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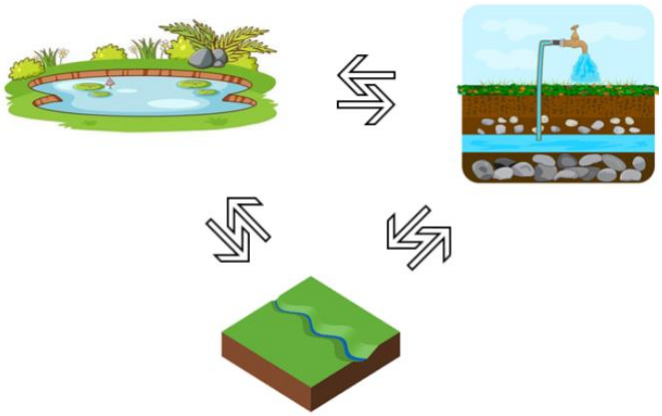

Project Title: Reinventing the Lost Trilogy of Ponds, Natural Drains and Groundwater with Focus on Shekha Jheel: A Case Study of Aligarh

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Declaration

This is to declare that the Thesis report titled "REINVENTING THE LOST TRILOGY OF PONDS, NATURAL DRAINS AND GROUND WATER WITH FOCUS ON SHEKHA JHEEL: A CASE STUDY OF ALIGARH" has been undertaken by the author in partial fulfillment of the requirement for Student Thesis Competition (STC) Season-2 Submission. The author has duly acknowledged all material and sources used in the report. The similarity level for the entire report is less than 10% as per the plagiarism checker X software. The research work undertaken is original and authentic.

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Disclaimer

This study is based on information gathered by Pranav Varshney from local organizations in Aligarh, secondary sources, and information found in state and Central government publications as of June 2022. All effort has been made to ensure the correctness of data. However, Pranav Varshney or SPA- New Delhi or Team NIUA/ NMCG does not guarantee the accuracy of the data or accept responsibility for the consequences of using this data.

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Abstract

Globally, the hydrological cycle in the urban areas is experiencing disruption and changes owing to factors such as increase in impervious surface, blocking and re- routing of drainage channels etc. Aligarh, a city located in the Ganga-Yamuna fertile doab plains, in the state of Uttar Pradesh is no different. Ironically, a city once selected by Sir Syed Ahmed Khan for establishing Aligarh Muslim University because of its 'aab-o-hawa' is suffering owing to depletion and degradation of water resources due to rampant urbanization. The need of the study arose from the dismal condition of the waterbodies and the disconnectedness between surface water and groundwater that is leading to an unhealthy environment in the city.

The major aim of the present study was to formulate strategies for reinventing the lost trilogy of ponds, natural drains, and groundwater. Study of district characteristics and assessment of water bodies and groundwater while identifying the issues and prioritizing water bodies were the broad objectives of the study. A detailed methodology was prepared for achieving the objectives. Extensive review of literature was undertaken for hydrology of the Doab area, especially for the study area. Further, in addition to the district analysis, a detailed and thorough study was carried out by preparing a baseline and analysing the various aspects such as environmental resources, demography, land use, Master Plan, physical infrastructure and industries in the city area.

As part of the baseline, a detailed inventory of ponds and natural drains within the municipal area was undertaken and certain ponds and natural drain stretches were identified on the basis of selected indicators, for which further detailed analysis was done with respect to the waterbody and its watershed. A similar exercise was done for Shekha jheel. It is evident that the impact of anthropogenic activities has been detrimental for the waterbodies and interventions for protection and conservation have to be taken up immediately.

Based on the analysis, proposals were worked out across all the spatial levels with focus on spatial planning and environmental planning approach and management.

सारांश

विश्व स्तर पर, शहरी क्षेत्रों को अभेद्य सतह में वृद्धि, जल निकासी चैनलों के अवरुद्ध और पुन: मार्ग आदि। के वजह से, जल विज्ञान चक्र में व्यवधान और परिवर्तन का सामना करना पड़ रहा है। अलीगढ़, उत्तर प्रदेश राज्य में गंगा-यमुना उपजाऊ दोआब मैदानों में स्थित एक शहर, भी इस परिवर्तन से अछूता नहीं है। विडंबना यह है कि एक बार सर सैयद अहमद खान द्वारा अलीगढ़ मुस्लिम विश्वविद्यालय की स्थापना के लिए अपने 'आबो-हवा' के कारण चुना गया शहर बड़े पैमाने पर शहरीकरण के कारण जल संसाधनों की कमी और गिरावट के कारण पीड़ित है। अध्ययन की आवश्यकता जलाशयों की दयनीय स्थिति और सतही जल और भूजल के बीच के संबंध का ना होना, से उत्पन्न हुई है, जो शहर को एक अस्वास्थ्य वातावरण की ओर ले जा रही है। वर्तमान अध्ययन का प्रमुख उद्देश्य तालाबों, प्राकृतिक बहाव/ नालों और भूमिगत जल के खोये हुए त्रित्व को फिर से खोजने के लिए रणनीति तैयार करना था। कारण /मुद्दों की पहचान करते हुए और जल निकायों को प्राथमिकता देते हुए, जिला विशेषताओं का अध्ययन और चित्रण और जल निकायों और भूजल का आकलन, अध्ययन के व्यापक उद्देश्य थे। उद्देश्यों को प्राप्त करने के लिए एक विस्तृत कार्यप्रणाली तैयार की गई थी। दोआब क्षेत्र के जल विज्ञान के लिए विशेष रूप से अध्ययन क्षेत्र के लिए साहित्य की व्यापक समीक्षा की गई। इसके अलावा, जिला विश्लेषण के अलावा, शहरी क्षेत्र में पर्यावरण संसाधनों, जनसांख्यिकी, भूमि उपयोग, मास्टर प्लान, भौतिक बुनियादी ढांचे और उद्योगों जैसे विभिन्न पहलुओं का आधार रेखा तैयार करके और विश्लेषण करके एक विस्तृत और गहन अध्ययन किया गया था। आधार रेखा के हिस्से के रूप में, नगरपालिका क्षेत्र के भीतर तालाबों और प्राकृतिक नालियों की एक विस्तृत सूची बनाई गई थी और कुछ तालाबों और प्राकृतिक नाले के हिस्सों की पहचान चयनित संकेतकों के आधार पर की गई थी, जिसके लिए जल निकाय और इसके जलक्षेत्र के संबंध में और विस्तृत विश्लेषण किया गया था। ऐसा ही अभ्यास शेखा झील के लिए भी किया गया था। यह स्पष्ट है कि मानवजनित गतिविधियों का प्रभाव जल निकायों के लिए हानिकारक रहा है और संरक्षण और संरक्षण के लिए हस्तक्षेप तुरंत किया जाना चाहिए।

विश्लेषण के आधार पर, स्थानिक योजना और पर्यावरण नियोजन दृष्टिकोण और प्रबंधन पर ध्यान देने के साथ सभी स्थानिक स्तरों पर प्रस्तावों पर काम किया गया था।

Table of Contents

List of Figures

List of Tables

List of Charts

List of Maps

List of Abbreviations

AMU :Aligarh Muslim University
CGWB:Central Ground Water Board
IUCN : International Union for Conservation of Nature
IUWM : Integrated Urban Water Management
IWRM : Integrated Water Resources Management

ODF : Open Defecation Free
SBM : Swachh Bharat Mission
SDG : Sustainable Develeopment Goals
SUDS : Sustainable urban drainage systems
UPPCB : Uttar Pradesh Pollution Control Board
UPSAPCC : Uttar Pradesh State Action Plan on Climate Change

1

INTRODUCTION

1 Introduction

"Environment" includes water, air and land and the inter relationship which exists among and between water, air and land, and human beings, other living creatures, plants, micro-organism and property as per the environment (protection) act, 1986. Here, each component has their own identity however, Water has an important role in our lives. In earth, Water can be found in different sources and in different forms. In the 19th Century, the great English poet Coleridge wrote, 'Water, water, everywhere, nor any drop to drink'. In the present times, the lines could be rewritten as 'water, water, nowhere, nor any drop to drink'. With respect to Surface water, Water bodies have various diverse functions which include domestic purpose, wastewater dilution, provisioning of ecological services, supports biodiversity, and temperature regulation and it also includes the various values within it like the recreational value and aesthetic value.

1.1 Need of the Study

With rapid urbanisation, there has been an increase in the pressure on the existing water systems with respect to resource extraction and pollution. Ground Water level decreased more than 4 m from 2011 to 2020 in Aligarh district. As per CGWB Report 2017, First Aquifer Group partly saline and Second Aquifer Group Brackish to Saline. Out of 12 blocks, 1 block is critical 5 blocks are in semi critical Category in Aligarh district. Stage of ground water extraction is 72.5% in Aligarh. In city area higher nitrate concentration is more common. It may be due to seepage of sewage into ground water. As per the Block wise Ground water resource assessment 2020, Aligarh city is in the "over exploited" Category. There are no monitoring stations in these water bodies as per UPPCB officials. Ponds and natural drains show solid waste disposal sites and water hyacinth in major area of the water bodies. There is Increasing dependency of Ground Water for Irrigation in 2 blocks of the region. As per the Smart City Proposal Stage 2 report 2017, the city administration also admits the weakness in rejuvenation of water bodies. They are poorly maintained and some have become more of a nuisance value rather than a place for recreation, family gathering and rejuvenation and threats is dependance on Ground water.

1.2 Aims and Objectives

1.2.1 Aim

Formulation of strategies for reinventing the lost trilogy of Ponds, Natural drains and Ground Water for Aligarh city and Shekha Jheel.

1.2.2 Objectives

1 To assess status of water bodies and Groundwater and analyses inter-relationship with people and activity
2 To identify issues and potential and prioritise waterbodies & natural drains for conservation.
3 To prepare a plan for developing a connect between people and waterbodies.
4 To reinvent the lost trilogy by rejuvenation of water bodies and sustainable use of groundwater.

1.3 Methodology

Analysis & Assessment of ponds/drains & Ground water

- Understanding of Area with respect to Aligarh district and the city.
- Mapping of various ponds/ drains from various sources.
- Inventory of ponds/drains
- Ground water assessment
- Assessment of Tourists & Resident Perception
- Governance structure and schemes overview.

Identification And Prioritization

- Identification of ponds/ drains (Prioritization)
- Identification of Ecosystem services
- Issues identification.
- Land identification for GW recharge.
- To carry out Water Quality assessment of selected ponds and Ground water sites.

Connect

- Interaction/ Incorporation of View points from major stakeholders, NGOs and the people of Aligarh and Shekha Jheel's nearby areas.
- Public meeting or Mohalla meeting
- Pani sanrakhshan Samvaad (पानी संरक्षण संवाद)
- Cleanup Drives

Strategies & Proposals

- Strategies for Rejuvenation of Ponds and Natural drains
- Proposals for Sustainable use of Ground water
- Design interventions for Prioritized ponds and drains and Shekha jheel & Surrounding area(Modified watershed)
- Action plan
- Master plan interventions.

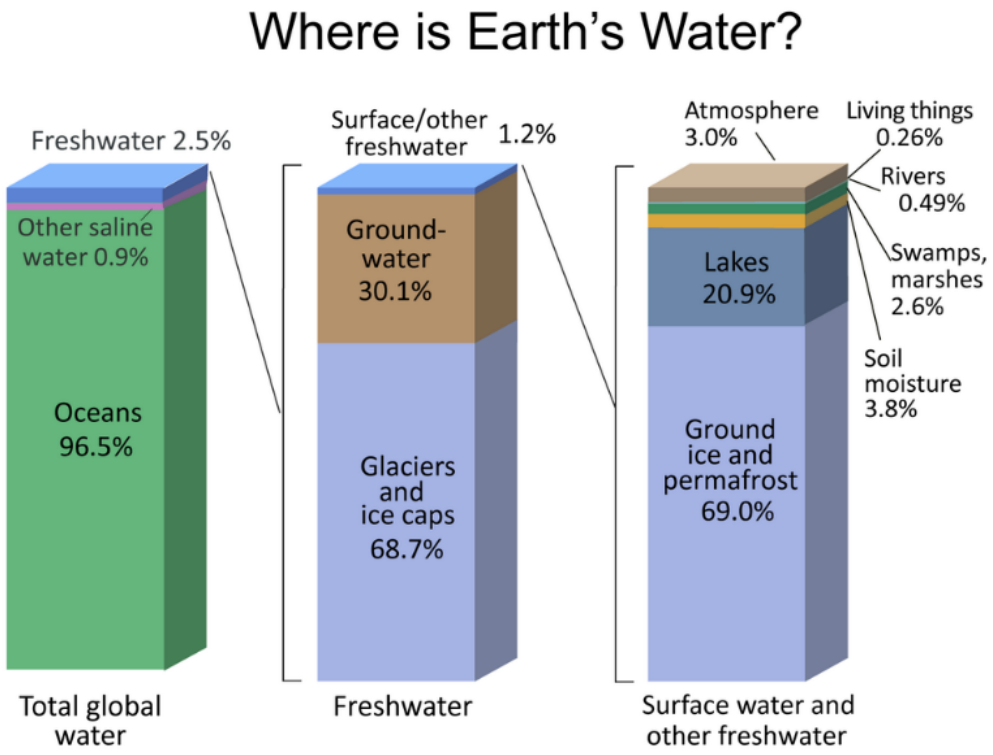
1.4 Scope and Limitation

Primary survey and field visit was restricted in Shekha Jheel area due to absence of permission from Chief Wildlife Warden Officer Uttar Pradesh.

1.5 Basic understanding of Water resources and their management

Water covers more than two thirds of the planet, but readily accessible freshwater – which is found in rivers, lakes, wetlands and aquifers – accounts for less than one per cent of the world's water supply. In the development field, Water is an important source and touches every aspect of it and it also has a relation with nearly every Sustainable Development Goal (SDG) directly or indirectly.

Figure 1-1 Earth's Water resources



Credit: U.S. Geological Survey, Water Science School. https://www.usgs.gov/special-topic/water-science-school
Data source: Igor Shiklomanov's chapter "World fresh water resources" in Peter H. Gleick (editor), 1993, Water in Crisis: A Guide to the World's Fresh Water Resources. (Numbers are rounded).

Source 1-1 (USGS, 2022)

There are various approaches for sustainable water management. Some of them are described below-

1.5.1 IWRM

Integrated Water Resources Management (IWRM) is a process which promotes the coordinated development and management of water, land and related resources in order to maximize economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems and the environment. (Global Water Partnership, 2022)

Because of this, IWRM is not a prescriptive definition of how water should be managed, but rather a wide framework that allows decision-makers to jointly determine the objectives of water management and coordinate the use of various tools to achieve those objectives. There is no one set model for IWRM because each country has a unique history, socioeconomic situation, cultural context, political background, and environmental qualities. Instead, IWRM can be tailored to address the issues faced in each local setting. Because of this, the objectives of IWRM range from country to country and the significance of economic, environmental, and social repercussions varies.

1.5.2 IUWM

IUWM approach broadly means managing freshwater, wastewater, and storm water as components of a basin-wide plan in an urban area. For developing countries like India, issues of universal access to water, assured water quality, safe sanitation, and strong governance gain prominence. There are 5 stages in IUWM process

1. Preparatory phase
2. Foundation phase
3. Planning and Design phase
4. Implementation phase
5. Operation and Maintenance phase

1.5.3 SUDS

Sustainable urban drainage systems (SUDS) are systems designed to efficiently manage the drainage of surface water in the urban environment. Sustainable urban drainage systems can provide an alternative to, or addition to, traditional drainage systems where surface water is drained directly and quickly into underground, piped drainage. As population has increased, particularly in urban areas, and 'soft', permeable landscape has been replaced with hard surfaces, surface water runoff has reached traditional piped drainage faster and in larger quantities. This has been exacerbated by the loss of rural features that might once have slowed the passage of surface water, being replaced with large, intensively farmed fields that rapidly discharge surface water into piped drainage or waterways that make their way into urban areas. The result has been higher peak flows resulting in serious flooding of urban areas, pollution, damage to habitat and contamination of groundwater sources. (Designing buildings, 2022)

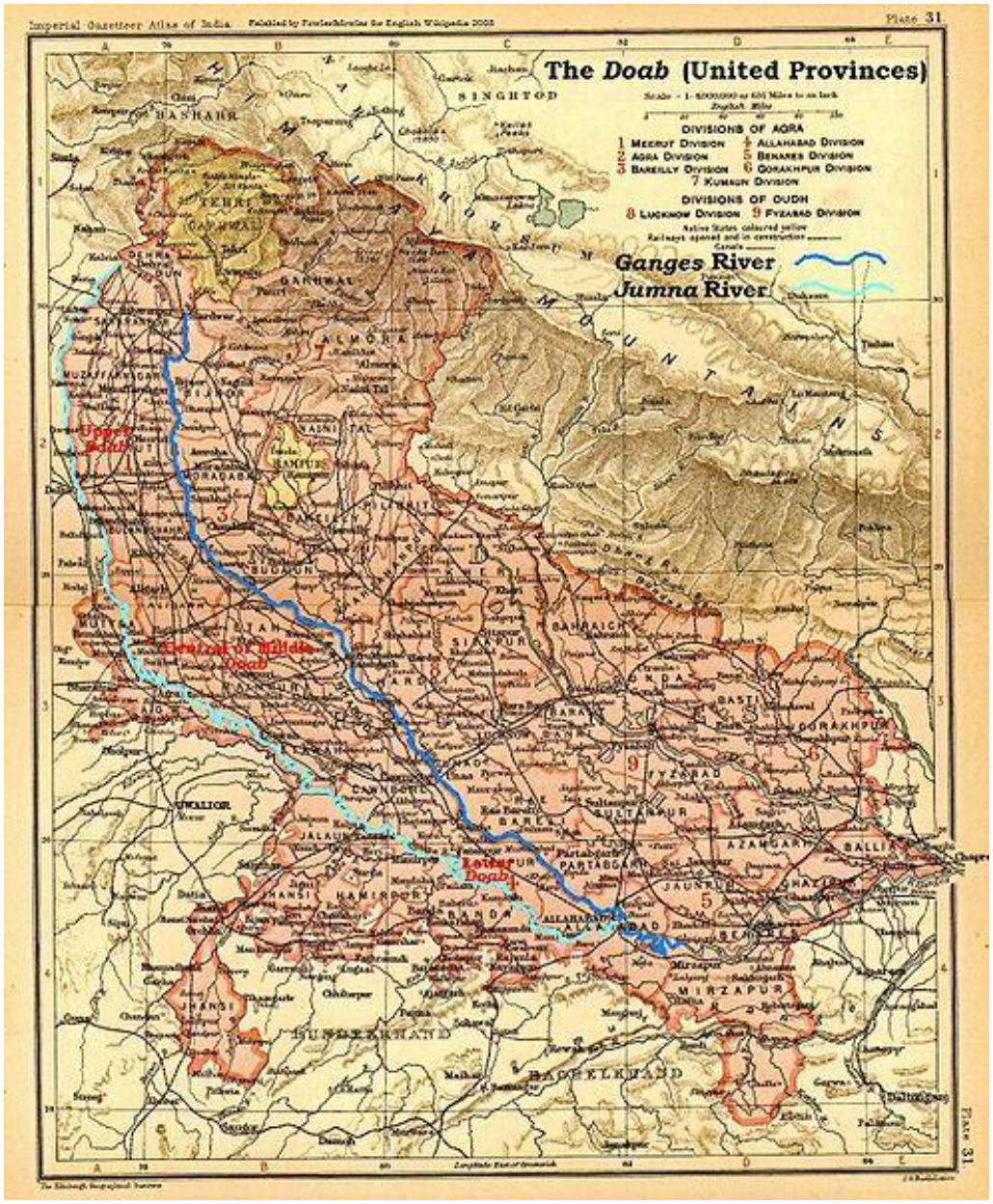
1.5.4 Sponge City

The Sponge City indicates a particular type of city that does not act like an impermeable system not allowing any water to filter through the ground, but, more like a sponge, actually absorbs the rain water, which is then naturally filtered by the soil and allowed to reach into the urban aquifers. This allows for the extraction of water from the ground through urban or peri-urban wells. This water can be easily treated and used for the city water supply. (World Future Council, 2022)

1.5.5 The hydrological and hydraulic history of Ganga Yamuna doab

Western Uttar Pradesh with the National Capital Territory has been blessed to be located in the doab of the holy *River Ganga and River Yamuna*.

Map 1-1 The Ganga Yamuna Doab



Source 1-2 Imperial Gazetteer of India Oxford University Press, 1908

This region famous as one of the most fertile regions in the world has always been blessed with immense natural resources and a green cover all over. The region has over half a dozen rivers flowing through it and rich with over a lakh-small and big water sources. But the recent past has seen these sources extensively being polluted. (India Water portal, 2022).

The main characteristics of doab are

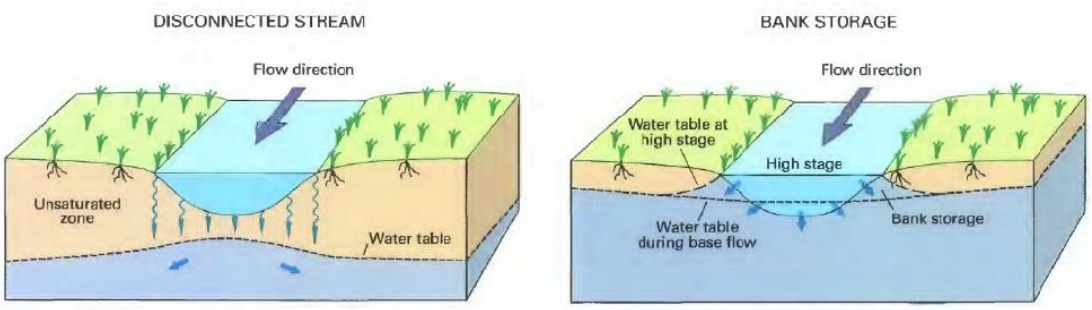
- Doab: Area between two rivers.
- Largest doab of India.
- High Ground water table.
- Flat surface and fertile soil.
- Good connectivity
- Flooding and Drought prone area
- Dependance on surface water

The doab has lots of activities and industrial areas due to this. Common Water tables can drop and water loss from an area can occur in situations of changing land use in urban areas. Very little surface runoff can be anticipated in a rural location with soil that has high soil storage capacity and rapid penetration rates. Thus, when paved areas grow, surface water bodies tend to fill up more quickly. Untreated sewage from homes, industry and agriculture eventually flows into the river. Unauthorized colonies and slum settlements along the banks of the river limit the natural flow and flow of the drains/ river. Water is taken for a variety of purposes, regardless of the flow of the river's environment. There is almost negligible recycling or reuse of water in various settlement in the doab area. Improper waste management increases the level of pollution in waterbodies/ rivers.

