deposits are dominated by alternating layers of clay, silty clay, silt, and fine sand, reflecting fluctuations in hydrological energy and depositional conditions. At Hulaskhera, archaeological horizons are interbedded with floodplain sediments, providing a valuable record of environmental and cultural evolution.

Chronological studies based on radiocarbon dating and archaeological evidence suggest that sediment accumulation in the region spans the Late Pleistocene to the Holocene, with many wetland archives preserving records of environmental changes during the last several millennia. Geochemically, the sediments are characterized by variations in total organic carbon (TOC), nitrogen, sulfur, stable isotopes ($\delta^{13}C$ and $\delta^{15}N$), and elemental composition, reflecting changes in vegetation, productivity, redox conditions, monsoon intensity, and anthropogenic influence. Together, these archives provide a robust framework for reconstructing Holocene palaeoenvironmental evolution, hydroecological dynamics, and human–environment interactions in the Middle Ganga Plain.



Google image of Hulaskhera Archaeological site



Location map of Hulaskhera Archaeological site and Karela Lake (Jheel)

Geoheritage, UNESCO Heritage, Archaeological Sites, Cuisine, and Culture - Hulaskhera Archaeological Site

The Hulaskhera Archaeological Site is located within the culturally and geologically significant Middle Ganga Plain of Uttar Pradesh. This region preserves a remarkable combination of geoheritage, archaeological heritage, biodiversity, and living cultural traditions that reflect thousands of years of interaction between humans and the dynamic floodplain environment.

From a geoheritage perspective, the area forms part of the vast Indo-Gangetic foreland basin, one of the world's largest alluvial plains. The landscape is characterized by meandering river systems, abandoned channels, oxbow lakes, flood basins, natural levees, and wetlands formed through Quaternary fluvial processes.

Although no UNESCO World Heritage Site is located directly at Hulaskhera several internationally significant heritage sites occur within the broader region. The nearest UNESCO World Heritage property is Agra Fort and Taj Mahal, while the sacred city of Varanasi has long been considered for UNESCO recognition because of its exceptional cultural and religious importance. The Ganga Plain itself is recognized globally for its archaeological richness and long history of human occupation.

Hulaskhera is among the important archaeological sites of the Lucknow region and has yielded evidence of continuous human habitation from the Neolithic, Chalcolithic, Early Historic, and Medieval periods. Excavations have revealed pottery, structural remains, terracotta objects, iron artefacts, beads, and cultural deposits that document the transition from early agricultural communities to more complex settlements. Nearby archaeological localities include Lakshman Tila, which is associated with the ancient origins of Lucknow, and Kaushambi Archaeological Site, one of the major urban centres of ancient northern India. The broader Middle Ganga Plain also contains significant archaeological sites such as Sravasti and Sankisa, which are closely linked with Buddhist history.

The cultural landscape surrounding Hulaskhera reflects the rich heritage of the Awadh (Oudh) region. The culture is characterized by a blend of Hindu, Islamic, and local folk traditions expressed through language, music, dance, festivals, crafts, and architecture. Visitors can experience authentic Awadhi cuisine, renowned worldwide for slow-cooking techniques and rich flavors.

Famous local dishes include:

- Galouti Kebab
- Kakori Kebab
- Tunday Kebab
- Shami Kebab
- Awadhi Biryani
- Nihari-Kulcha
- Sheermal
- Roomali Roti
- Kulfi Falooda
- Malai Gilori

Street-food culture around the park is equally vibrant, offering chai, bun makkhan, pav bhaji, chaat, momos, ramen, and fusion snacks popular among students and families. Vegetarian foods such as poori-sabzi, kachori, seasonal vegetables, and traditional sweets including peda, jalebi, and revri are also widely consumed. Local agricultural products, especially wheat, rice, pulses, and sugarcane, continue to support the rural economy and shape regional food habits.