1.6 The concept of Trilogy/Interconnectedness

Although there is frequently a hydraulic connection between surface and ground water, it is challenging to monitor and quantify these interactions. In order to transport water from places of recharge to areas of release, ground water travels through flow channels with variable lengths. There are three main ways that streams interact with ground water-either they gain water by receiving inflow from the ground through the streambed (a gaining stream), lose water to the ground by losing it through the streambed (a losing stream), or they do both, gaining in some places and losing in others. (USGS, 2022)

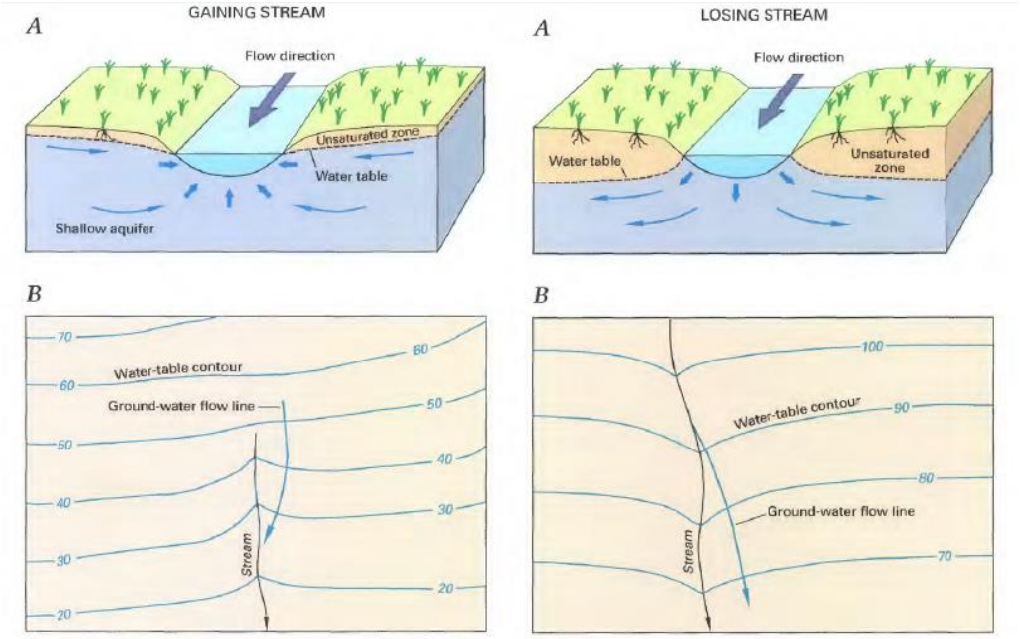
Figure 1-2 Interaction and Disconnection impacts



Source 1-3 Ground Water and Surface Water: A Single Resource (USGS, 2022)

Unsaturated zone divides disconnected streams from the groundwater system. Stream water travels into the streambanks as bank storage if stream levels increase faster than nearby ground-water levels.

Figure 1-3 Gaining Streams and Losing Streams from/to the ground water system



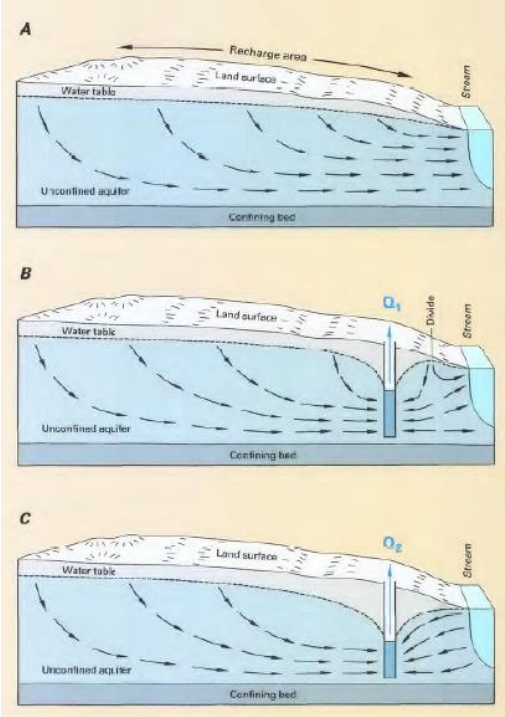
Source 1-4 Ground Water and Surface Water: A Single Resource (USGS, 2022)

In a schematic hydrologic setting where ground water discharges to a stream under natural conditions (A), placement of a well pumping at a rate (Qi) near the stream will intercept part of the ground water that would have discharged to the stream (B). If the well is pumped at an even greater rate (Q2), it can intercept additional water that would have discharged to the stream in the vicinity of the well and can draw water from the stream to the well (C).

The surface water can receive ground-water inflow as depicted in (A), lose water as seepage to ground water (B), or both (C). The type of geologic materials presents and the amount of time water spends in touch with those materials are two important factors that affect the chemistry of the water in drainage basins. A significant conduit for chemical transfer between

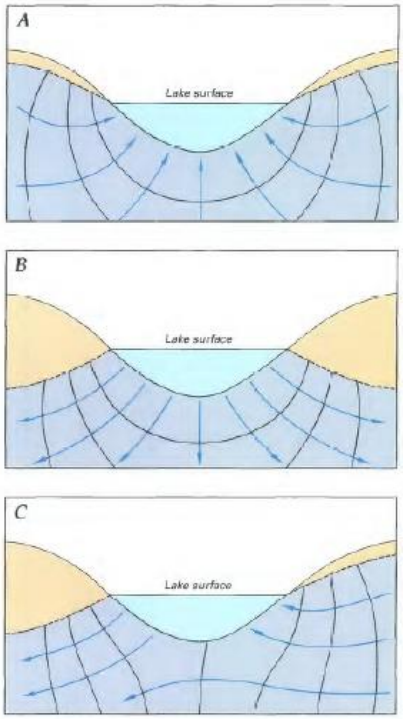
terrestrial and aquatic systems is provided by water flow between groundwater and surface water.

Figure 1-4 Behavior of abstraction of ground water and impacts on Ground water flow



Source 1-5 Ground Water and Surface Water: A Single Resource (USGS, 2022)

Figure 1-5 Surface water interaction with GW



Source 1-6 Ground Water and Surface Water: A Single Resource (USGS, 2022)

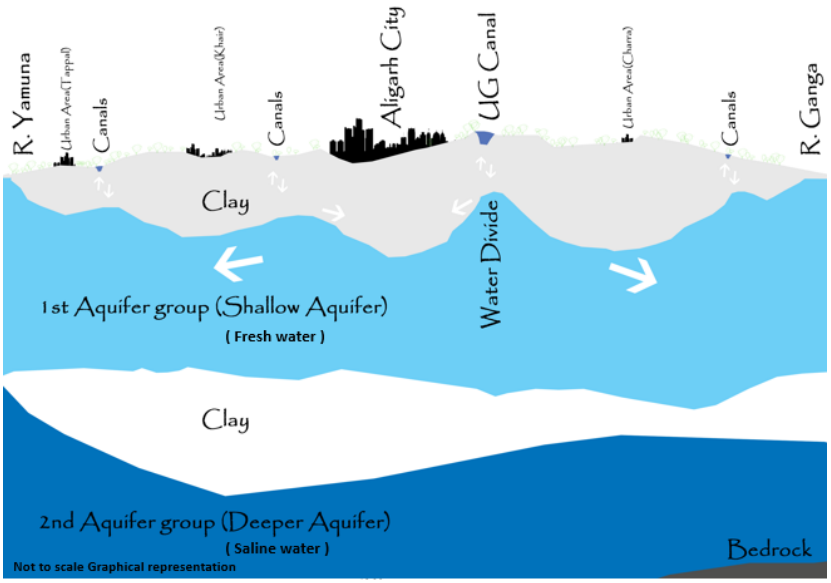
The position of lakes/ wetlands in relation to local and regional ground-water flow systems greatly influences their hydrological and chemical features in glacial and dune environments. Where streams naturally seep into the ground, where ground-water withdrawals generate seepage from the stream, and where floods cause stream water to become bank storage, contaminants in streams can easily alter the quality of ground-water. The relationship between surface water and ground water is crucial for evaluating how vulnerable a surface water body is to acidic precipitation. That is why, Understanding the function of riparian zones and how ground water and surface water interact is necessary for effective management of water resources. (USGS, 2022)

1.7 Water resources in Aligarh: A historical Perspective

Koil (Aligarh historical name) was described by Ibn Battuta as "a lovely town surrounded by mango groves." The name Sabzabad, which means "the green country," appears to have been given to Koil's environment from these similar groves. Jahangir also makes a point of referencing the Koil forest, where he killed wolves. The natural drainage was then hindered by different canal distributaries that cross the drainage lines; as a result, the water remained stagnant for a long time, causing fever and illness. The district's huge jhils and dhak jungle encompassed a sizable portion of the territory. Given the extent of the district, there could never have been any jhil at all, even though the largest of the jhils are now small. The area must have been extremely well-cultivated over a lengthy period of time. (Final report on the Revision of Settlement in the district of Aligarh, 1982).

Clay soil, poor natural drainage, and numerous jhils—areas where surface water pools but cannot find a suitable outlet—define this tract. There were no significant intentional or natural surface disparities in the district. The Sengur Nadi had a breath of about 12.1 m and a depth of about 1.2 m during the rainy season, and its banks were sloping in its soft, clayey bottom. River karon /karwan's area is approximately 8.8m wide and 1.5m deep when it was raining. The Choiyya Nadi had a width of around 51.8m and when it rains, it widens to 2.4m. The history also included information on the ferries and ghats in the districts, which in 1820 generated a net income of around 7,673. But there were no ferries at the time, in 1875. The few jhils and natural water reservoirs were restricted to the depressions in the highest level of the district because the majority of the surface is dry. The canal authorities have drained some of these, and steps were being initiated to train the remaining ones. There were additional decently sizable jhils in Gopi Bhavan Garhi, sheikha, Ikri, and Gursikaran in Koil in addition to the other adhawan jhil. There were several jhils in Barauli Pargana in the Aligarh as well. In 1885, Only 4.8m to 5.4m of water are submerged in the district's interior. However, the water is not particularly close to the surface in either the canal or one of the rivers. Around 5676 acres or almost 22.9 sq km were devoted to mango gardens and other fruit trees in 1875. Nim, mango, jaman, pipal, babool, Mahua, Faras, and ber are the main plantation plants. In August 1869, Dr. Whitwell examined the water in the prison, the railroad station, and other places. It was the sixth analysis report for drinkable water from 1870. Where he mentioned that it would be ideal to provide the entire population with water from the Ganga Canal because it seemed to be free of any contaminants. Additionally, sewage matter had contaminated every sample that was taken in the city area. The area around the fort in north

part of the city was scattered with marshes and shallow water that swell up so much during the rains that they made the area inaccessible and, therefore, secure against attack during that time of year. The fort became utterly inaccessible during the rainy months and no military operation could be conducted against it due to the elevated level on which it was situated being intermingled with enormous swamps and deep morasses. The 9.7m deep and 0.3m to 30.4 m wide ditches, in which there was always 3m of water. (Atkinson, 1875)



Earlier there were areas in north eastern part of the city which holds good amount of water and also gave rise to the growth of deep morass but eventually the Aligarh drain came in to existence through which the hydrological character got changed. For the aim of collecting rainwater and using it for drinking, villagers used to build ponds. Now it serves as landfills for solid waste. Ground water replaced ponds and rivers as a primary source of irrigation. (Siddiqi, 1981)

1.8 The Study in context of Reimagining Urban Rivers and STC-Season 2

On August 12, 2011, the National Mission for Clean Ganga (NMCG) registered as a society under the Societies Registration Act of 1860. It served as the National Ganga River Basin Authority's (NGRBA's) implementation arm and was established in accordance with the 1986 Environment (Protection) Act (EPA). Since the formation of the National Council for Rejuvenation, Protection, and Management of River Ganga on October 7, 2016, NGRBA has been abolished (referred as National Ganga Council). The National Ganga River Basin Authority (NGRBA) has two mandates that must be carried out by NMCG: 1. To ensure effective pollution abatement and river rejuvenation by adopting a river basin approach to promote inter-sectoral coordination for comprehensive planning and management; and 2. To maintain minimum ecological flows in the river Ganga with the aim of ensuring water quality and environmentally sustainable development. The Vision for Ganga Rejuvenation constitutes restoring the wholesomeness of the river defined in terms of ensuring "Aviral Dhara" (Continuous Flow"), "Nirmal Dhara" ("Unpolluted Flow"), Geologic and ecological integrity. To achieve the objectives, NMCG shall carry out the following key functions namely: (i) Implement the work programme of National Ganga River Basin Authority

(NGRBA), (ii) Implement the World Bank supported National Ganga River Basin Project, (iii) Coordinate and oversee the implementation of projects sanctioned by Government of India under NGRBA, (iv) Undertake any additional work or functions as may be assigned by MoWR,RD &GJ in the area of conservation of river Ganga, (v) Make rules and regulations for the conduct of the affairs of the NMCG and add or amend, vary or rescind them from time to time, (vi) Accept or to provide any grant of money, loan securities or property of any kind and to undertake and accept the management of any endowment trust, fund or donation not inconsistent with the objectives of NMCG, (vii) Take all such action and to enter all such actions as may appear necessary or incidental for the achievements of the objectives of the NGRBA. The Union Government approved the Namami Gange Programme, an integrated conservation mission, as a "Flagship Program" in June 2014 with a budget outlay of Rs. 20,000 crores in order to achieve the twin goals of effective pollution reduction and conservation and rejuvenation of the National River Ganga. The STP, River front Development, River- Surface Cleaning, Biodiversity, Afforestation, Public Awareness, Industrial Effluent Monitoring, and Ganga Gram are the main pillars of the Namami Gange Program. Its implementation has been divided into Entry-Level Activities (for immediate visible impact), Medium-Term Activities (to be implemented within 5 years of time frame) and Long-Term Activities (to be implemented within 10 years).

India's top national think tank for urban development and planning is the National Institute of Urban Affairs (NIUA). The National Institute of Urban Affairs (NIUA) serves as a focal point for the creation and dissemination of cutting-edge research in the urban sector and aims to offer creative responses to the problems posed by India's rapid urbanisation while laying the foundation for inclusive and sustainable cities in the future. In order to support and direct the Government of India in its goals for urban development, NIUA was created as an apex organisation in 1976. Since then, it has collaborated closely with the Ministry of Housing and Urban Affairs, as well as other public and private sectors, to pinpoint important study areas and fill in the gaps in urban planning and policy. The Institute's team includes planners, engineers, researchers, architects, and analysts. It also develops toolkits and specialised training programmes to increase the capacity of local, regional, and governing agencies. The Institute offers cross-disciplinary expertise and technical assistance for city and state-level projects. Its current work focuses on 6 areas in order to deepen and broaden the urban knowledge bases across the nation.

1 Urbanization & Economic Growth
2 Urban Governance (Digital) & Municipal Finance
3 Urban Infrastructure & Built Environment
4 Environment, Climate Change & Resilience
5 Social Development (Inclusive and sustainable cities)

The purpose of this sponsored thesis competition is to invite students to write a scientific dissertation/thesis on the topic of the contest. The purpose of the contest is to give students the opportunity to design blue skies and innovative solutions to reinvent the look and control of the rivers that flow through the city. This contest is sponsored by the National Mission for Clean Ganga (NMCG) and the National Institute for Urban Affairs (NIUA). The Themes of

the competition are Reducing River pollution, rejuvenating water bodies, creating a Vibrant River Zone, Generating River related economy and Engaging citizens in river management activities.

1.8.1 Urban River Management Plan (URMP)

One of the tools used by NMCG to put into practice the guidelines for the management, conservation, and rejuvenation of the River Ganga.

Table 1-1 Table describing the objectives of URMP

DESIGN PHILOSOPHY	Environmentally responsible	Economically beneficial	Socially inclusive
ELEMENT	ENVIRONMENTAL	ECONOMIC	SOCIAL
VISION	The river will be able to support a habitat for biodiversity to thrive	The river will provide opportunities for economic development	The river will be celebrated among the citizens
OBJECTIVES	1. To ensure effective regulation of activities in the floodplain 2. To keep the river free from pollution 3. To rejuvenate waterbodies and wetlands in the city 4. To enhance the riparian buffer along river banks 5. To adopt increased reuse of treated wastewater 6. To ensure maximum good quality return flow from the city into the river	7. To develop eco-friendly riverfront projects 8. To leverage on the economic potential of the river	9. To inculcate river-sensitive behaviour among citizens 10. To engage citizens in river management activities

Source 1-7URMP

The current thesis project touches almost every objective of the URMP but major focus is on objective 3, 6 and 10. In addition to it, the study is also focused on the ground water prospectus.

1.9 Conclusion

It is obvious that the area around Aligarh had good hydrology and ecology in the past in terms of water and forest. Due to factors like a rise in impervious surface area, the blocking and rerouting of drainage channels, etc., the hydrological cycle in urban areas around the world is being disrupted and changing. The poor state of the waterbodies and the separation between surface water and groundwater, which is causing an unhealthy environment in the city, are what prompted the necessity for the study. The surface water can benefit by implementing the implementation strategies which will ultimately help the ground water heal.

2

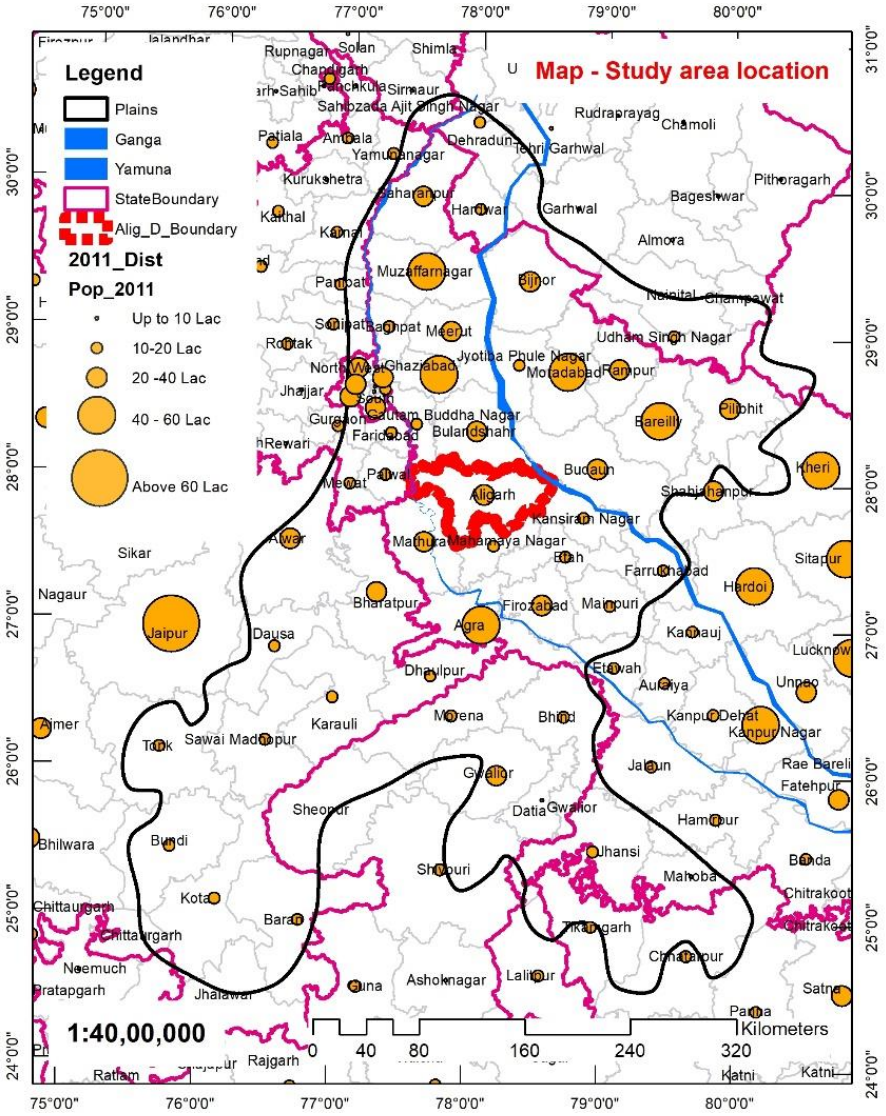
DISTRICT LEVEL

2 District level

2.1 Background

Out of 6 Physiographic Divisions i.e. The Northern mountains, The Northern Plains, The Peninsular Plateau, The Indian Desert, The Coastal Plains, The Islands, the study area lies in the Northern plains.

Map 2-1 Map showing study area location

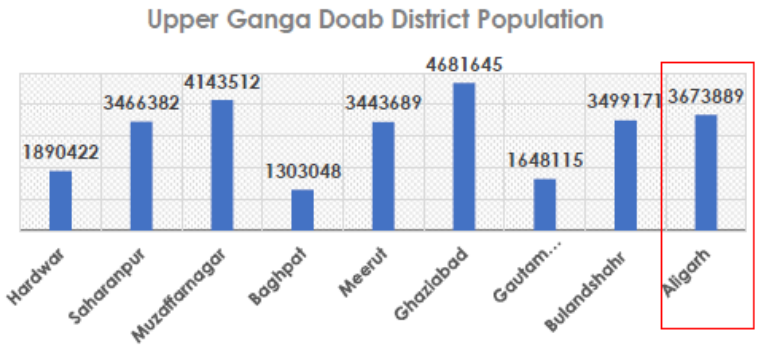


Source 2-1 Mapped from (Survey of India Toposheet, 2005)

The Northern Plains are formed of alluvial soil. It is a prosperous region in India in terms of agriculture. It has access to water and cultivated land via the river networks. It has 2 major plains - (a) The Western plain (Punjab Plains) (b) The Ganga-Brahmaputra plain (The Ganga plain and Brahmaputra plain) The former one has 3 plains divisions- (a) Upper Ganga Plains, (b) Middle Ganga Plains, (c) Lower Ganga Plains. The study area is in upper Ganga plains and the Upper plains largely include the Doab of Ganga and Yamuna in the western Uttar Pradesh. The Aligarh district Area is 3,650 sq. km and the Population is 36,73,889 persons (Census 2011) It is surrounded by Large populated districts like Gautam Budhha Nagar,

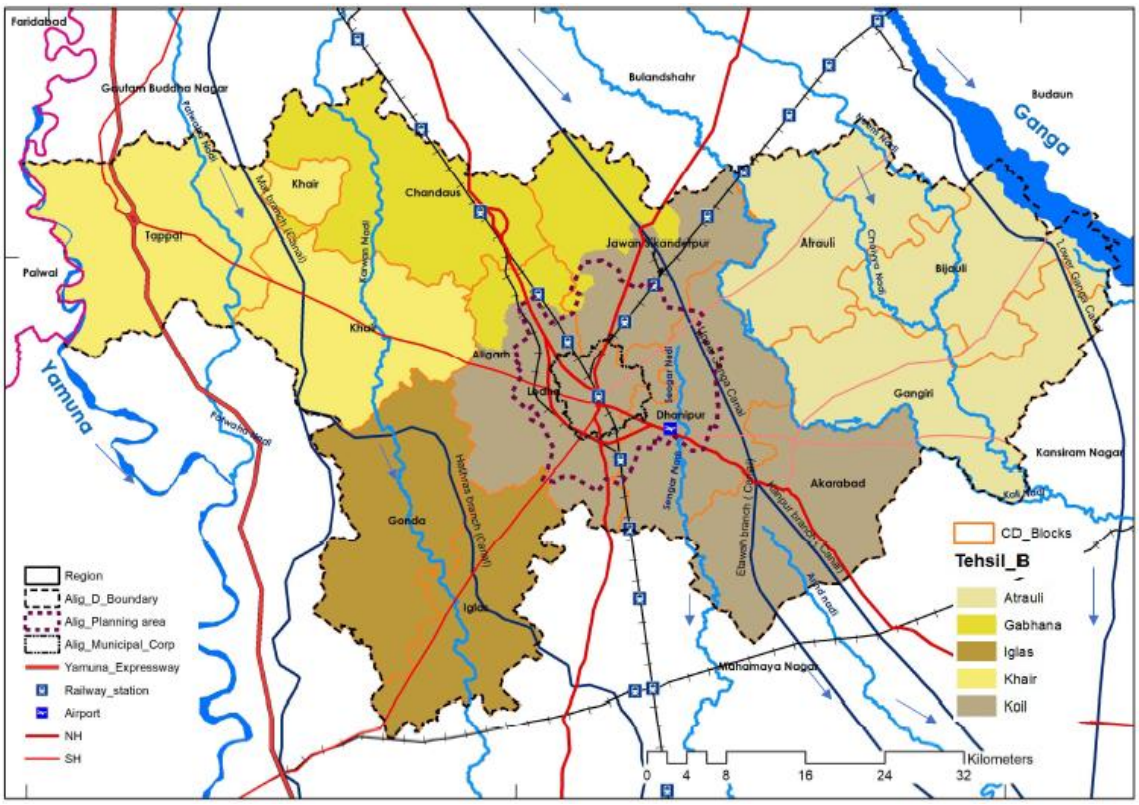
Delhi, Agra, and Bareilly. In North, there are Gautam Budhha Nagar, Bulandshahar districts, In South there are Mathura, Hathras, In West there are Palwal (Haryana) East: Baduan, Kansiram Nagar Similar pattern of Population is observed in the Doab Districts. The district has 5 Tehsils, 12 CD Blocks, 12 Municipal bodies, and 1210 Villages in the district. Demography and Socio-economic profile of Uttar Pradesh is observed as Population: 19,98,12,341, Growth rate: 20.23%, Density: 821 p/sqkm, Sex ratio: 908, Literacy is around 69.72% and 79.24 percent of men and 59.26 percent of women are literate.

Chart 2-1 Upper Ganga Yamuna Doab Districts Populations



Source 2-2 (Census of India, 2011)

Map 2-2Aligarh District – Administrative Boundaries

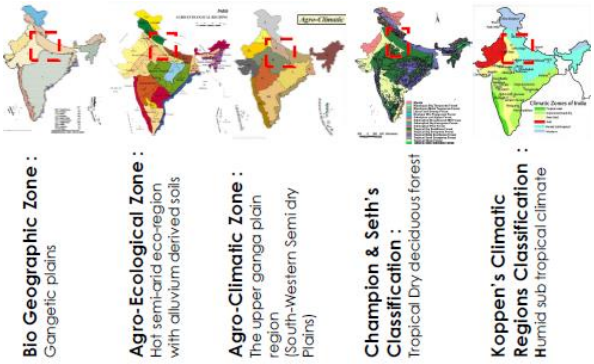


Source 2-3 Mapped from (Survey of India Toposheet, 2005)

Demography and Socio-economic profile of Aligarh District is observed as Population: 36,73,889, 19,51,996 are males, 17,21,893 are females, Growth rate: 22.78%, Density: 1008

p/sq km, Sex ratio: 882, Literacy: 67.52%, Male 80.11% Female 52.80%. The major drainage of district is by Ganga and Yamuna and Drained by 8 small rivers Karwan, Sengur, Arind, Kali, Choiyya, Neem, Badganga, Patwaha. Important Canals in the district are Upper ganga Canal which is 63.26 km long in the district, Designed flow: 5000 cusec, Actual flow in 2021 -3100cusec and Lower ganga Canal and various branches like mat, Hathras, Kanpur and Etawah.

Figure 2-1 Various Classification zones



Source 2-4 (Author, 2022)

2.2 Environmental Resources

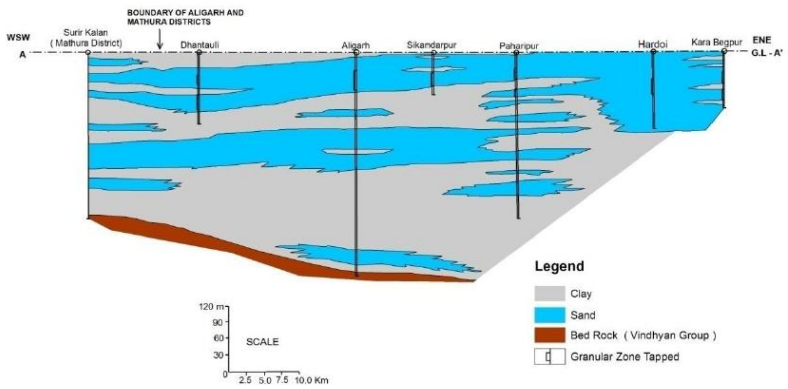
2.2.1 Abiotic Environment

2.2.1.1 Land Environment

2.2.1.1.1 Geology and Lineaments

Geologically, the area is covered with a pile of moderately thick Quaternary sediments, including various grades of sand, clay and canker. Alluvial deposits unconformably cover the Vindhyan Rock Group. Geologically, the area is covered with a pile of moderately thick Quaternary sediments, including various grades of sand, clay and canker. Alluvial deposits unconformably cover the Vindhyan Rock Group.

Figure 2-2 Geological Section East West Direction

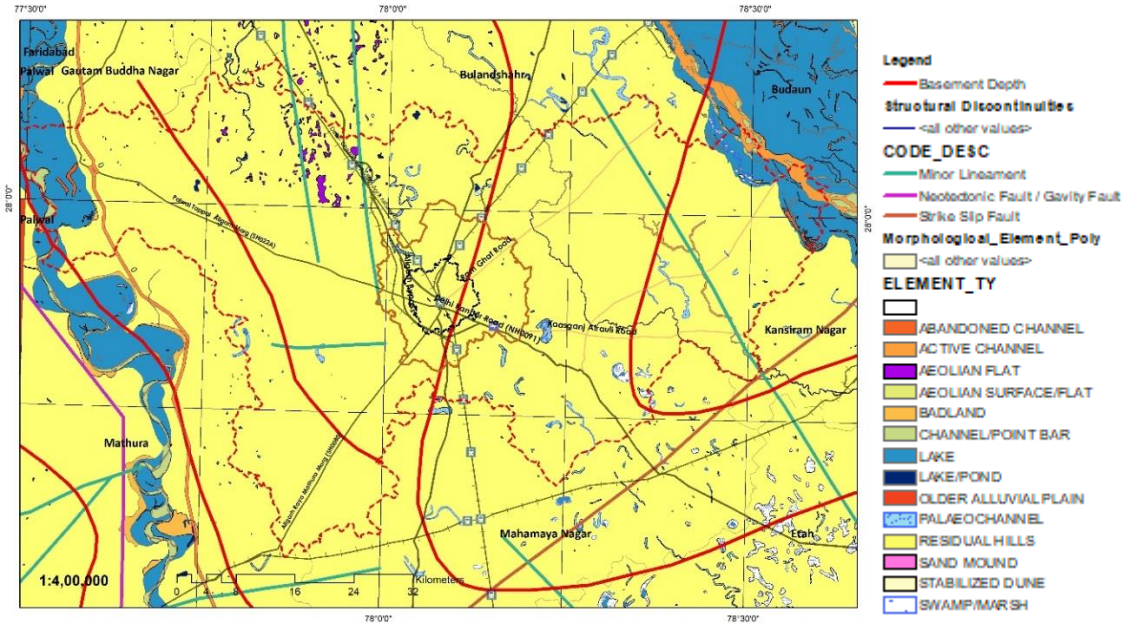


Source 2-5 (Khan S. , 2017)

The study reveals the presence of thick piles of alluvial deposits with alternating grades of sand, clay and silt. The lithological changes in the area are fine to medium sand, and cankers are

associated with clay formation in various ways. The basement Vindhyan shale encountered at Aligarh station to a depth of 327 m. (Khan S. , 2017)

Map 2-3 Geology and Lineaments Map

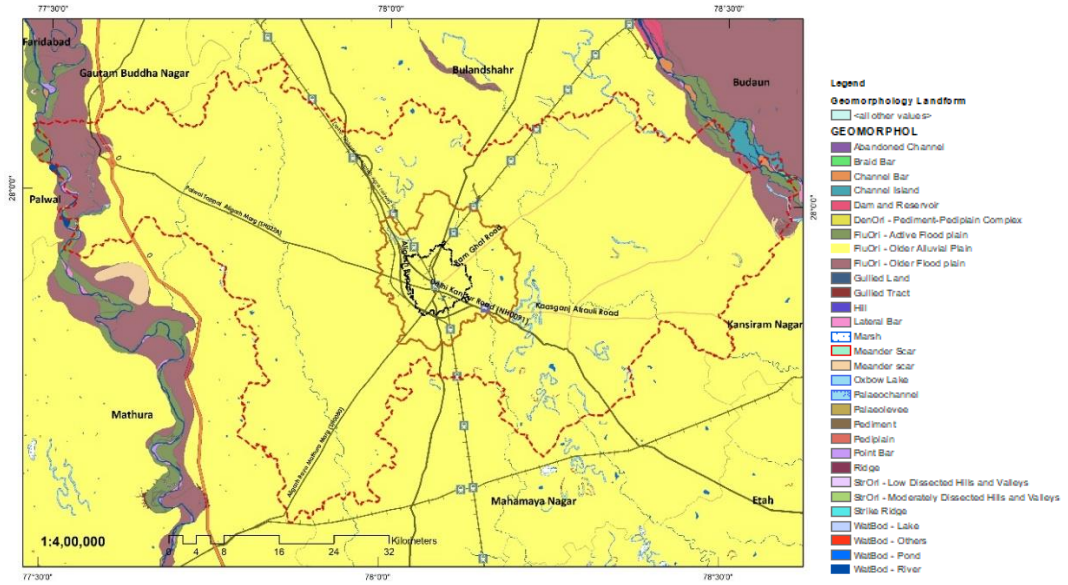


Source 2-6 Mapped from (Bhukosh, 2022)

2.2.1.1.2 Geomorphology

Genesis based there are three level classifications level 1,2 and 3. In Level 1, Origin: Fluvial origin is the major genetic class of the district out of 11 Genetic classes**,** In Level 2, Unit: Older Alluvium plain is the major landform of the district out of 42 landforms and In Level 3, Ox bow lake, Meander scar, Paleochannels are major landforms present out of 417 geomorphic schemas.

Map 2-4 Geomorphology Map (Morphological element)



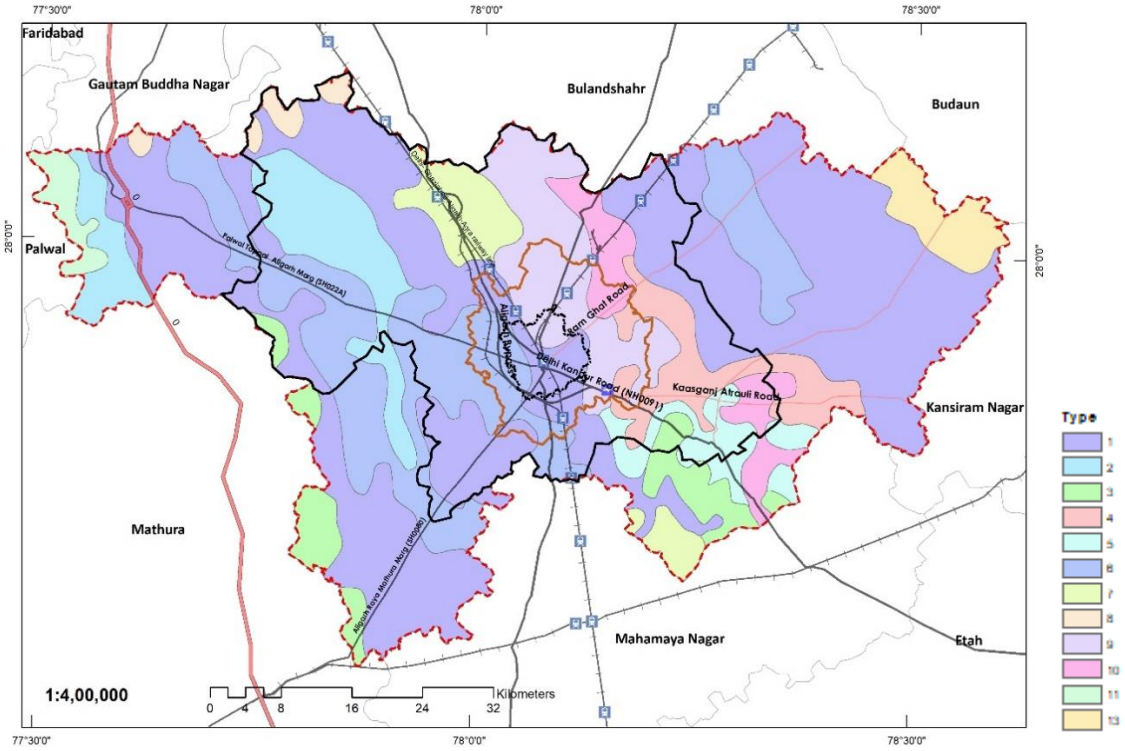
Source 2-7 (Bhukosh, 2022)

2.2.1.1.3 Soil

Major soil type is Sandy loamy. Further it is divided as Dumat (clay), Balui Dumat (sandy clay), Bhur (sandy), Reh (Alkaline) and loam soil.

As per NBSS&LUP, there are various classes of soils which are explained following-

Map 2-5 Soil classification



Source 2-8 Mapped from (Khan S. , 2017)

(1) indicates Deep, loamy soils and slightly eroded, (3) indicates deep, fine soils moderately saline and sodic associated with loamy soils, slightly eroded, (4) indicates deep, fine soils and slightly eroded associated with loamy soils slightly saline and moderately sodic, (5) indicates deep, silty soils with moderately salinity and sodicity associated with loamy soils with moderate salinity and sodicity and water logging, (6) indicates deep, silty soils and slightly eroded associated with loamy soils slightly saline and slightly sodic, (7) indicates deep, loamy soils, moderate salinity and sodicity associated with loamy soils with moderate salinity and strong sodicity, (9) indicates deep, silty soils and slightly eroded associated with fine soils.

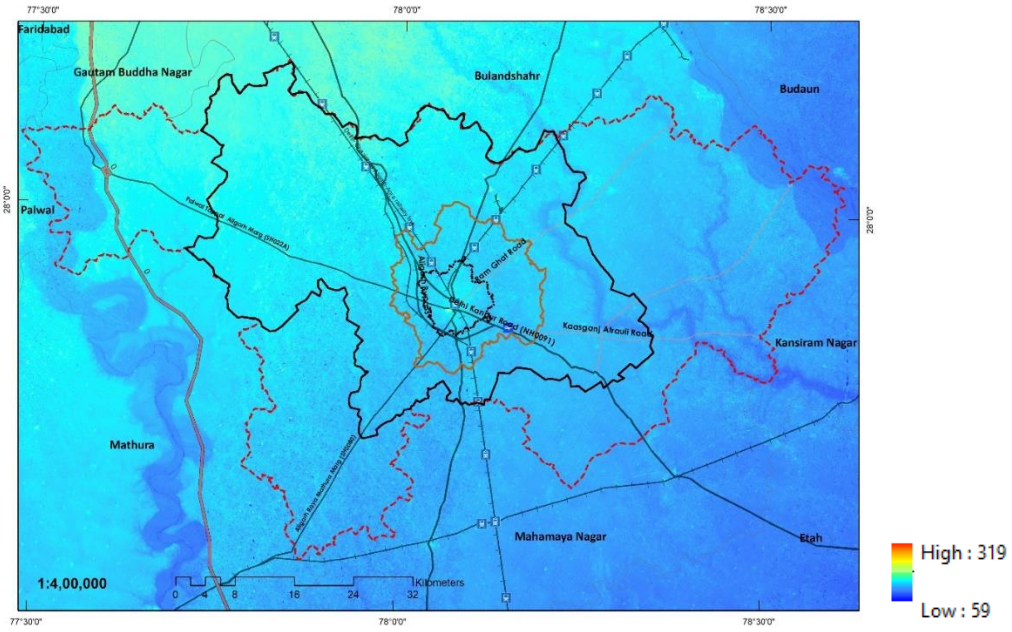
2.2.1.1.4 Elevation

Ranges from 212 m to 168 m in the region and Maximum elevation is 212 m. Average elevation is 175 m and the average gradient of the slope of land surface is 2cm/km., The 'upper kots' area in Aligarh is the most important ridge and there are depressions in the Aligarh.

2.2.1.1.5 Slop

The slope of the area is regular except near the top elevation or around some depressions. Most of the area is under the slope less than 1%.

Map 2-6 Elevation map

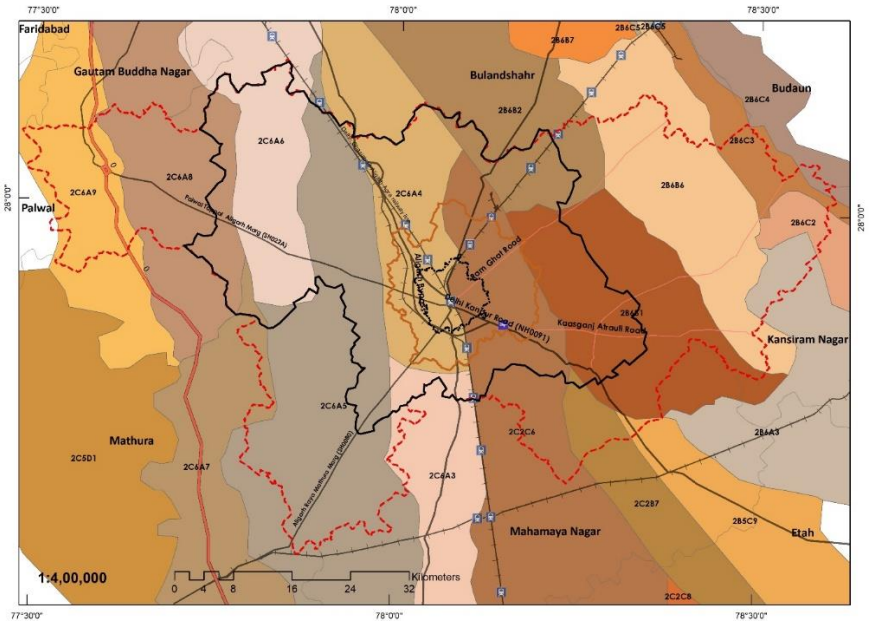


Source 2-9 Cartosat-1 Digital Elevation Model (Carto DEM) and analysis by author in ArcGIS 10.8

2.2.1.2 Water Environment

It includes Surface water which includes River, Canal, drains, Water bodies and Ground water. **Rivers**: The main rivers which flow in the region are Kali Nadi, Sengur nadi. The Kali nadi is the tributary of Ganga River and Sengur nadi is tributary to Yamuna River.

Map 2-7 Watershed map



Source 2-10 (SLUSI, 2022)

Water Quality: There is no monitoring stations in water bodies and drains, However Kali nadi shows "E Category" and 30 mg/l Above BOD values (ex 34mg/l in feb 2022) As per the Water Quality Data of the Polluted River Stretches Kali nadi (East) from 2018 except 2020 in two locations before and after ram ghat road/ wave distillery.

Table 2-1 Table showing the Quality of surface water for Kali River

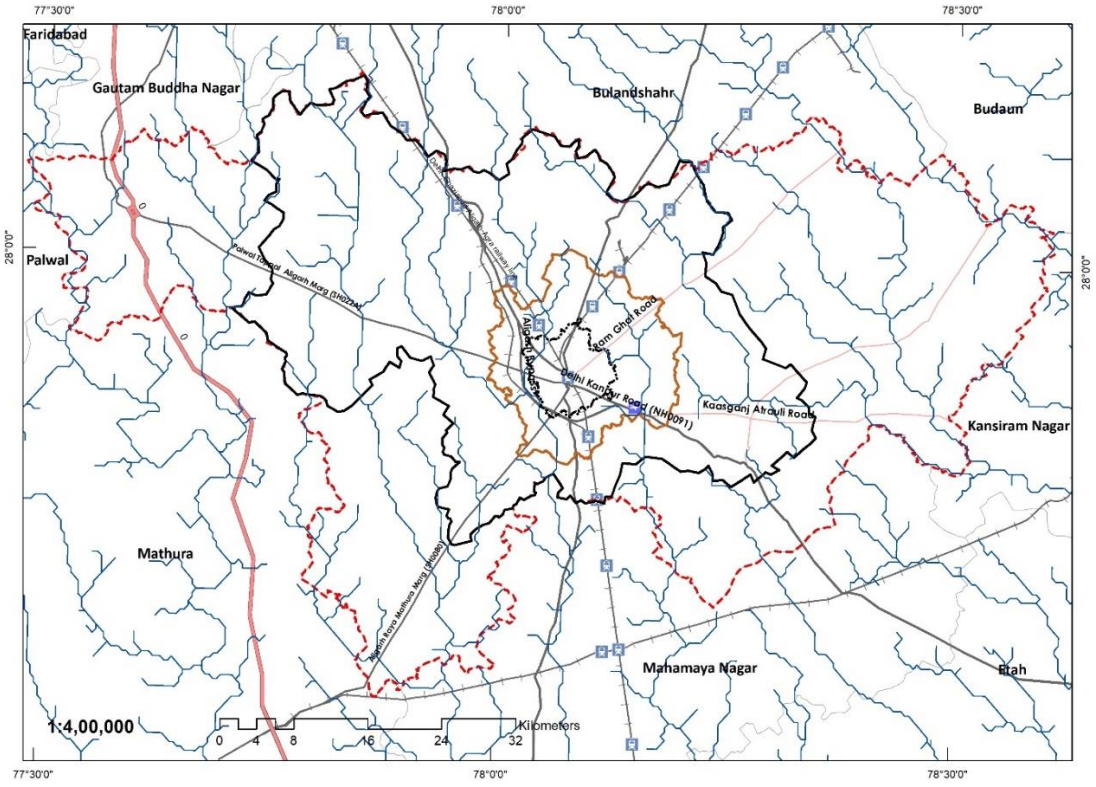
	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022
DO (mg/l)	NIL	2.6	3.9	2	3	NIL	2.5	4.1	2.1	3
BOD (mg/l)	65.9	30.3	13.3	33.3	34	70.0	32.7	13.9	33.3	34
COD(mg/l)				122.8	152				126.4	152
Catagory		E	D	E	E		E	D	E	E

Source 2-11 (UPPCB, 2022)

Canal: UGC, 3100 cusec of actual water discharge in 2020-21 and various distributaries, minors, escapes are present in the area. Due to Urban expansion, koil distributary after 37.610 km, Gadrana (11km) and boner (4.64km) minors are too damage to supply water. They now acting as a nalas (Carrying waste water).