Local Conveniences

1. Medical Facilities and Emergency Care

Around Hulaskhera Archaeological Site and Karela Jheel (Lucknow Region)

The Hulaskhera archaeological site lies in the southern part of Lucknow near Mohanlalganj. In case of medical emergencies, the following hospitals provide reliable healthcare facilities:

- Medanta Super Speciality Hospital, Lucknow – A major tertiary-care hospital with emergency, trauma, cardiology, neurology, and critical-care services.
- Apollo Medics Super Speciality Hospitals – Well-equipped multispecialty hospital located on Kanpur Road with 24-hour emergency services.
- Max Super Speciality Hospital Lucknow – Advanced healthcare facility in Gomti Nagar for specialist consultations and emergency care.
- Avadh Hospital Lucknow – Easily accessible hospital for general medical emergencies.

2. Assistance in Case of a Lost or Stolen Passport

For international visitors:

1. Immediately report the loss at the nearest police station and obtain a First Information Report (FIR).

2. Contact your embassy or consulate in New Delhi or the nearest diplomatic mission.
3. Visit the nearest Passport Seva Kendra (PSK) in Lucknow for documentation support.
4. Keep digital copies of your passport, visa, travel insurance, and identity documentsbefore the excursion.

Important emergency numbers in India:

- Police: 112
- Ambulance: 108
- Tourist Helpline: 1363 or 1800-11-1363

3. Markets and Shopping Areas

Near Hulaskhera and Karela Jheel

For daily necessities, snacks, stationery, and field supplies, participants may visit nearby markets in Lucknow city:

- Aminabad Market – One of Lucknow's oldest bazaars, known for clothing, handicrafts, footwear, and local cuisine.
- Patrakarpuram Market – Popular commercial hub offering restaurants, pharmacies, ATMs, and convenience stores.
- Janpath Market – Good for souvenirs, handicrafts, books, and local products.
- Nakhaas Market – Traditional market famous for local merchandise and cultural ambience.

Conclusions

The Middle Ganga Plain represents one of the most significant Quaternary landscapes of the Indian subcontinent, where interactions among climate, fluvial dynamics, ecology, and human societies have shaped the environment over thousands of years. The combined study of the Hulaskhera Archaeological Site, and Karela Lake, provides a comprehensive understanding of the region's geological evolution, palaeoenvironmental history, biodiversity, and cultural development.

Hulaskhera Archaeological Site illustrates the close relationship between early human settlements and the fertile floodplains of the Ganga basin. Its archaeological remains demonstrate how ancient communities utilized the abundant water resources, fertile alluvial soils, and favourable environmental conditions created by the dynamic river systems of the Middle Ganga Plain. The site therefore serves as an important archive for understanding human adaptation to changing landscapes during the Late Holocene.

Karela Lake represents a valuable natural laboratory for reconstructing past environmental and climatic changes. As an oxbow-type floodplain lake formed through channel migration of the Gomti River system, it preserves sedimentary records that document fluctuations in monsoon intensity, hydrological conditions, vegetation, and sediment supply since the Late Pleistocene. Multi-proxy studies from such wetlands contribute significantly to regional palaeoclimatic and palaeoecological reconstructions.

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Annexure

Field Excursion Guidelines: Do's and Don'ts

To ensure the safety of all participants and to promote responsible scientific field practices, all participants are requested to adhere to the following guidelines throughout the field excursions.

Keep a valid passport (for international participants) or a government-issued photo ID (for Indian participants) with you at all times during the field excursion.