Drains: There are various drains like Aligarh, Cherrat, Jafri, Konchor, chhahari, Lahtoi, Bijaigarh drains. Through bioremediation Aligarh and Jafri will be rejuvenated under a piolet project under smart city mission.

Map 2-8 Stream map

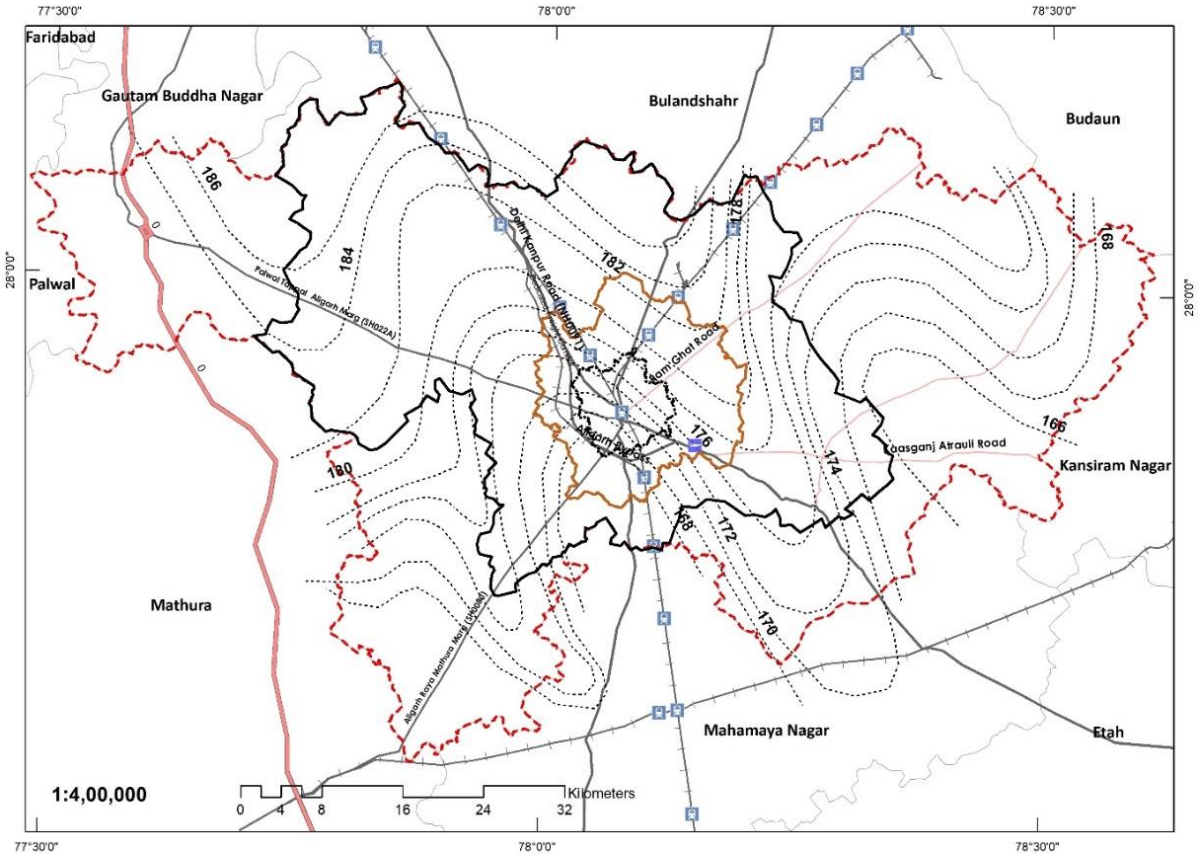


Source 2-12 Cartosat-1 Digital Elevation Model (Carto DEM) and analysis by author in ArcGIS 10.8

Water bodies/wetlands/ponds: There are different sources having different numbers of water bodies/ wetlands. More than 150 water bodies in the region as per SOI and In Planning area 2021 there are 110 water bodies in the SOI as per the mapping done by the author and Master plan has 37. One of the water bodies from the region, Shekha jheel (Bird Sanctuary) exhibits biodiversity and tourism spot for the local and nearby people. The size ranges from few ha to 25 ha. And support species richness more than166 species.

Ground water/Aquifer: (Quality, depth, flow, fluctuation, Fence Diagram) Ground water flow is from north-west to south-east. The gradient of water table varies from 0.16 to 4.0 m/km.

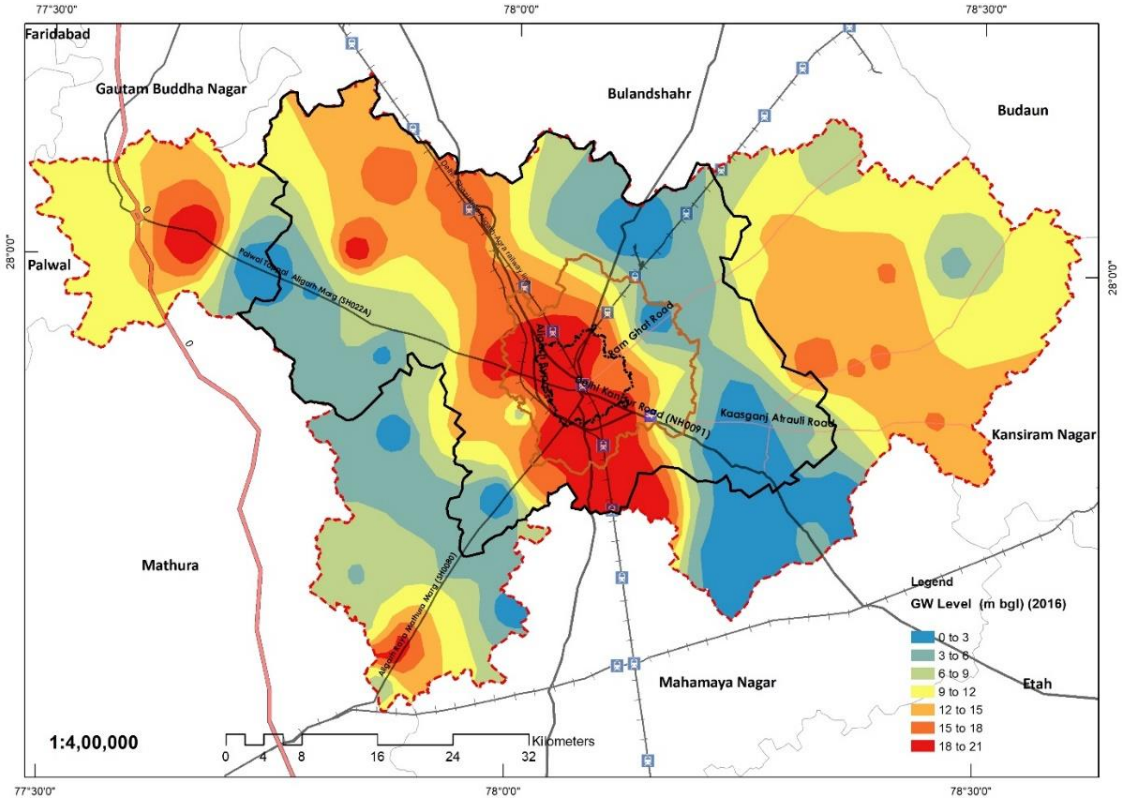
Map 2-9 Ground water flow (sub-surface flow)



Source 2-13Mapped from (Khan S. , 2017)

Some of the Standards were highlighted and pH values should be between 6.5 to 8.5/9.2 (corrosive & sealing action), Total Hardness as Caco3 : Permissible 300mg/l and max up to 600 mg/l, Higher concentration may cause urinary diseases of kidney, bladder and stomach disorder , Cl : Permissible 250mg/l, max up to 1000mg/l, Bicarbonate HCO3- :below 600 mg/l, Nitrate: 45mg/l, max up to 100mg/l (important for plant nutrient), Sulphate: 200mg/l, max up to 400mg/l (cause noticeable taste), Fluoride: up to 1.5 mg/l (causes dental and skeletal fluorosis.)

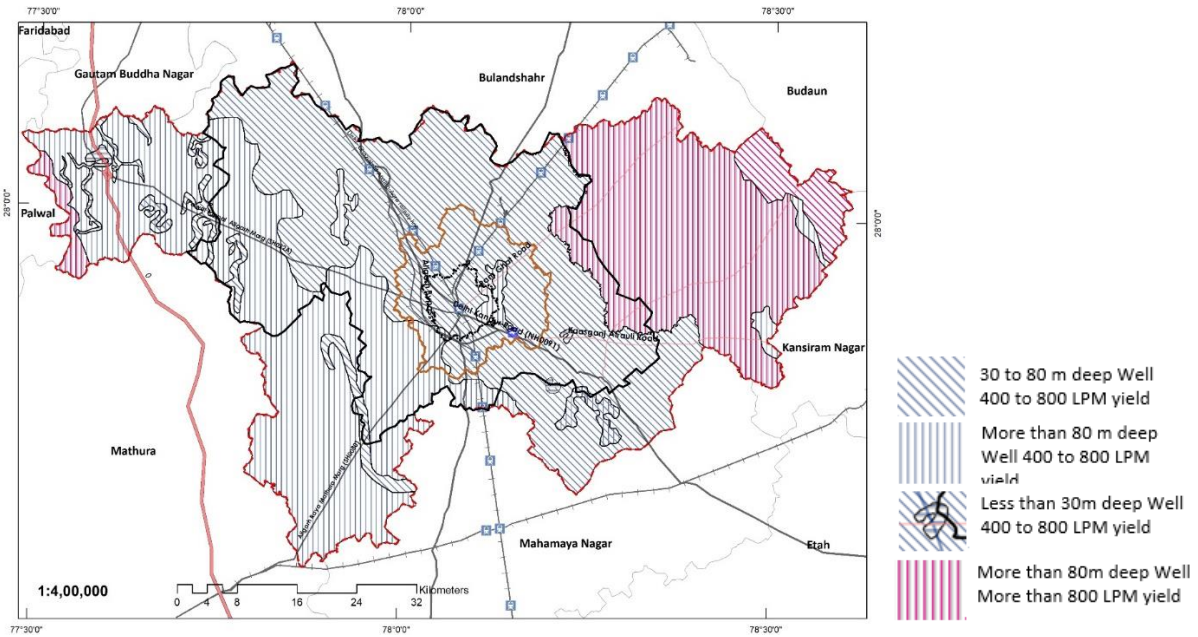
Map 2-10 Post monsoon Ground water level 2016



Source 2-14 (Khan S. , 2017)

The Ground Water Prospects map has been prepared with the help of Bhuvan - Bhujal (Ground Water Prospects and Quality Information System) ISRO. The map is used for locating recharge structure on the ground.

Map 2-11 GW prospectus map



Source 2-15 (BHUVAN, 2022) (Khan S. , 2017)

Table 2-2 Ground water Level, trend and category

Block Name	Water level (Pre) (mbgl)	Water level (Post) (mbgl)	Trend (2004 -2013)	CGWB category 2017	CGWB category 2020
Lodha	9.7 to 19.8	7.85 to 19.95	Pre : Rising 33.81 cm/yr Post: Rising 28.0 cm/yr	Safe	Semi-Critical
Jawan sikenderpur	1.75 to 21.0	0.85 to 20.7	Pre : Declining 0.19 cm/yr Post: Rising 6.13 cm/yr	Safe	Semi-Critical
Dhanipur	4.0 to 26	1.1 to 26.98	Pre : Rising 0.08 cm/yr Post: Declining 2.27 cm/yr	Safe	Safe
Akbarabad	1.75 to 8.3	0.25 to 8.0	Pre : Rising 33.81 cm/yr Post: Rising 28.00 cm/yr	Safe	Safe
Atrauli	6.8 to 13.6	6.2 to 12.55	Pre : Rising 27.08 cm/yr Post: Rising 20.44 cm/yr	Safe	Safe
Bijauli	7.5 to 14.3	6.5 to 15.5	Pre : Rising 3.36 cm/yr Post: Declining 6.10 cm/yr	Safe	Safe
Chandaus	13.55 to 15.24	13.36 to 14.8	Pre : Declining 17.89 cm/yr Post: Declining 20.02 cm/yr	Over-exploited	Semi-Critical
Gangiri	13.8 to 16.72	13.1 to 16.21	Pre : Declining 12.85 cm/yr Post: Declining 5.09 cm/yr	Safe	Semi-Critical
Gonda	4.17 to 12.34	1.8 to 11.12	Pre : Rising 10.43 cm/yr Post: Rising 9.87 cm/yr	Over-exploited	Safe
Iglas	7.5to 17.65	3.65 to16.9	Pre : Declining 24.92 cm/yr Post: Declining 6.39 cm/yr	Safe	Critical
Khair	4 .75 to 14.67	3.75 to 13.1	Pre : Rising 1.37 cm/yr Post: Rising 3.70 cm/yr	Safe	Semi-Critical
Tappal	4.60 to 22.6	2.28 to 21.6	Pre : Rising 7.13 cm/yr Post: Rising 5.68 cm/yr	Safe	Safe

Source 2-16 (Khan S. , 2017)

Table 2-3 Ground water resource development assessment

Block Name	Ground water resource, extraction, contamination and other issues	Total GW resources 2013(MCM)	Draft (Removal) 2013(MCM)	Stage
Lodha	Second Aquifer Group & part of First Aquifer	2092.9	60.17	121%

	Group has inferior ground water quality in terms of salinity.			
Jawan sikenderpur	Second Aquifer Group & part of First Aquifer Group has inferior ground water quality in terms of salinity.	2391.8	63.75	80%
Dhanipur	First Aquifer Group is fresh. Second Aquifer Group is Saline	2269.1	52.72	68%
Akbarabad	First Aquifer Group is fresh. Second Aquifer Group is Saline	2098.9	48.45	59%
Atrauli	First Aquifer Group is fresh. Second Aquifer Group is Saline	1716.6	48.45	89%
Bijauli	First Aquifer Group is fresh. Second Aquifer Group is Saline	2441.9	54.6	75%
Chandaus	First Aquifer Group is fresh. Second Aquifer Group is Saline	2943	46.11	104%
Gangiri	First Aquifer Group is fresh. Second Aquifer Group is Saline	2592.6	75.41	90%
Gonda	First Aquifer Group is fresh. Second Aquifer Group is Saline	1837.3	59.74	102%
Iglas	First Aquifer Group is fresh. Second Aquifer Group is Saline	1837.3	46.55	76%
Khair	First Aquifer Group is fresh. Second Aquifer Group is Saline	1999.2	53.51	88%
Tappal	First Aquifer Group is fresh. Second Aquifer Group is Saline	3090.5	54.19	85%

Source 2-17 (Khan S. , 2017)

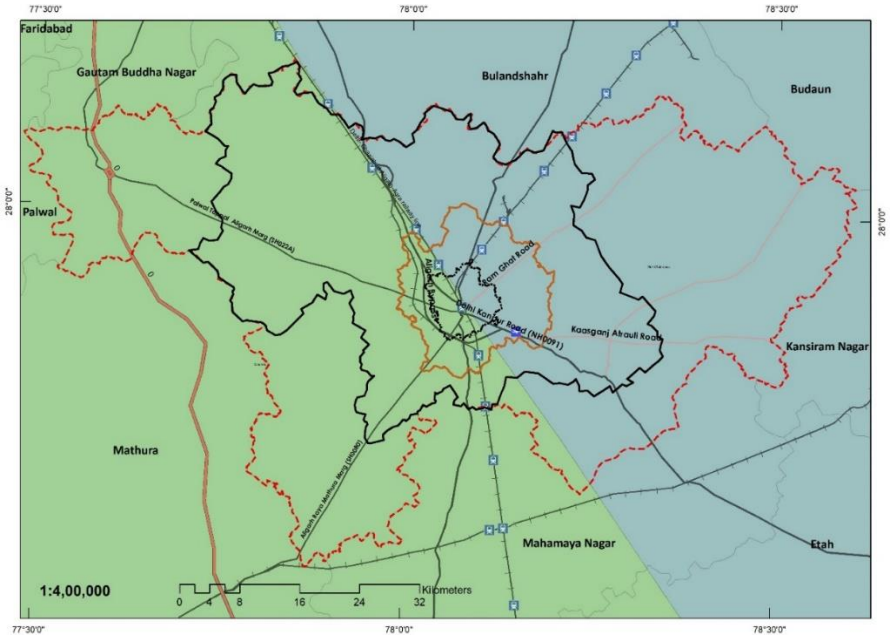
The ground water level fall is observed in the post monsoon period 0.19 to 24.52 cm/yr as per 2013 estimates. First aquifer is fresh and second aquifer group is saline. Net Annual Ground Water Availability is 789.80 MCM and Gross Annual Ground Water Draft is 665.6 MC. The Stage of Ground Water Development 84% and the Number of Over exploited Blocks are 2 (Iglas and Chandaus). The major issues for ground water is Dependency of Ground Water Irrigation in all blocks, Intensive Ground Water Development, Declining trend of water level and Ground Water Quality in few blocks. (Khan S. , 2017)

2.2.1.3 Climate

India is divided into fifteen Climatic regions mainly based on the prevailing temperature and rainfall as per National Atlas & Thematic Mapping Organization. Aligarh has a monsoon influenced humid sub-tropical climate, typical of north central India. Avg Annual max temp: 31.3 deg Celsius, Avg Annual min temp: 17.9 deg Celsius, Avg Annual rainfall: 754 mm, Avg Rainy days are 33 only. (EXTREME WEATHER EVENTS and CLIMATOLOGICAL TABLE PERIOD: 1981-2010, 2022). Maximum relative humidity of 85% and minimum

relative humidity of 37% were recorded in August and May, respectively. The district's average yearly potential evapotranspiration is 1529.1 mm. (Khan S. , 2017)

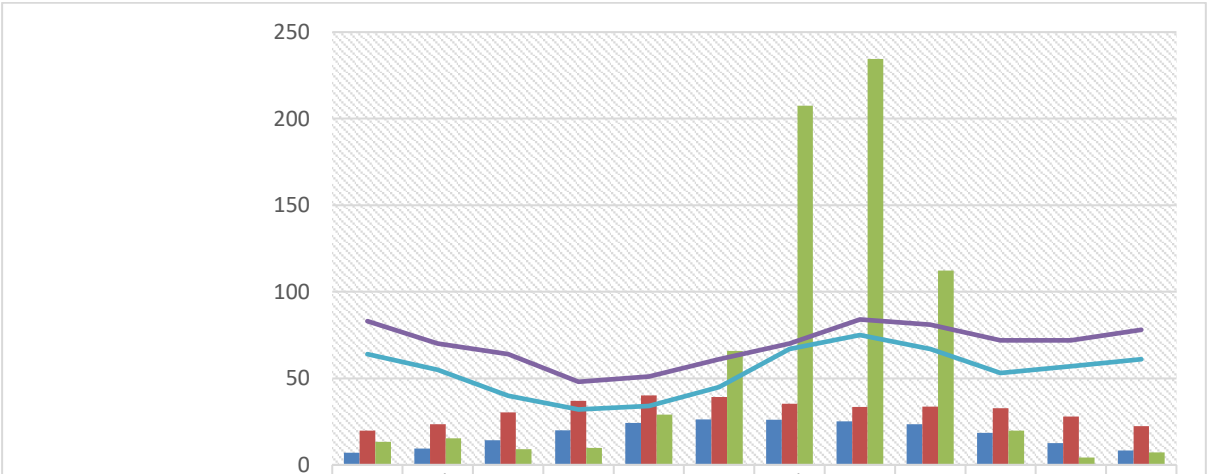
Map 2-12 Climatic region



Source 2-18 (National Atlas & Thematic Mapping Organisation (NATMO), 2022)

UPSAPCC 2014: Annual rainfall predicted to increase by 15% to 20% in the 2050's as compared to the baseline. Annual max temperature predicted to increase by 2 degrees Celsius towards 2050's and 4.5 degree Celsius towards 2080's.

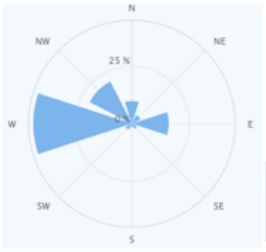
Chart 2-2 IMD data showing various parameters of Climate setting



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Min temp	7.1	9.5	14.3	19.9	24.2	26.3	26	25.2	23.5	18.4	12.6	8.3
Mean Max temp	19.8	23.5	30.3	37	40.1	39.2	35.3	33.4	33.6	32.8	27.9	22.3
Mean total rainfall (mm)	13.4	15.4	9.1	9.8	29	65.8	207.4	234.5	112.2	19.7	4.3	7.2
RH at 8.30 IST(%)	83	70	64	48	51	61	70	84	81	72	72	78
RH at 17.30 IST(%)	64	55	40	32	34	45	67	75	67	53	57	61

Source 2-19 (EXTREME WEATHER EVENTS and CLIMATOLOGICAL TABLE PERIOD: 1981-2010, 2022)

Figure 2-3 Wind Observation



N Northern	NE Northeastern	E Eeastern	SE Southeastern	S Southern	SW Southwestern	W Western	NW Northwestern
9.8%	4.2%	16%	2.4%	1.5%	3%	42.7%	20.5%

Source 2-20 (World Weather, 2022)

Wind blew from the west 42.7% of the time in the district.

2.2.2 Biotic Environment

2.2.2.1 Flora and Fauna

Almost 247 Species has been observed as per E-bird website with 4 major hotspot of bird areas in Aligarh such as Shekha jheel, Aligarh fort, AMU-Abdulla Hall and AMU Campus.

Shekha Jheel is an Important bird area in aligarh which supports almost 166 Species (Residents and Migratory birds) and it is a Bird Sanctuary since 2016. Black necked stork, Saras crane and Wooly necked stork are the main attraction.

Reserved Forest: Iron factory (north) which support flora and fauna in and around the area.

Gardens: AMU Botanical Garden

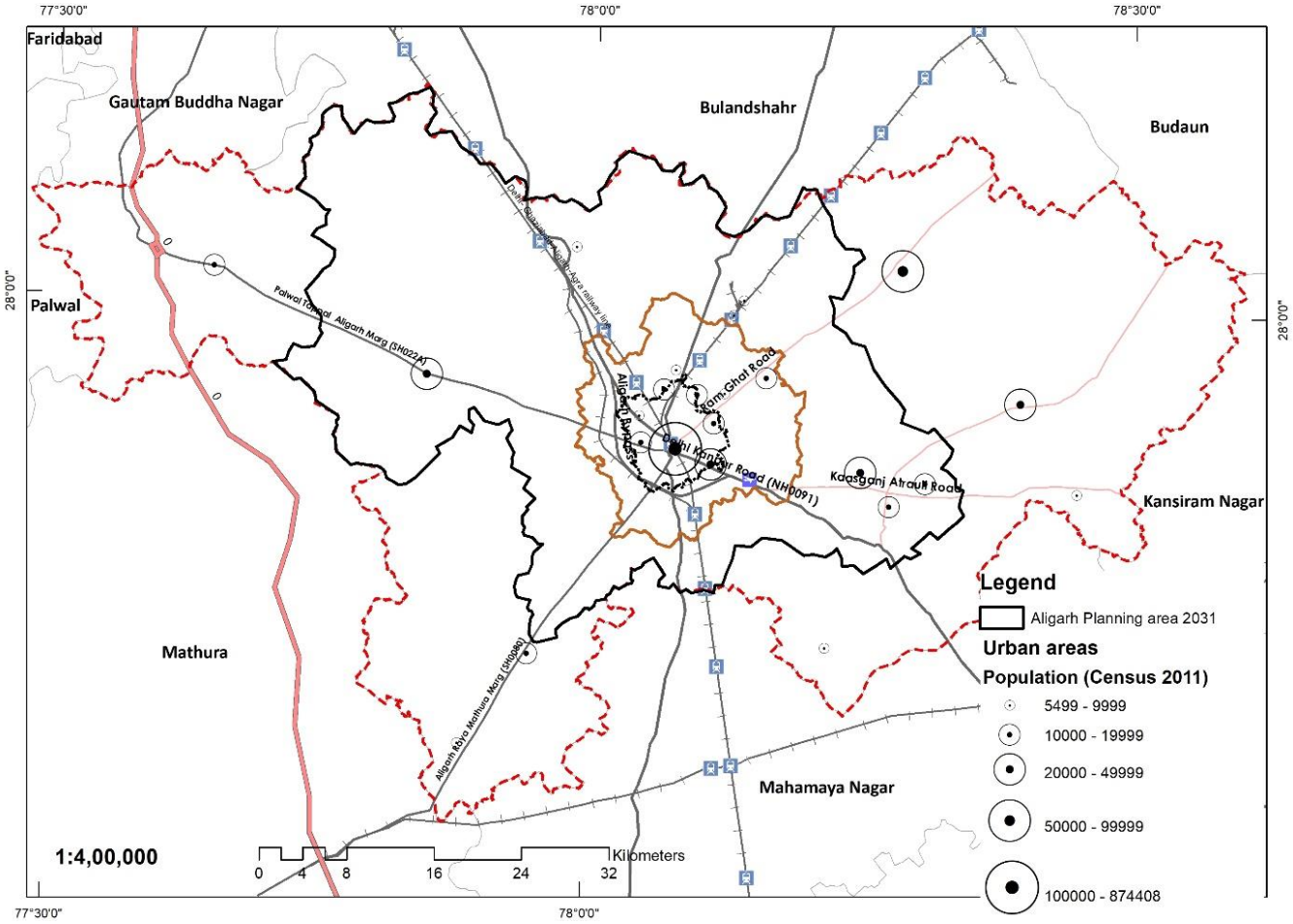
Park: Naqvi Park.

Globally threatened species: 29 / 382 species found as per Avibase - The World Bird Database in Aligarh region and 90 species count observation in Aligarh as per Biodiversity portal.

2.3 Demographic and Socio-Economic Profile

The area of the district is 3600 sq km. The literacy rate of the district is 67.5% and for male it is 78.0% and for female it is 55.7%

Map 2-13 Urban areas



Source 2-21 (Census of India, 2011) (Survey of India Toposheet, 2005)

Table 2-4 Urban area details

Urban Area	Households	Population
Jatari (NP)	3057	18387
Khair (NPP)	5883	35751
Gabhana (CT)	993	5886
Atrauli (NPP)	8093	50412
Chharra Rafatpur (NP)	3274	21146
Gangiri (CT)	814	5576
Harduaganj (NP)	2384	13690
Aligarh (M Corp.)	147363	874408
Jalali (NP)	3358	20238
Kauriaganj (NP)	1862	12244
Pilkhana (NP)	1730	11518
Vijaigarh (NP)	1176	7124
Qasimpur Power House Colony (CT)	1627	7791
Sarsaul (CT)	1686	9267
Ashrafpur Jalal (CT)	2031	11785

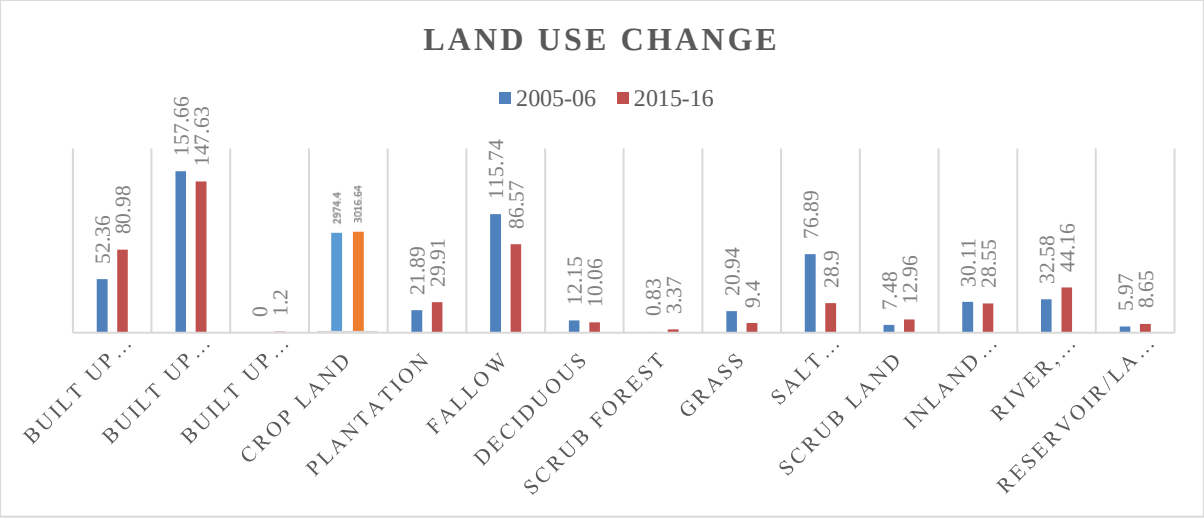
Deosaini (CT)	1190	6920
Kwarasi (CT)	2830	15763
Rampur (CT)	882	5499
Manjoor Garhi (CT)	1546	9381
Ramgarh Panjoopur (CT)	3083	18897
Dhaurra Mafi (CT)	2318	13241
Dhanipur (CT)	3581	20511
Iglas (NP)	2598	15478
Beswan (NP)	978	6278

Source 2-22 (Census of India, 2011)

2.4 Land-use land Cover

Bhuvan LULC maps has been identified through portal and observation has been identified. A major part of the land in the district is covered from agriculture crop land.

Chart 2-3 Trend of the LULC



Source 2-23 (Author, 2022)

Table 2-5 Percentage change observation from 2005 to 2015

LULC 1st Category	LULC 2ND category	%Change
Built up	**Built up Urban**	54.7%
	Built up Rural	-6.4%
	Built up Mining	120.0%
Agriculture	**Crop land**	1.4%
	Plantation	36.6%
	Fallow	-25.2%
Forest	**Deciduous**	-17.2%

	Scrub forest	306.0%
	Grass	-55.1%
Barren	**Salt affected land**	-62.4%
	Scrub land	73.3%
Wetland	**Inland Wetland**	-5.2%
	River, streams, canals	35.5%
	Reservoir/lake/ ponds	44.9%

Source 2-24 (BHUVAN, 2022)

Bhuvan Observation over district: Increased by more than 50%: Urban built up, scrub forest and scrub land. Increased by less than 50%: Cropland, plantation, Streams, ponds. Decreased Rural built up, fallow, deciduous forest, grass, salt affected land, Inland wetland.

2.5 Agriculture

It is impressive how the district's irrigation potential has grown. Wheat, rice, barley, millet, and maize are the area's main crops. Additionally, the district also grows other commodities like sugarcane and oil seed and their classification- Rabi: Weat, Jaw, sarson, Kharif: Bajra, dhan, Maize(makkka) , arahar ki daal (Rainfed), Zaid: Dalhan (Moong ki daal), tilhan. It has been observed from 1994 to 2014 that since 2010, pulses have been cultivated more than other cereals due to a change in the cropping pattern.

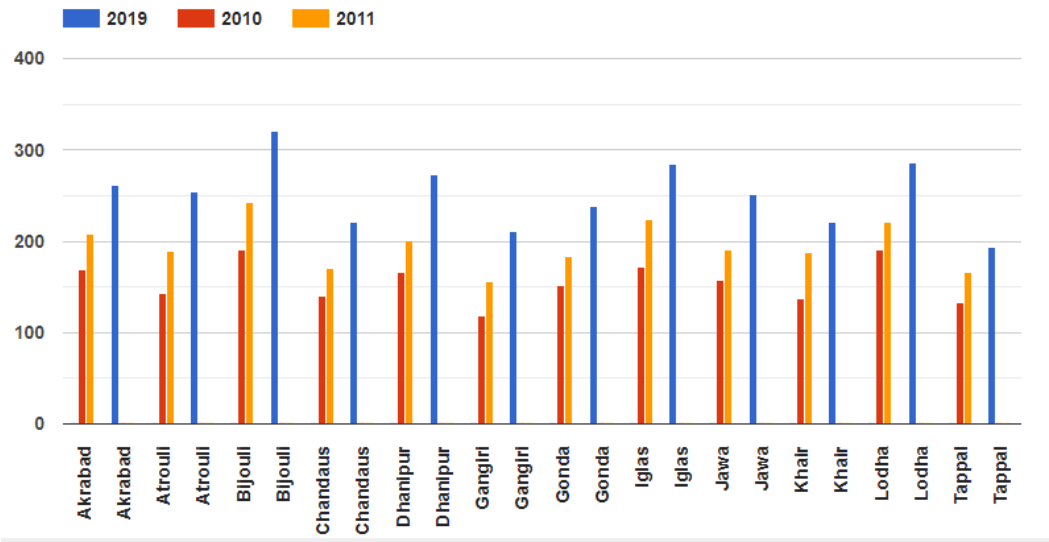
Table 2-6Cropping calendar

Jan	**Feb**	**March**	**Apr**	**May**	**June**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**
Rabi				Zaid			Kharif (Rainfed)				

Source 2-25 (Author, 2022)

Source of Irrigation: Canal, Tube wells: Public and Private. Contribution of Ground water of private tube wells are more in nature. Ground water, which irrigates 278196 acres and accounts for 92 percent of the district's total irrigation capacity, is the main source of irrigation. About 8% of the district's total irrigation area, or 25364 hectares, is serviced by the canals for irrigation.

Chart 2-4 Trend of Fertilizer consumption



Source 2-26 (UPDES, 2022)

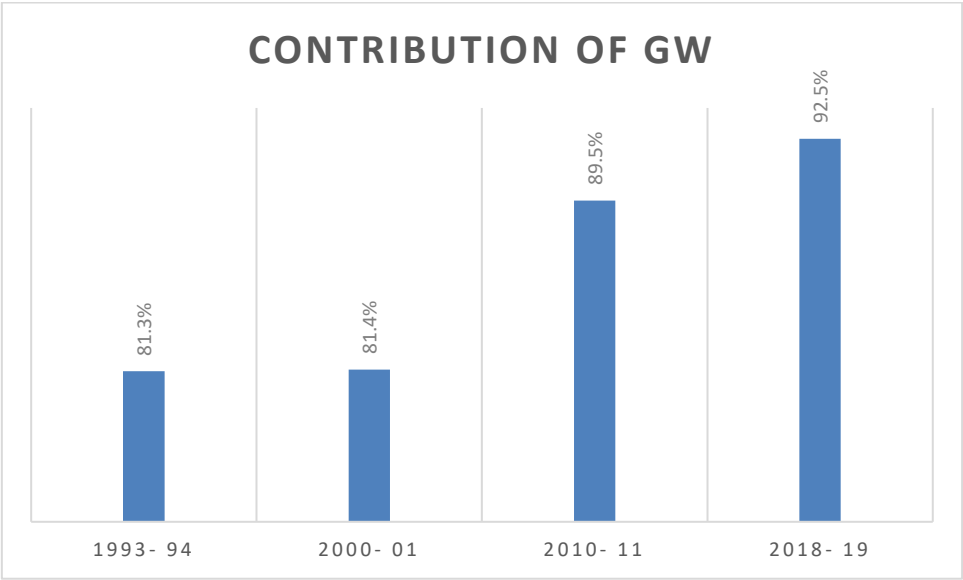
Increasing trend of consumption of fertilizers per hectare of gross sown area in these blocks

Table 2-7 Absolute values in hectare for irrigated land from ground water.

Year	Area irrigates by Ground water (ha)	Total
1993- 94	314744	387242
2000- 01	226626	278568
2010- 11	256789	286824
2018- 19	281269	304042

Source 2-27 (UPDES, 2022)

Chart 2-5 Contribution of Ground water for irrigation over years



Source 2-28 (UPDES, 2022)

2.6 Major Issues

1. Various depressions lead to water accumulation.
2. Ground water depletion in 2 blocks in post monsoon period by 2 to 6 cm per year and Few locations have crossed the acceptable limit and few locations are approaching the acceptable limit for the GW Quality.
3. Distributary and minors are degraded and acting as drains
4. No surface water monitoring in the region except Kali River (2 locations only)
5. Agriculture dependency on Ground water is increasing being presence of rich network of Upper Ganga Canal.

3

PLANNING & CITY AREA LEVEL

3 Planning and City area level

3.1 Background

Aligarh is famous for Aligarh Muslim University and its Industrial activities like Locks and Brassware Industries.

Some of the Persons like Urdu poet Shaharyar Khan, etc., Poet Gopal das Neeraj, etc., Actor Bharat Bhushan, etc., Composer Prem Kishor Pataka, etc. has made Aligarh Proud. It is also famous for its Tehzeeb and Tea.

Figure 3-1 Aligarh key Identity on Globe

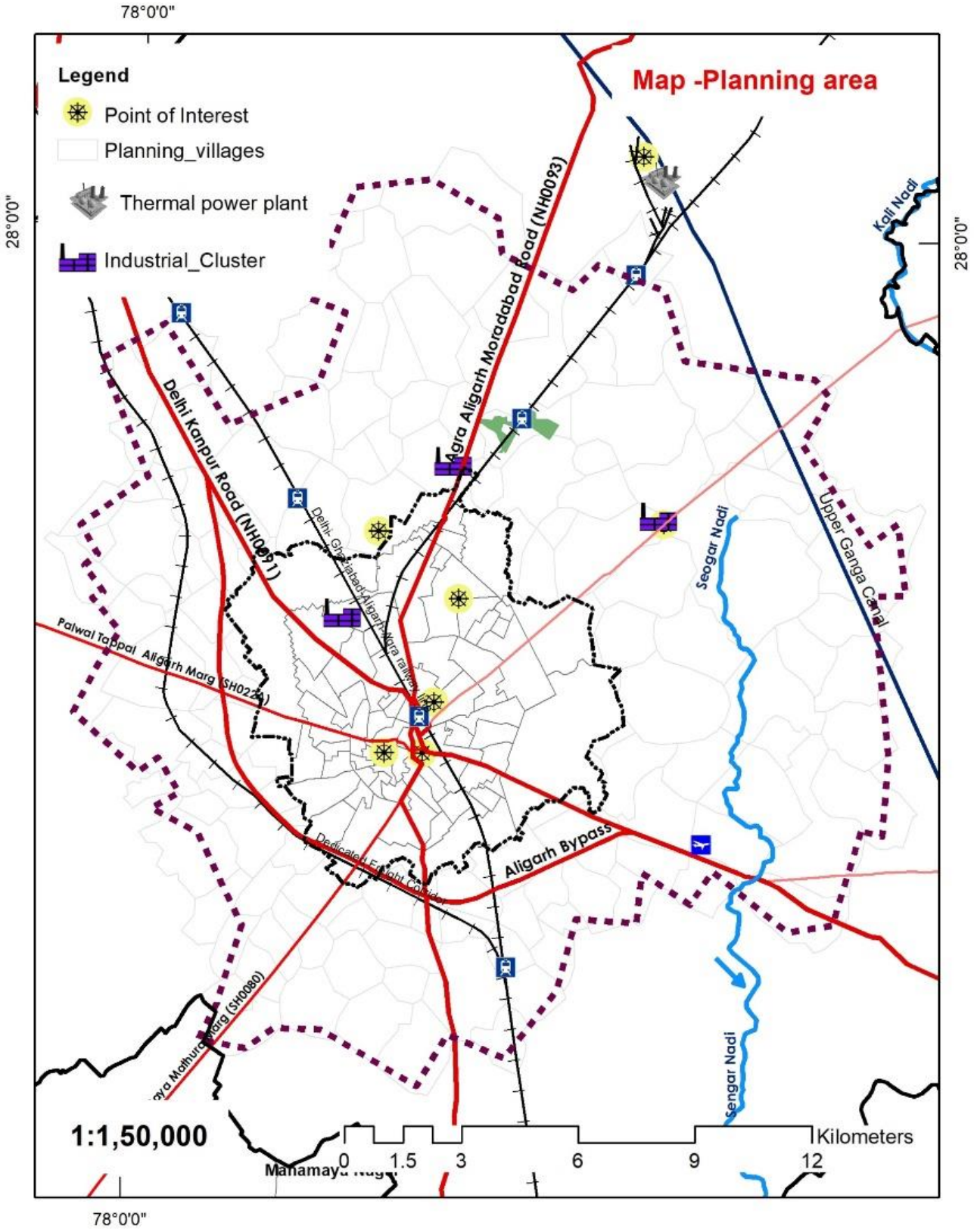
Source 3-1 (Author, 2022)

There are numerous places of Interest like Upper kot Jama Masjid & wholesale market, Center point (Commercial hub), Talanagri & Cherrat : Industrial clusters, Harduaganj: Thermal power plant, Shekha jheel : Bird sanctuary, Aligarh Fort : Protected area.

It is well connected via Railway- Delhi-Aligarh-Kanpur- Howrah main route and Aligarh-Bareilly Branch line and Presence of Aligarh Railway station (Class A) in its heart. Roads- 2 NHs 2 SHs and 4 MDRs (NH91, NH 93 and SH22A, SH80).

It is 130 km from National Capital New Delhi. It also has Aligarh Mini Airport (Regional connectivity) and soon will become National airport after land acquisition. The process is on from 2022.

Map 3-1 Region of the study area



Source 3-2 (Author, 2022) Mapped from (Survey of India Toposheet, 2005)

3.2 Historical Context

In SKUNDPURAAN, Kol was a Malecha tribe that wander in the forest. In MAHABHARAT, Raja buddha Sen built the fortress on higher part and it was believed Kol was jhil (lake). During the travel to India in 1342 around, Ibn Battuta (from his Rihala book) from banaya to koil to jalali to tajpur. About Koil he observed that It's a handsome city possessing gardens. Most of the trees are mango. Bain/ Baolies are here along the road where he used to rest during his travel. It was a custom that Villagers (Aligarh city to Shekha jheel) used to construct ponds to collect rain water and drink water from it the whole year. Some of the place here took their name from lake, tank and sheet of water such as pokhar, kunda, dig, dabha, daha, nimna, dariya, tal, kachhar, jal etc. (Siddiqi, 1981)

The Town early origin is Khai Dora and it was once a Moat for the fort in the city. The north western part of Aligarh town was full of water throughout the year, which also gave rise to the growth of deep morass before the excavation of Aligarh drain.

During 1500-1600 Another Aligarh Fort on northern side was establish and during 1724-28, Upper cot Zama Masjid was constructed. Sabit Khans' tank was once linked with the Aligarh Jama masjid through underground channel. Mughal period also witnessed locks making in Aligarh. During 1787, SE Part of the town was under forest as per James Rennell's memoir a map of Hindustan. Main source of water was Well and river.

Sources of irrigation were ponds and lakes and water reservoirs in villages. Construction of Upper Ganga Canal happened in 1852 and in 1870, Johnson and company was established for Lock making.

In 1885, Sir Syed Ahmed Khan consulted various reputed persons while selecting AMU site and it was observed that Aligarh's "Aab-o-hawa" is "perfectly suitable" for the intellectual and physical well-being of an individual. The water levels and the quality of water was reasonably good.

During 1899 to 1940 Increase in villages abadi and growing value for agriculture land led to sharp decline of the groves. During the Independence in 1947 a shift in urban areas from rural areas is observed. Then in 1968, Harduaganj Thermal Power Station was established.