Do's	Don'ts
1. Follow the instructions of the excursion leaders, coordinators, and local authorities at all times. 2. Remain with the group and inform the excursion leader before leaving the designated route. 3. Wear appropriate field attire, including sturdy closed-toe footwear, full-length trousers, a hat or cap, and weather-appropriate clothing. 4. Carry sufficient drinking water, personal medications, sunscreen, insect repellent, and other essential field supplies. 5. Keep a valid photo identification and your excursion registration details with you during travel. 6. Respect local customs, religious sites, cultural heritage, and private property. 7. Follow the Leave No Trace principles by carrying back all waste and helping to keep field sites clean. 8. Use designated trails and approved observation areas to minimise environmental disturbance. 9. Observe geological, ecological, archaeological, and cultural features carefully without causing any damage.	1. Do not collect rocks, fossils, archaeological artefacts, biological specimens, or any other materials without prior authorization. 2. Do not damage, deface, or remove material from geological outcrops, caves, monuments, heritage structures, or other natural features. 3. Do not wander alone or separate from the excursion group without informing the field leaders. 4. Do not climb unstable slopes, cliffs, rock formations, or enter hazardous areas unless specifically instructed or supervised. 5. Do not swim or enter rivers, lakes, lagoons, or coastal waters unless expressly authorized by the excursion leaders. 6. Do not consume alcohol, recreational drugs, or engage in unsafe or irresponsible behaviour during the excursion. 7. Do not operate drones or other restricted equipment without obtaining the necessary permissions. 8. Do not photograph restricted installations, sensitive locations, or local residents without prior permission.

10. Record field observations systematically and collect samples only with prior permission from the excursion leaders and the relevant authorities.

11. Exercise caution near cliffs, riverbanks, caves, unstable slopes, road cuts, and other potentially hazardous terrain.

12. Respect wildlife by maintaining a safe distance from animals, birds, reptiles, insects, and their habitats.

13. Immediately report any illness, injury, emergency, or hazardous situation to the excursion organizers.

14. Be prepared for changing weather conditions and comply with all safety advisories issued by the excursion leaders.

9. Do not create excessive noise or disturb local communities, religious activities, wildlife, or natural habitats.

10. Do not leave valuables unattended or rely solely on mobile phone connectivity in remote areas.

11. Do not undertake any activity that may compromise your safety, the safety of fellow participants, or the conservation of the area's geological, ecological, archaeological, or cultural heritage.

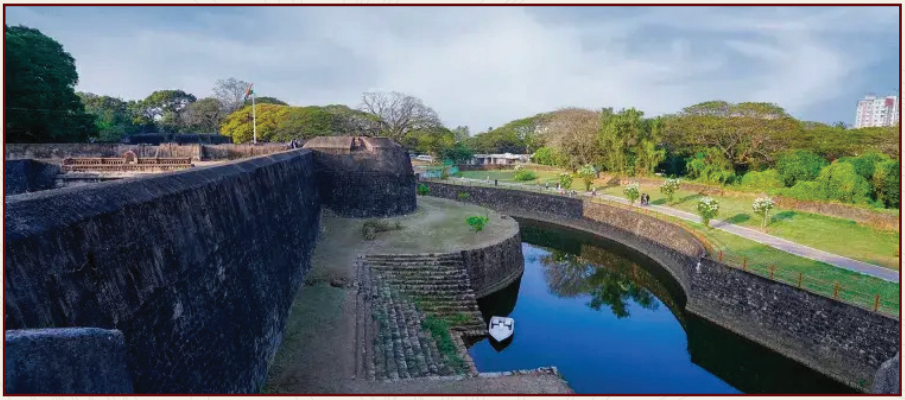
Disclaimer

Participation in the field excursions is entirely at the participant's own risk. While the Organising Committee and excursion leaders will make every reasonable effort to ensure participant safety and provide appropriate guidance, they shall not be held responsible for any personal injury, illness, loss of personal belongings, property damage, delays, or unforeseen incidents arising during travel or field activities. Participants are expected to act responsibly, follow all instructions issued by the excursion leaders, and comply with applicable local laws and regulations throughout the excursion.

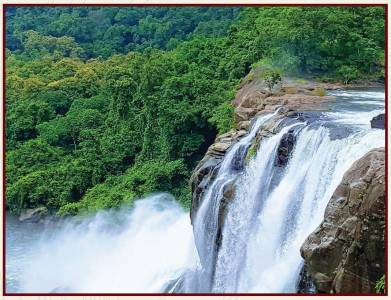












Scan for
Field Guide Book

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