In 1975, J & Company collapsed and formation of micro and small-scale industries across Aligarh city took place. During1981 to 1991, decadal population growth rate was highest in the district (29% in the district while average was 22%). In 1992, Talanagri was proposed for the good industrial growth. Establishment of various large industries around Aligarh gave rise in population

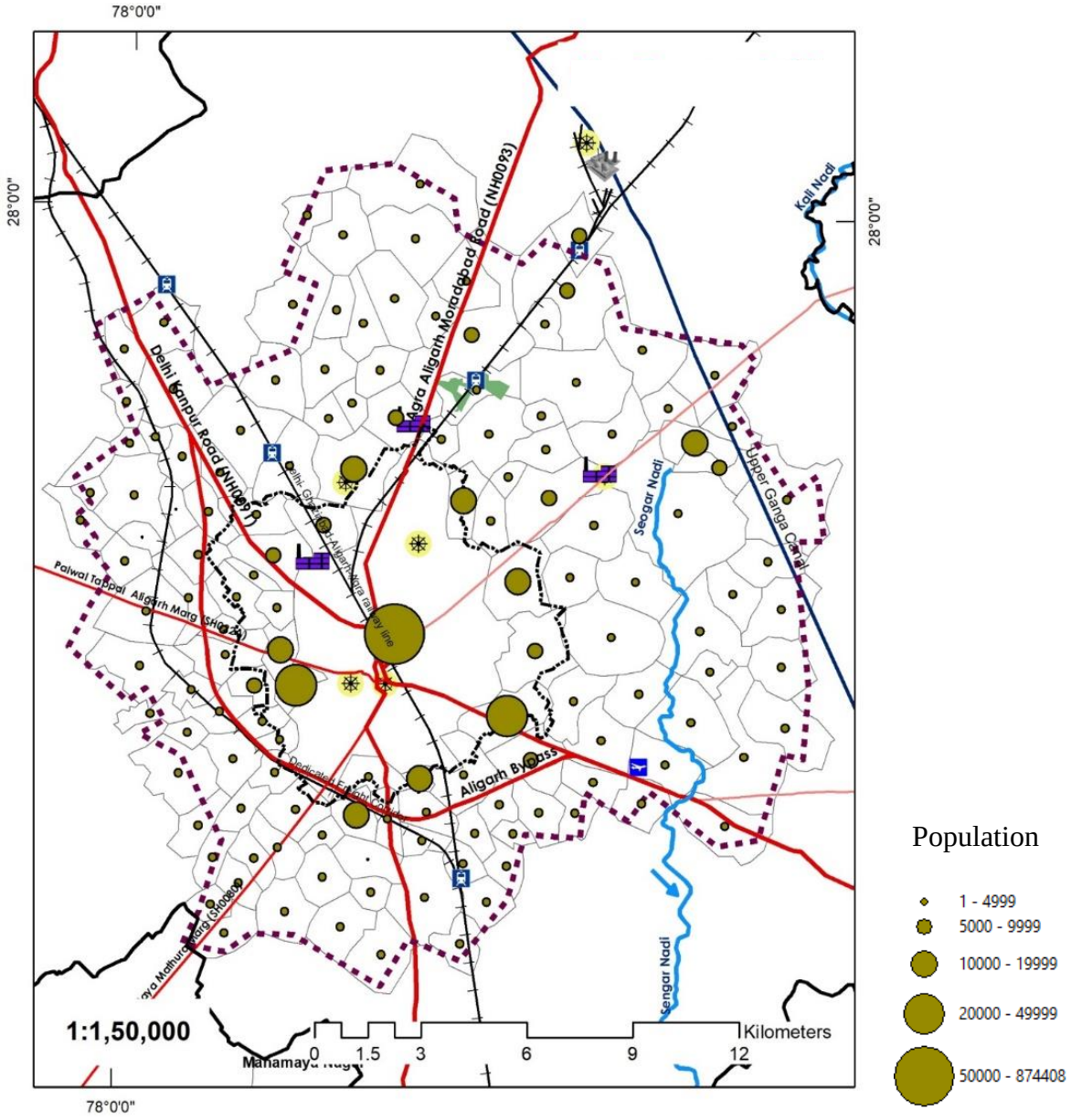
During 2000-2016 People started to think about major issues, (2004 Udaan society) Various societies were established to revive the natural resources and other issues. (Conservative approach of people) In 2005 JNNURM started, in 2014, AMRUT & SBM (Enhancement of existing infrastructure) started, Under Smart city mission 2015 rejuvenation of 2 ponds is being undertaken.

In 2022, five AMRUT Sarovar will be developed.

3.3 Demography and Socio-Economic profile

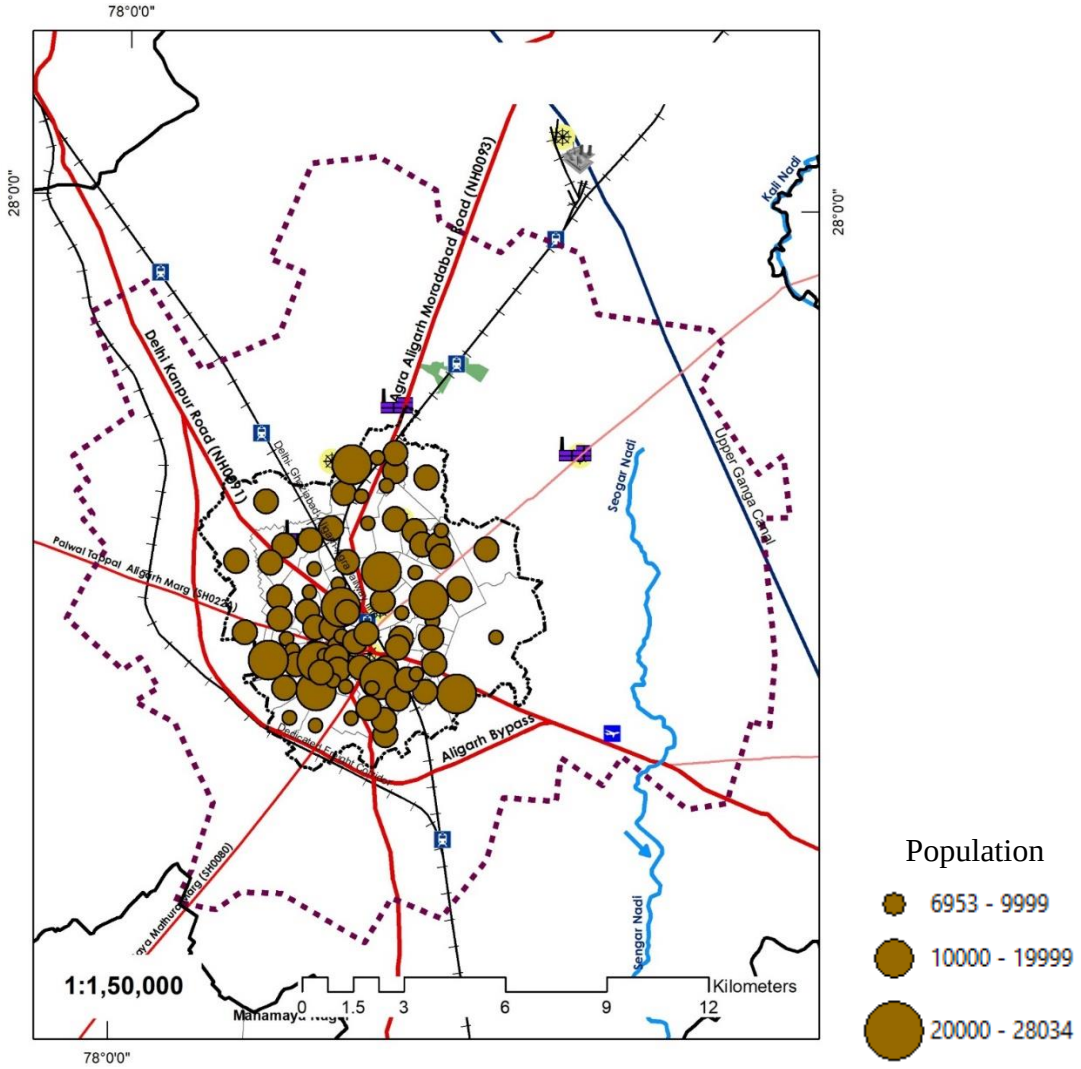
Aligarh Planning area as per the Master Plan 2021 has 129 villages & 9 Census town & 2 urban area as per 2011 and 10 villages are above 5000 population. The Rural population is 1,70,480and Urban area population is 8,88,098. So, Total population is 10,58,578 which is 28.1% of District population. It is noted that Aligarh city has 4 Zones and 80 wards.

Map 3-2 Population distribution



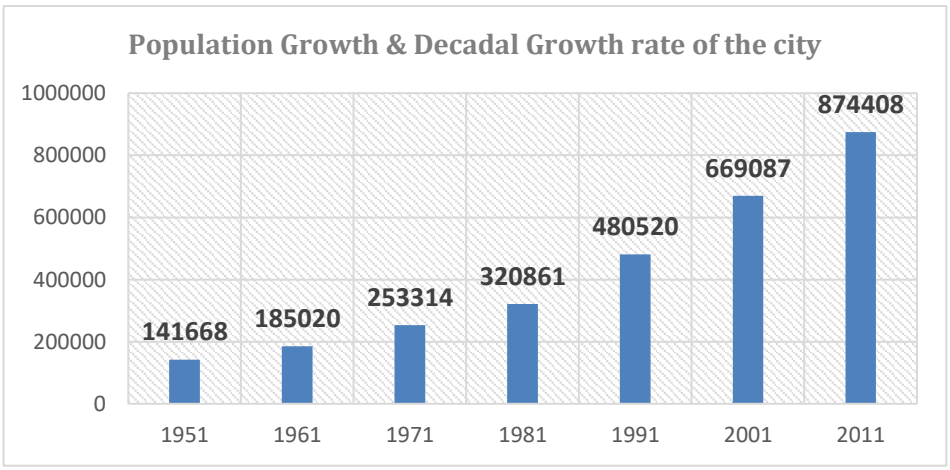
Source 3-3 (Author, 2022) Mapped from (Survey of India Toposheet, 2005)

Map 3-3 Population of Aligarh city (wards wise)



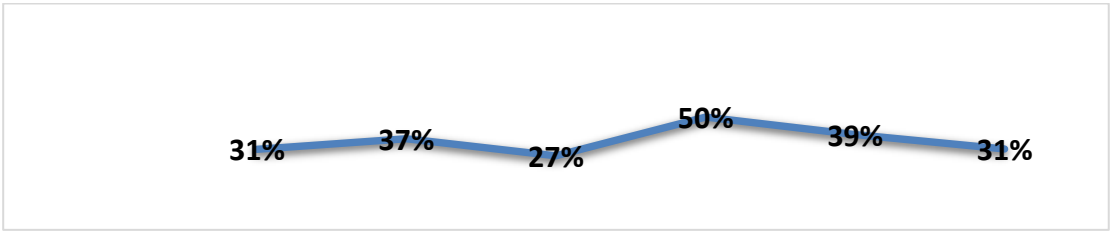
Source 3-4 (Author, 2022) (Survey of India Toposheet, 2005) (Census of India, 2011)

Chart 3-1 Population growth



Source 3-5 (Census of India, 2011)

Chart 3-2 Decadal growth rate



Source 3-6 (Author, 2022)

Aligarh city covers 40.43 sq km. As per Census of India 2011 the total population is 8,74,408 and density is 21,627 p/sq km, Sex ratio is 894 and literacy rate is 68.52% the last decadal growth 30.69% is observed from 2001 to 2011. 24.2% of the population of Aligarh district resides in Aligarh city and it is the 53rd Most populous city in India. However as per the request of Proposal for Solid waste management 2021, the city area is 63.82 sq km and the population is 13,21,579 and the density is 20708 p/sq km.

3.4 Land Use

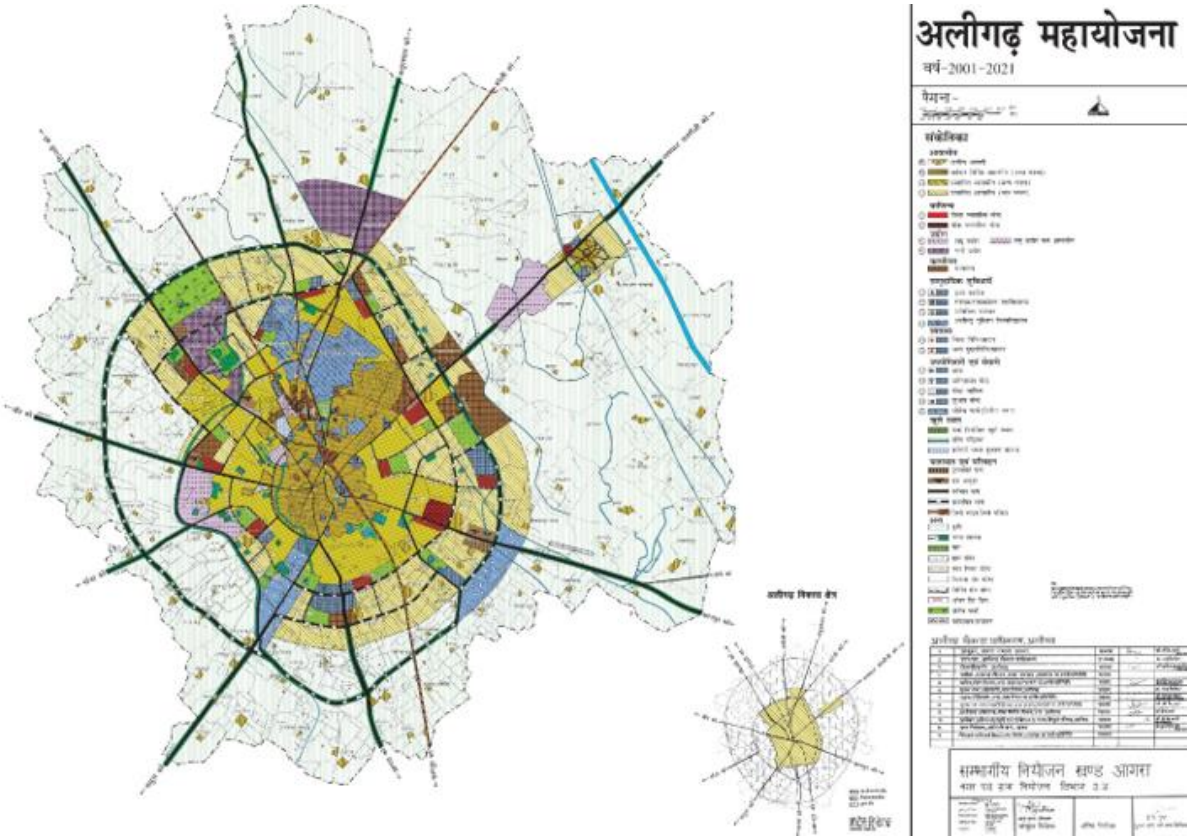
In 1975, Aligarh was declared as Aligarh regulated area which comprises Aligarh Municipality and 110 Villages. During 1980 Aligarh got its Proposed master plan 2001 with an area of 4980 ha Aligarh Development Authority was formed in 1981. The planning area has excluded the cantonment board land, land of India navy, Airforce and Army within 8 km. In 2003, Aligarh got its 2nd Proposed Master plan 11470.5 ha. and Now Draft Master plan 2031 is available for public suggestions till 5 July 2022.

Table 3-1 Land use Comparison and with URDPFI 2014

Land Use	Proposed Master plan 2001	Proposed Master plan 2021	URDPFI
Residential	44.2%	53.42%	36 to 39
Public & Semi public	9.1%	11.21%	10 to 12
Commercial	3.6%	2.26%	5 to 6
Industry	10.2%	9.4%	7 to 8
Recreational	8%	9.67%	14 to 16
Transportation	13.3%	9.45%	12 to 14
Agriculture, Water bodies and special areas / Mix use	11.6% (University area)	4.59%	

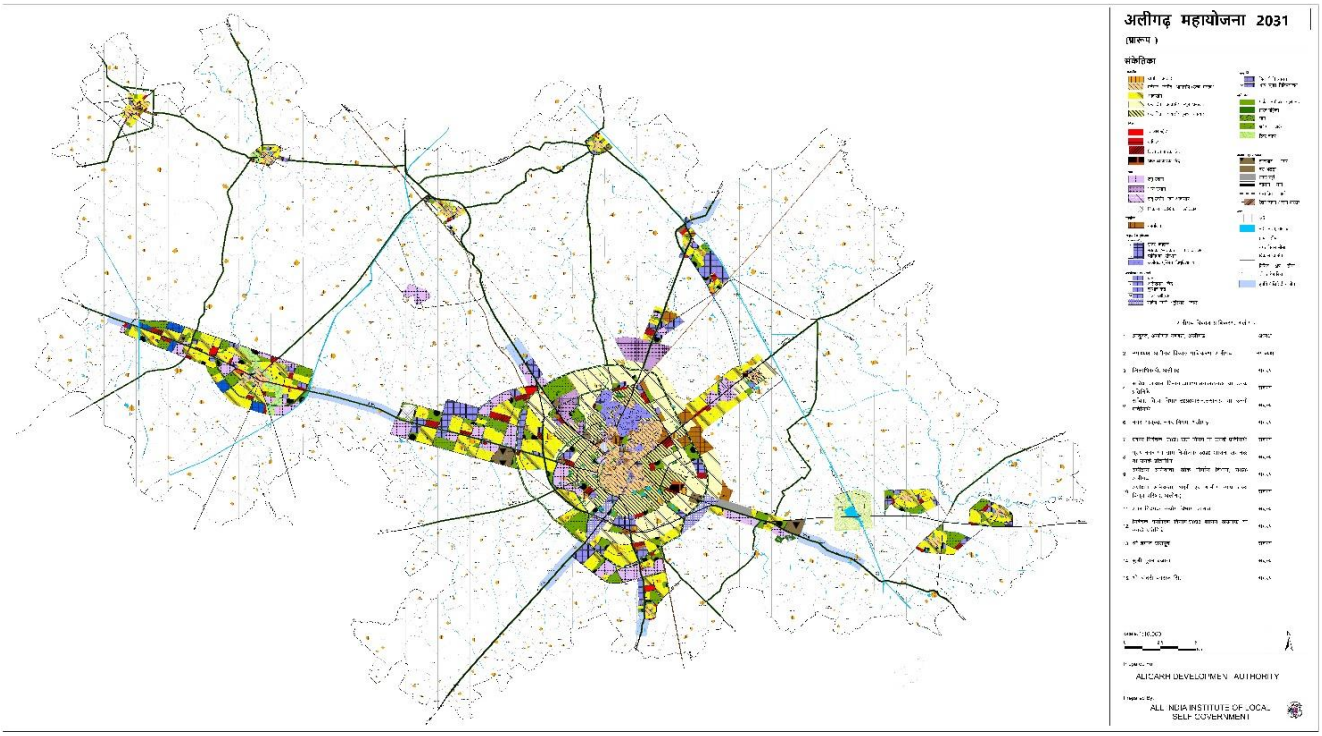
Source 3-7 (Aligarh Development Authority, 2022)

Map 3-4 Proposed Land use 2021



Source 3-8 (Aligarh Development Authority, 2022)

Map 3-5Aligarh Proposed Land use plan 2031 (Draft)



Source 3-9 (Aligarh Development Authority, 2022)

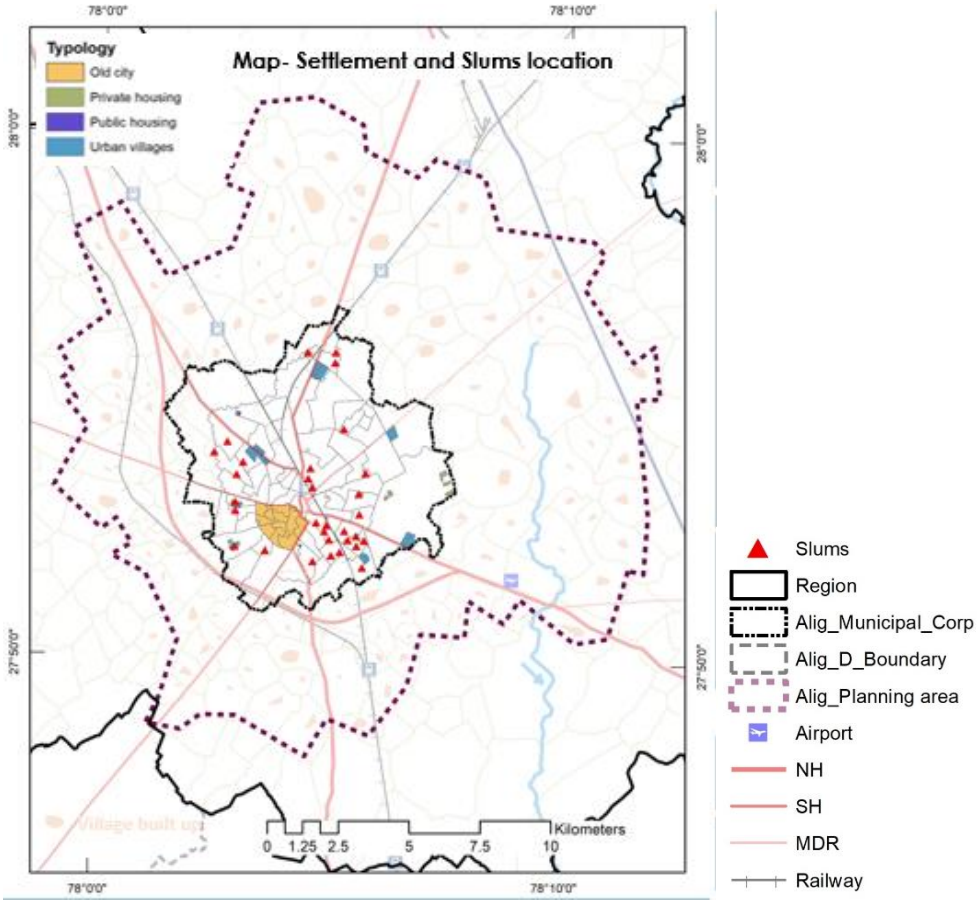
Map 3-6 Aligarh Extended master plan

Source 3-10 (Aligarh Development Authority, 2022)

3.5 Settlement Typology

The city has various type of settlement typologies such as planned development, unplanned development, old city area and privately owned developed colonies Old city is a place of relatively narrow streets surrounding variable sized & irregular shape of plots. Major commercial streets in old city which draws heavy traffic congestion.

Map 3-7 Settlement typology



Source 3-11 (Author, 2022) Mapped from (Survey of India Toposheet, 2005) and (City Sanitation Plan, 2014)

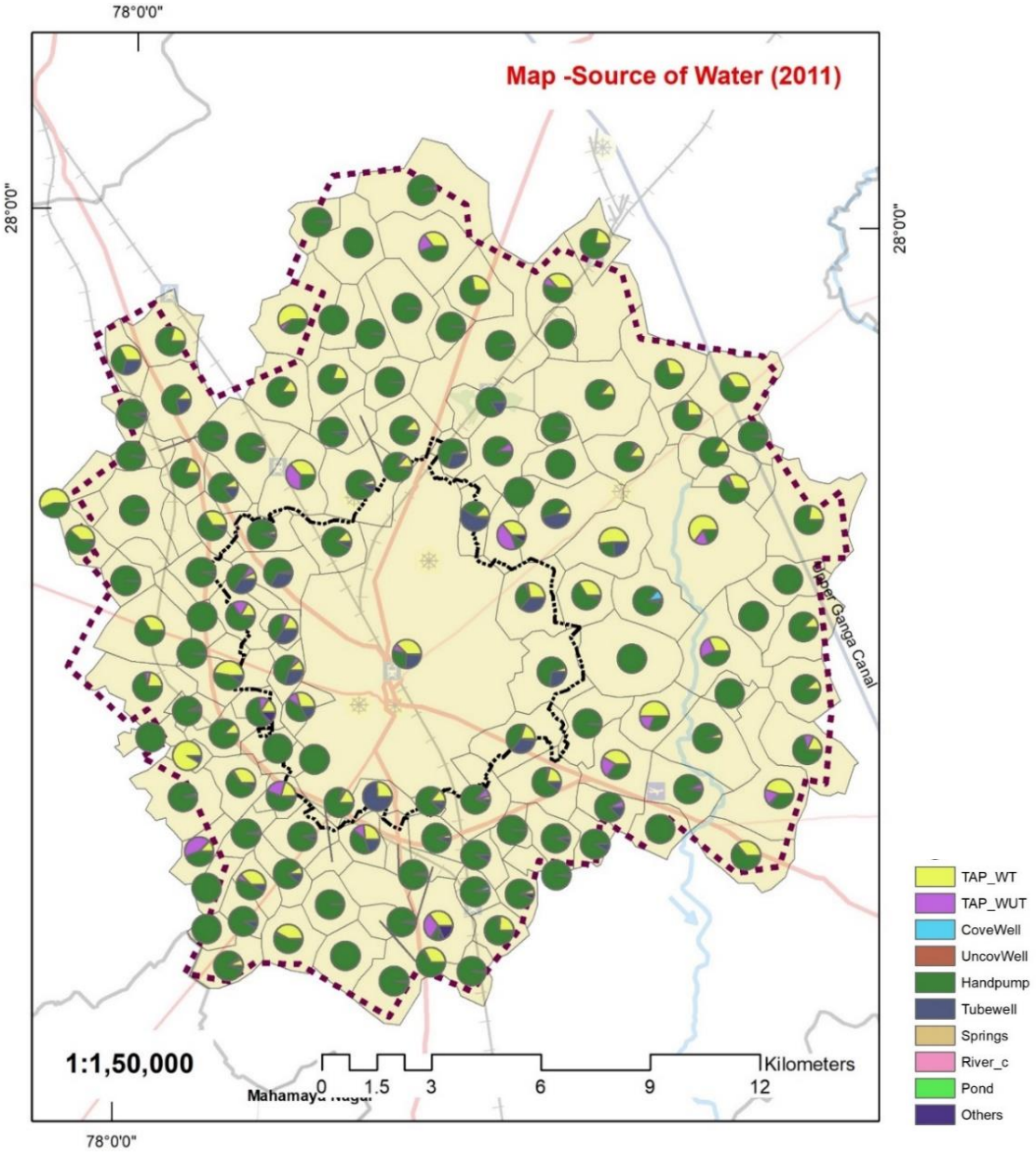
The maximum proportion of slums lies on the southern part of the city along the water bodies. There has been a sharp increase of Slum population from 2001 to 2011 and numbers of slum in 2001 were 174300 (26%) and in 2011 were 367134 (44%) as per the Census of India. Further, the city has a high percentage of slum population (41.98%) with barely any access to civic amenities.

3.6 Physical Infrastructure

3.6.1 Water Supply

Only Pariyavali village has tap connection of 10% and rest of the villages have no coverage and demand is being met with hand pumps and individual borewell. Almost all the villages are dependent upon Handpump as per the Census of India 2011.

Map 3-8 Source of water in villages



Source 3-12 (Author, 2022) Mapped from (Census of India, 2011)and (Survey of India Toposheet, 2005)

Piped water supply system was introduced in Aligarh city in the year 1975. The Municipal supply is mainly dependent on groundwater for supply and to make matters worse, the water supply and sanitation status was well below the MoUD Service Level Benchmarks in 2015 with coverage of water supply connection being only 31.1 percent and per capita supply being 90 LPCD, implying that most of the households would be dependent on private borewells. The city has 124 numbers Tube wells, 6 Nos of UG Storage, 7 Nos RCC Overhead tanks, 8 Water ATMs, some tankers. 14 locations from the city are receiving contaminated water issues as per the local newspaper.

Table 3-2 Demand and supply and overview of the connections

Demand	Supply	Gap
205 MLD	120 MLD	85 MLD

Houses	Water connection	Gap
2.32 lacs	1.06 lacs	1.26 lacs

Hand pump	Working	Non working/ others
4580	75%	25%

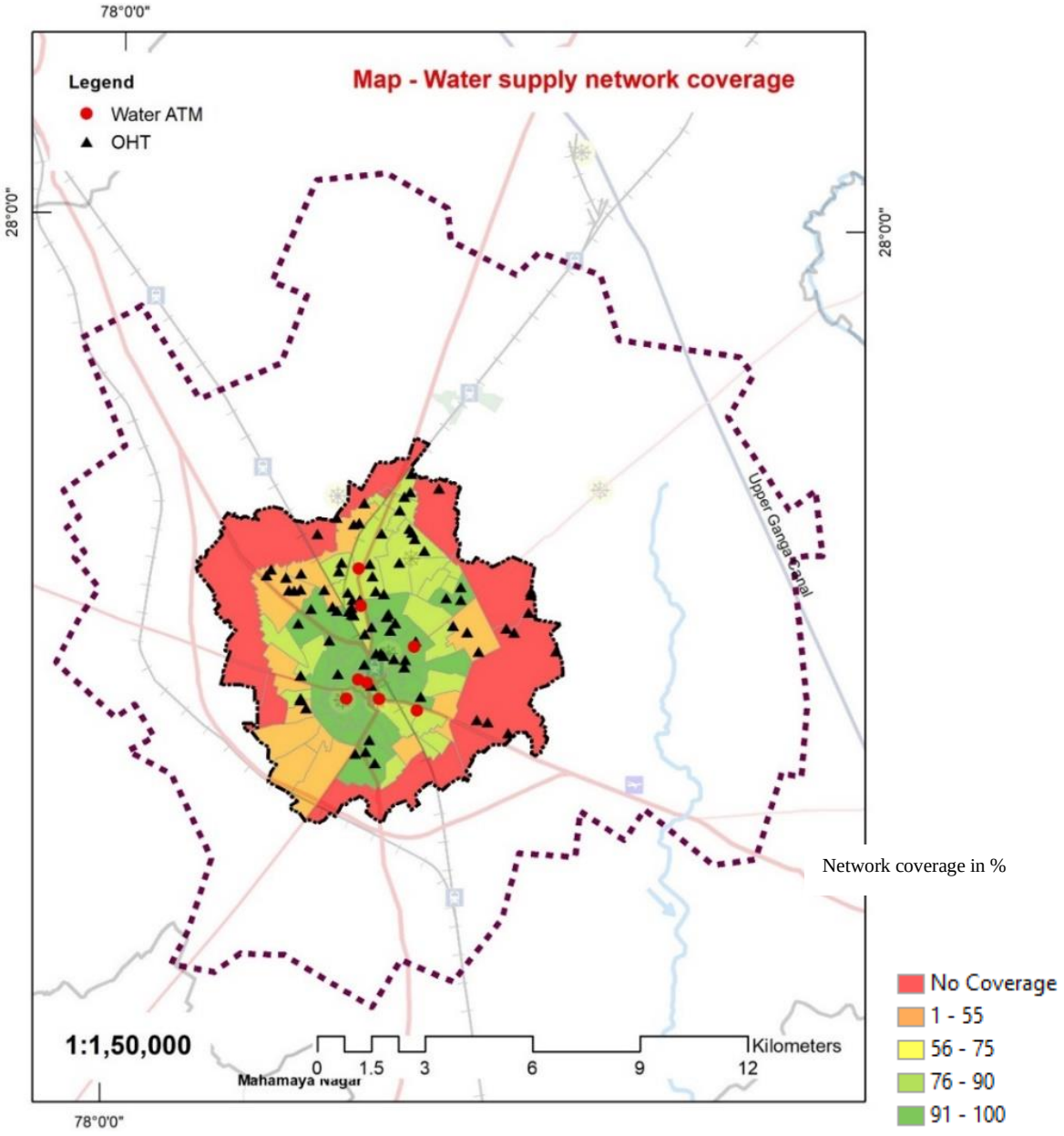
Source 3-13 (PrimarySurvey, 2022)

Table 3-3 Coverage and Benchmark comparison

Parameters	**Existing Scenario**	**Benchmark-MoUD**
Population Coverage of water supply Connection (Water supply connection)	82,326 (31.1%)	100% (2,64,290)
Area Coverage of Distribution network	Ward wise 2019 data is shown	
Per capita supply	90 lpcd (lowest in state SAAP 2016)	135 lpcd
Extent of metering of water connection	0%	100%
Non-revenue water	21.4%	20%
Continuity of water supply	2-4 hours 3 times a day	24 hours
Cost recovery	78.3%	100%
Efficiency in collection of water supply connection	87%	90%
Quality of water supplied	88.32%	100%

Source 3-14 (PrimarySurvey, 2022)

Map 3-9 Network coverage of Water supply in percentage



Source 3-15 (Author, 2022) Mapped from (Survey of India Toposheet, 2005)

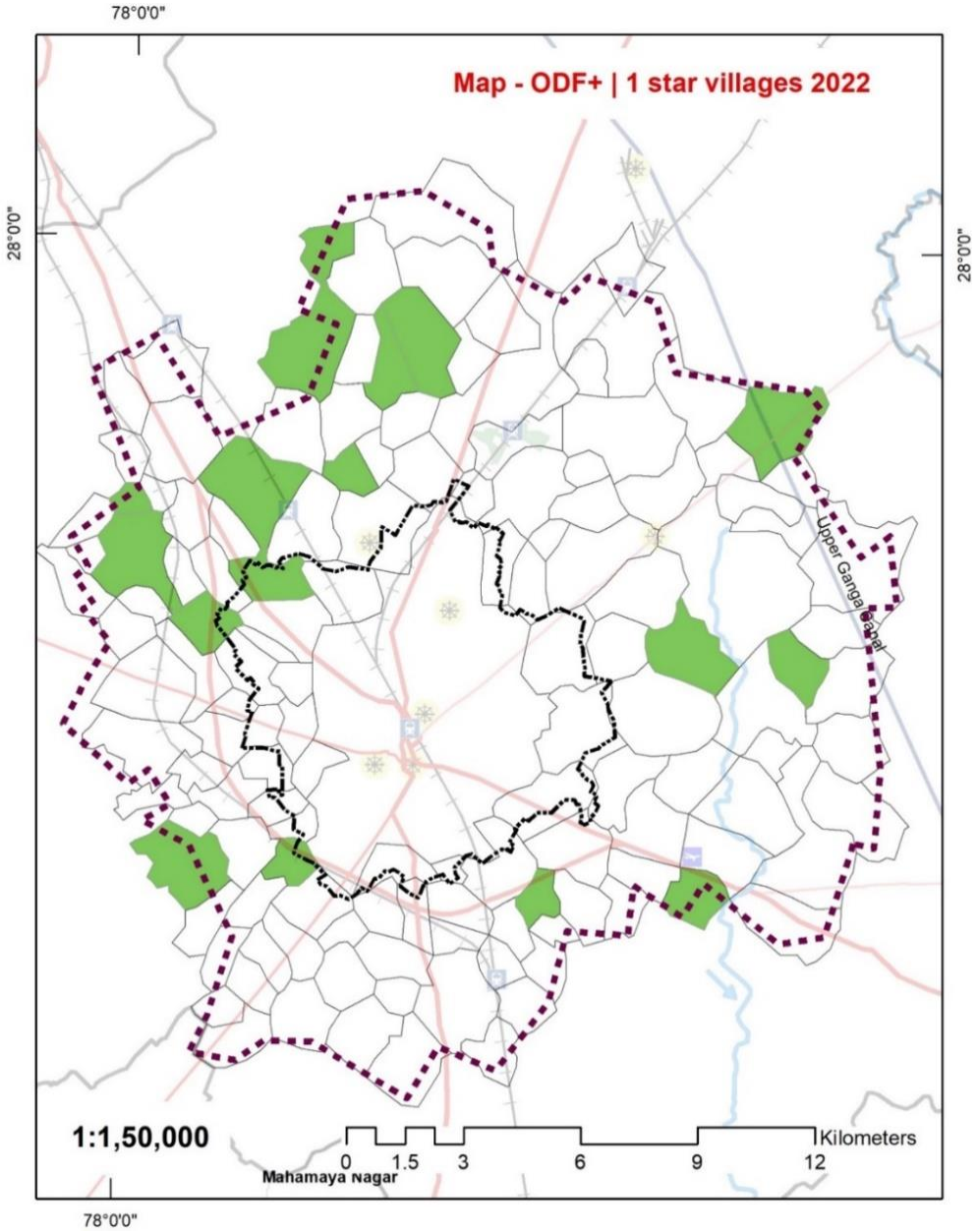
Distribution system comprises of PVC/GI/AC Pressure Pipes in sizes ranging from 65 mm to 400 mm dia. Total length of distribution system is nearly 731 KM as of 2016.

Schemes that are ongoing in the area include Water supply 24 X 7 under smart city mission.

3.6.2 Sewerage and Sanitation

Most of the household in the villages are dependent upon septic tank system. Census of India 2011 and as per SBM G portal 2022, 17 villages are ODF+ villages out of 129 villages.

Map 3-10 Green colored Villages showing ODF+



Source 3-16 (Author, 2022) Mapped from (Survey of India Toposheet, 2005)

The Aligarh city has received ODF+ (2019) and ODF++ certification by QCI in 2020.

Table 3-4 Capacity of Waste water treatment in Aligarh

Location	Capacity	Status
Mathura-Iglas road (STP)	45 MLD	Under Construction
Mathura-Iglas road (FSTP) (1000 Rupee septic tank cleaning service)	32MLD	Recently started working Feb 2022
AMU STP	10 MLD	Treatment for amu
AMU SWING (Constructed wetland)	1000 people	Treatment for amu

Source 3-17 (PrimarySurvey, 2022)

The Sewerage network and coverage study was carried out and following observation were made. In terms of Septage management, An FsTP was opened in Feb 2022.

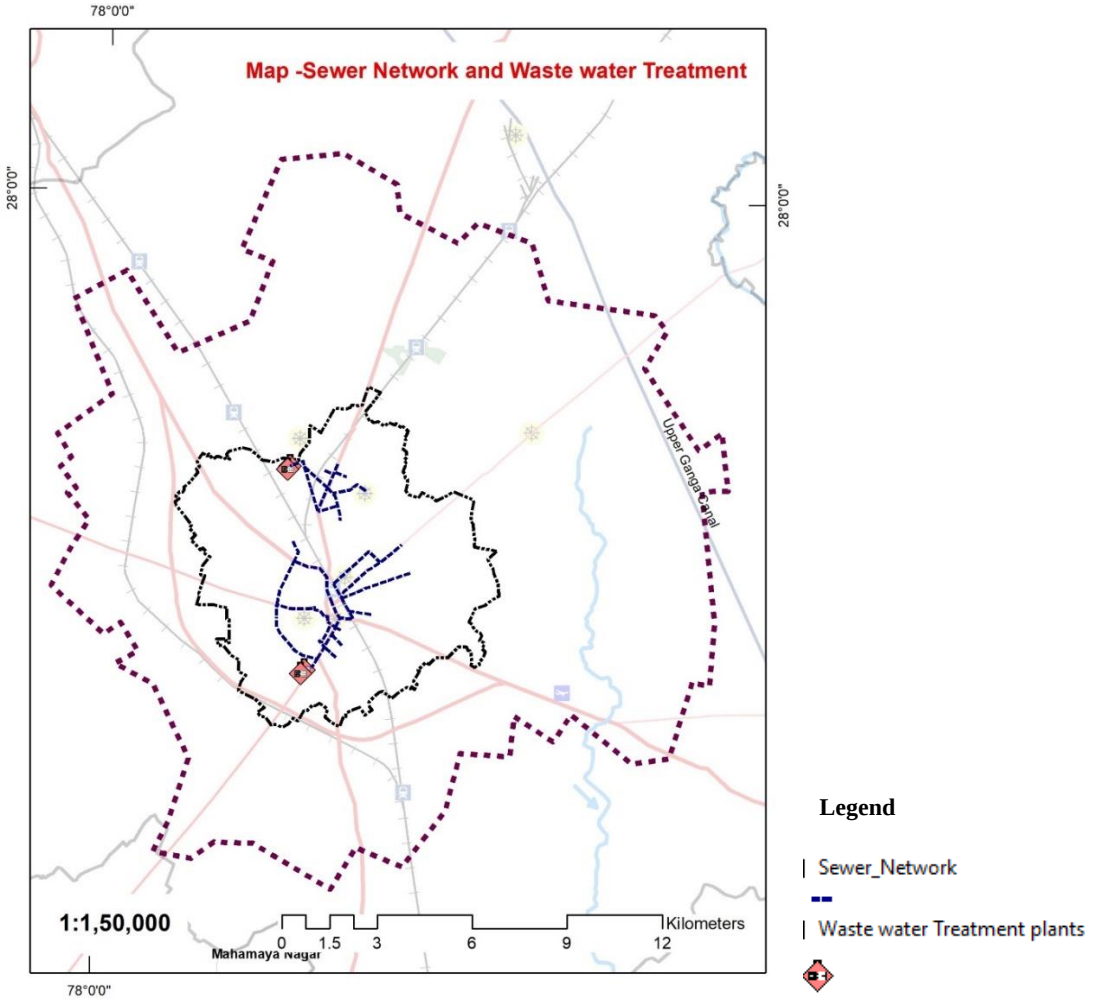
Table 3-5 Coverage and Gap assessment

Parameter	Gap
Sewerage Generation = 79.08 Capacity=55 MLD	24.08 MLD
Population covered= 20%	80% Population uncovered
Network coverage(Area)=3.54%	96.46% Area unsewered

Source 3-18 (PrimarySurvey, 2022)

The Untreated sewage is directly disposed of in the open drains and open plots. Only 3.54 % of the city's population is connected to the sewerage network with rest being dependent on on-site sanitation systems that have a high chance of polluting groundwater and waterbodies.

Map 3-11 Sewer network coverage

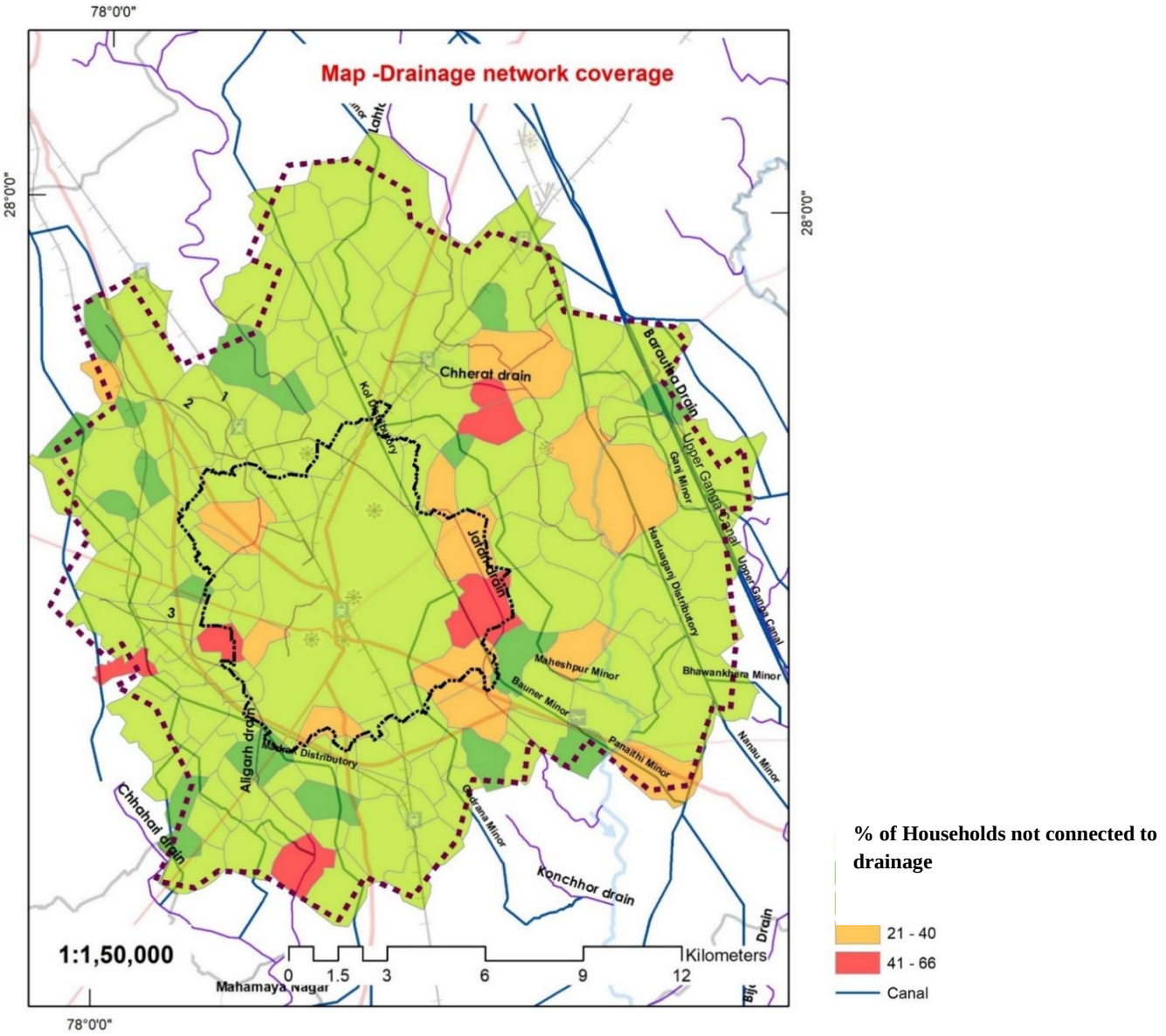


Source 3-19 (Author, 2022) Mapped from (Survey of India Toposheet, 2005) and (CityGIS Aligarh (ALIGARH SMART CITY LTD), 2022)

3.6.3 Storm water management

There is no monitoring for surface water quality. Due to Urban expansion, Koil distributary after 37.610 km, Gadrana and boner minors are too degraded to supply water and acting as a nalas (Carrying waste water and storm water).

Map 3-12 Drainage network coverage



Source 3-20 (Author, 2022)mapped from (Survey of India Toposheet, 2005)

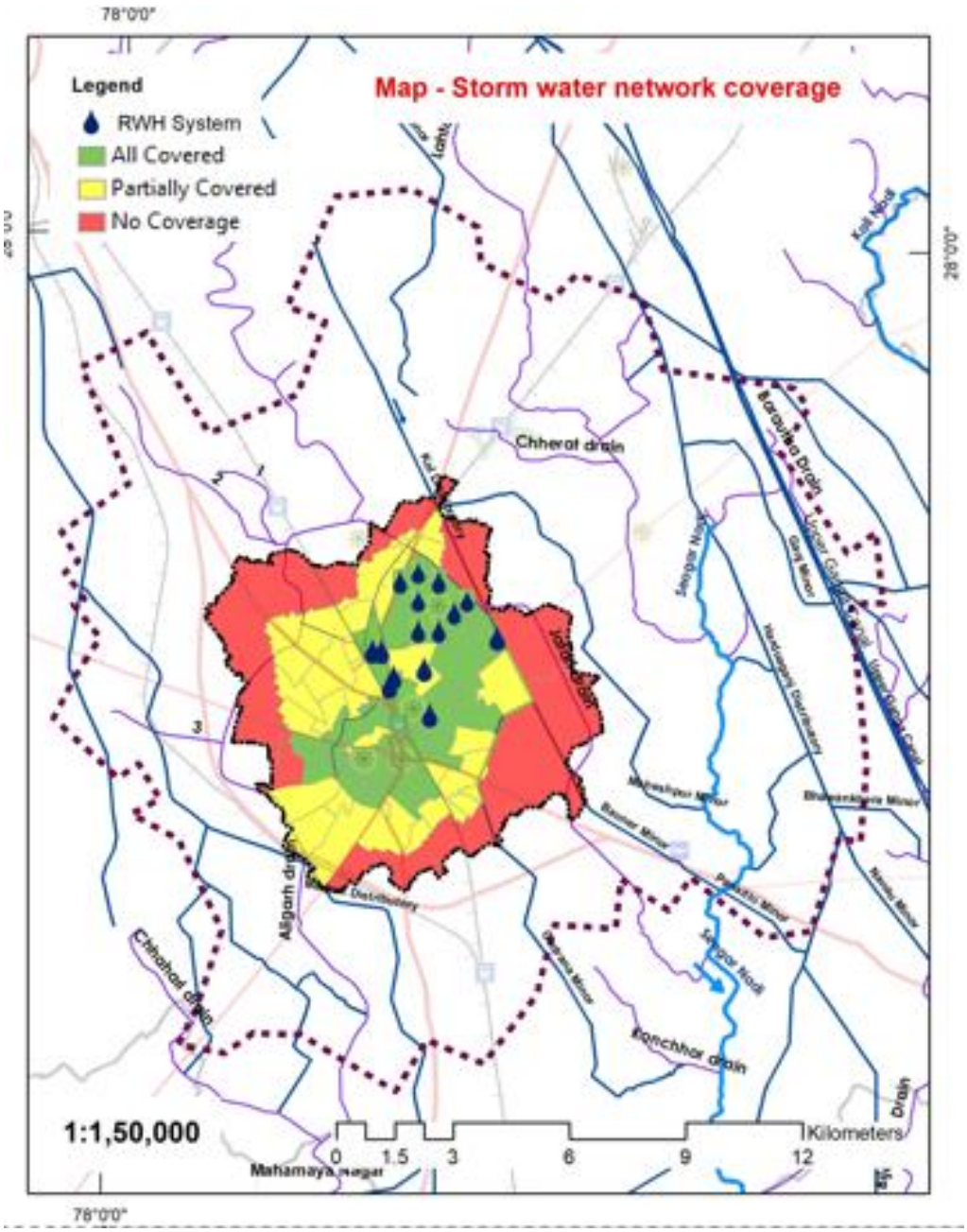
There is no Primary drain in the area. Secondary drain are Aligarh, Jafri, Chherat, Lahtoi drains (Connects to Yamuna and Sengur river) and Tertiary drains are Nalas and Engineered drains. 50 large drains (nallas) with total length 68.33 and small drains (nali) with a length of 1276.92 km. The city of Aligarh is short of 579 km of storm drains as per the sanitation plan 2014.

Table 3-6 Coverage and Gap assessment

Parameter	Gap
Coverage of Storm Water Drainage Network = 60%	40% area uncovered and partially covered
Incidence of water logging/flooding = 108	108 points/area need attention

Source 3-21 (City Sanitation Plan, 2014)

Map 3-13 Storm water network coverage



Source 3-22 (Author, 2022) mapped from (Survey of India Toposheet, 2005)

There are More than 32 locations where RWH System is installed. Few of them are-

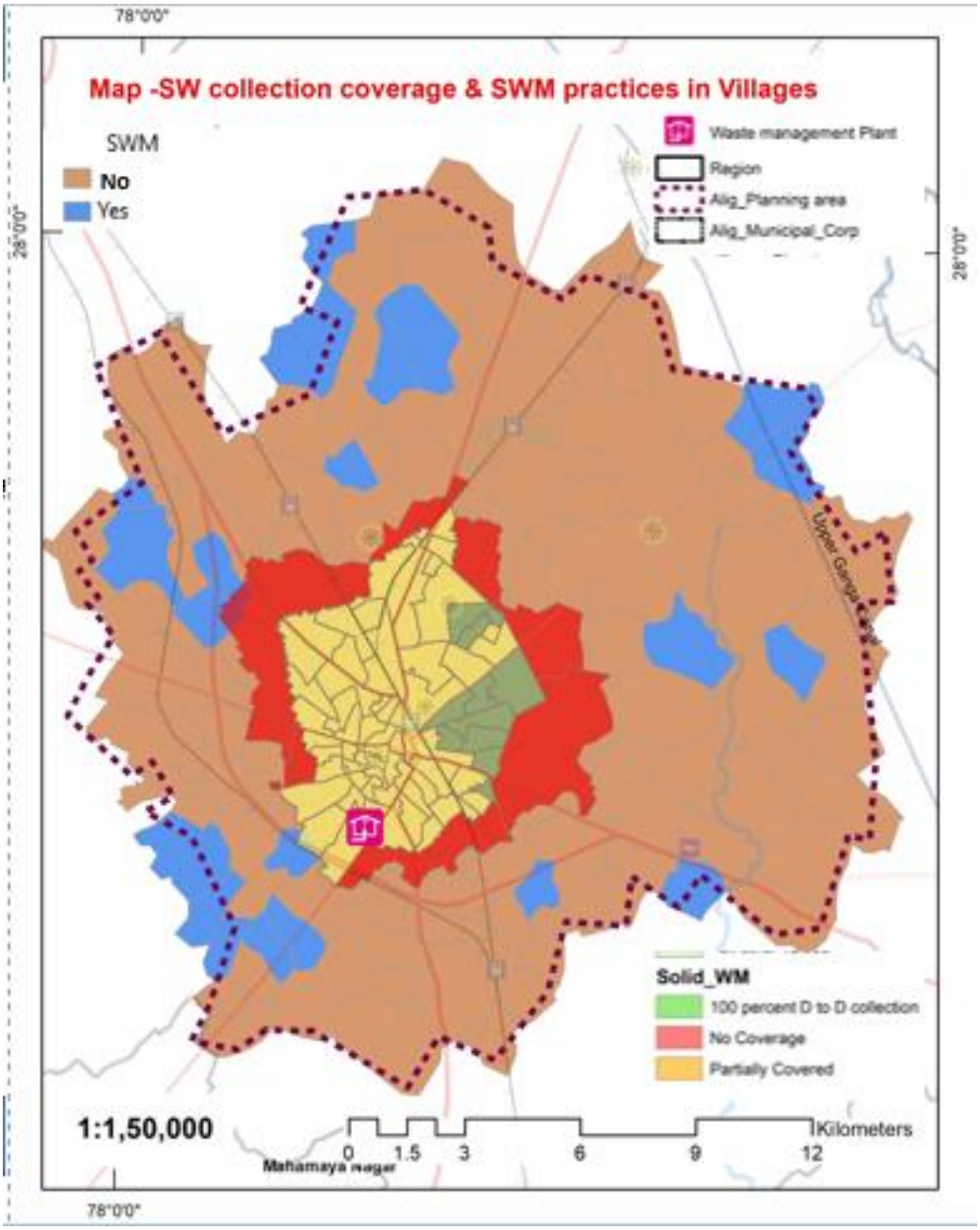
Treasury Collectorate, In front of Police line Hospital, Women's College, Jawahar Bhavan, Tibbiya College, Gandhi eye Hospital, Modular RWH at Commissioners office, Approx. 07 Nos. Govt. Buildings for Rain Water Harvesting - Phase- II, Aligarh Muslim University has established 18 nos. Rain water harvesting units at various place of the campus.

It was a Malaria prone city 2 decades back and Recently 39 locations within city and 104 villages are identified as Dengue and Malaria sensitive locations by Health department of Aligarh.

3.6.4 Solid waste management

Only few villages in the planning area are practicing SWM practices.

Map 3-14 Solid waste practices coverage



Source 3-23 (Author, 2022) mapped from (Survey of India Toposheet, 2005)

The waste management and Waste collection in the city is entrusted with the A2Z Pvt Ltd Plant and Nagar Nigam. The city stood 173rd in 2018 and 145th in 2019 and 30 Rank in 2020 and 34 rank in 2021 in Swatchhta Survekshan. Out of 80, 70 wards are practicing door to door collection and 10 Wards have 100% door to door collection.

The city received 3 stars in GFC certification. There are 267 points in Garbage dumping and 175 dustbin locations as per the City GIS. 3 areas are identified by Aligarh Municipal Corporation to dump the C & D waste and 33 locations for the twin bins for the collection of solid waste.

There is 1 wet waste treatment plant working inside the Aligarh MC area. 660.79 Tones per day waste is generated from the Aligarh city and transported via Tractors, Tata Ace, Compactors to the treatment plant site. Apart from these facilities, solid waste is dumped near the water bodies and the open drains and leads to pollution in the existing natural system. Bio-remediation of legacy waste in Aligarh (0.6 Lac MT) is in progress.

Table 3-7 Basic overview of Solid waste in the city

Parameters	Description
Current Population= 13,21,579	No of HH = 264290
Per Capita waste generation	About 500 gm
Total waste Generated	660.79 TPD
Total waste Collected	435 TPD

Source 3-24 (PrimarySurvey, 2022)

Table 3-8 Bifurcation of Solid waste generated

Type of Waste	Quantity (MT)	%
Domestic waste	329.67	49.89%
Commercial and others	165.92	25.11%
C & D waste	99.12	15.0%
Road & Drain silts	66.08	10.0%
Total	**660.79**	**100%**

Source 3-25 (PrimarySurvey, 2022)

After generation, Most of the Solid waste are dumped into the water bodies and open plots. Household waste are also given to Kabadi shop and Nagar Nigam mini trucks for door-to-door collection and then transporting to SWM plants. Some of the works are also ongoing such as Waste to energy plant 300 TPD (Under execution), Medical waste treatment plant and Integrated waste management system (Tender stage).

Night sweeping initiated in notified commercial areas under SBM. Composting increased: 24.35 mt/d 2013 to 34.42 mt/d 2016 and Revenue Collection from City Compost is INR 12.73 Lakh (2015-16).

3.7 Industrial Profile

The economy is mainly dependent on the secondary and the tertiary sector with 96.1% of the workers being classified as household industry workers (8.48%) and others (87.7%). (Census of India, 2011)

As per CPCB, (57/100 rank in score) Aligarh is a Severely Polluted Area in 2018 assessment. The CEPI action plan of Aligarh is under preparation since 2018.

There are a total of 5006 industrial units in Aligarh city. Of these, there are 3500 small scale industries, 2000 medium scale and 6 large industries.

In the Planning area, there are three Industrial Areas- I T I Industrial Area, UPSIDC Industrial Area sectors I and II (Tala Nagri) and Chherat Industrial Area.

As per RTI filed by the author, Regional Office has identified 297 Industries in the district. The report has 12 pages and contains the names of each Industries.

It is requested to incorporate the industries as per the category of CPCB as Red, Orange and white so that correct decisions can be made with respect to pollution.

The second RTI filed and Documents received as per the NGT order OA no. 1038/2018. 3 pages contains the list of the non-complying activity in red and orange category industries in Severely &Critically Polluted Industrial area and within 5km from boundary of Severely &Critically Polluted Industrial area identified by UPPCB for closure around Aligarh area.

In ITI industrial area there are 1 small red category industry and 4 large red category industries and environmental compensation of 50000 for small and 960000 for large industries recovered from these industries.

Out of those industries 17 industries are identified for the compensation as per Water act 1974.

As per the CPCB 2020, Shakti Nagar area is a contaminated site. For this UPPCB had carried out GW and SW samples in 2020. However, soil/ waste/ sediment samples were not carried out and the study is in process.

Table 3-9 Table showing the Score obtain by Aligarh as per CPCB Assessment

Assessment Year	Air	Water	Land	CEPI Score	Status
2009	53	48	48	**63.83**	As_Wn_Ln
2018	56.25	61.88	11.88	**64.42**	As_Wc_Ln

Source 3-26 (CPCB, 2022)

Table 3-10 Category wise Major Industries

	Industry	Category
Major Industries	Locks Industry	RED
	Brass hard ware & Sculpture Industry	RED
	Wheat flour	RED
	Metal Industry	RED
	Thermal Power plant	RED

Source 3-27 (Author, 2022)

Table 3-11 Category wise Small Industries

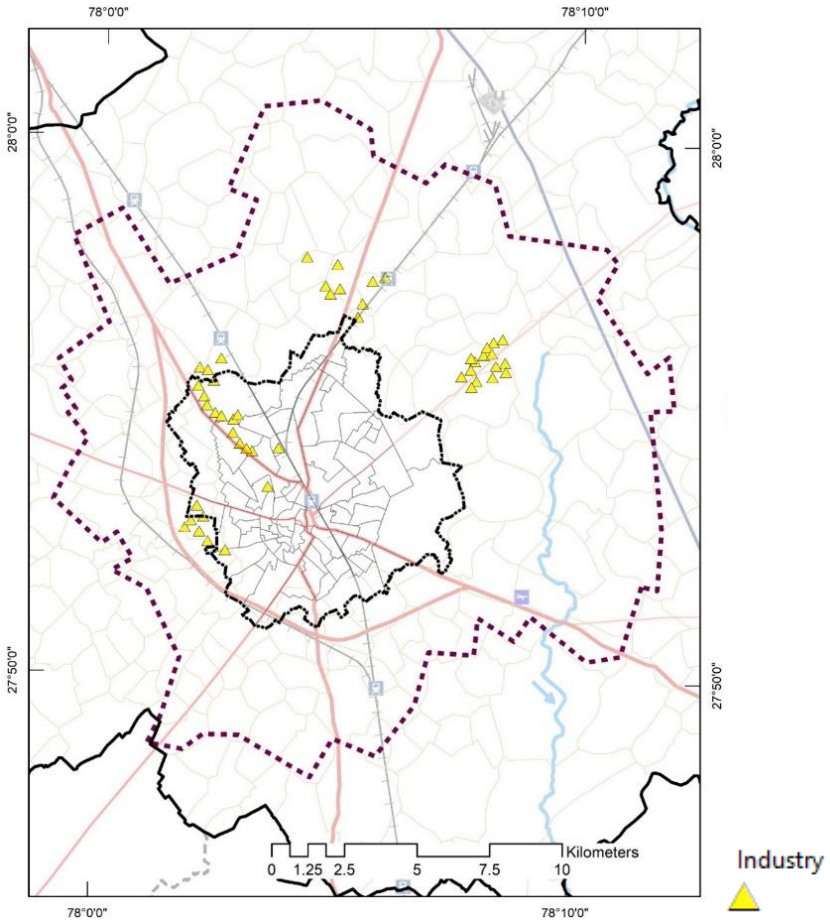
	Industry	Category
Small Industries	Agro based (Slaughter houses)	RED
	Jute processing without dyeing	Orange
	Zink-die (Polish)	RED
	Wood based furniture	Green
	Timber Industry	Green
	Metal based Steel fabrication	RED
	Engineering units	White
	Electric machinery and transport equipment	White
	Repairing and servicing	Orange
	Applique	White
	Carpets & durries	White

Source 3-28 (Author, 2022)

Map 3-15 UPSIDC Talanagri and Cherrat

Source 3-29 (UPSIDA, 2022)

Map 3-16 Industries locations



Source 3-30 (Author, 2022) mapped from (Census of India, 2011)

Most important commodities exported out of and manufactured in the city are Locks, Brass Hardware, Sculpturing, Garments.

Aligarh exhibition began on a modest scale in 1880 as a horse show. Gradually, it assumed importance and is considered as one of the biggest industrial exhibitions of state at present and is held every year. It attracts a large number of traders and dealers from all over the country.

This makes Aligarh a significant economic hub and will spur population expansion.

3.8 Conclusion

In addition to the regional context of district, a detailed and thorough study was carried out by preparing a baseline and analysing the various aspects such as environmental resources, demography, land use, Master Plan, physical infrastructure and industries in the planning area which indicates that the condition of the area is poor and it need immediate actions.

3.9 Major Issues

1. The forest and the water environment including related traditions of pond lost during the growth of the area.
2. Ground water depletion in city by 0.9m to 1.5m per year & Overexploited category.
3. Broken water channels and less identified waterbodies in the proposed land use plan 2021 and There is no separate land use classification of Water bodies and Riparian buffer and no width mentioned.
4. Gap in the Infrastructure and presence of slums and influx of various activities leads to degradation of most of the water bodies.
5. From the industrial profile, CEPI Score has raised sharp from 48 to 61.88 (Neutral to critical) in terms of water category.

4

PONDS, NATURAL DRAINS AND GROUND WATER

4 Ponds, Natural drains and Ground Water

4.1 Ponds

The definition and mapping have been studied. There is no such universal definition of ponds however there are few sources where the definitions have been defined. Some of them are discussed below-

1. Pond has been defined as a tank or lake or any other inland water body having an area of 0.5 acre (2023 sqm) or more. (Haryana Pond and Waste Water Management Authority)

2. Ponds having size of > 0.5 acres as per revenue records (Central Pollution Control Board)

3. Pond/Water body: A depression on land or a lowland area that usually holds water or remains saturated through most of the year, such as a lake, tank, pond, marsh or swamp. (URMP (Urban River Management Plan): A common framework for urban river management developed by NIUA)

The mapping has been done by taking all the possible sources such as Survey of India Toposheets, Master plan 2021, City GIS and GSI(Geology), GSI(Geomorphology), Uttar Pradesh Environmental Compliance Portal identified 6 wetlands in the city.

Through primary survey some of the ponds were also mapped because they are not mapped anywhere. The Nagar nigam listed 30 ponds in their boundary and District Environmental plan 2021 listed 27 ponds but map was not available.

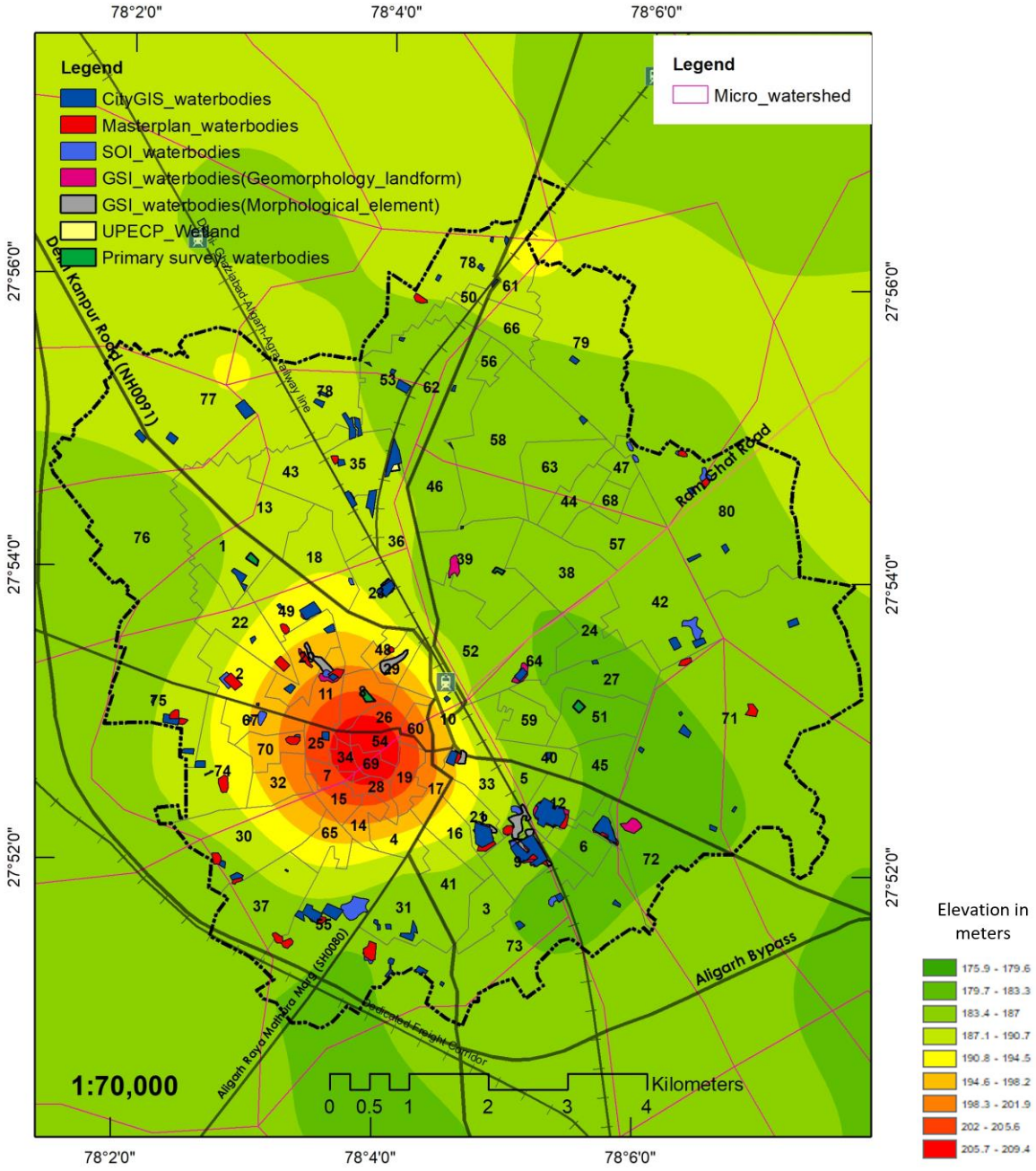
Figure 4-1 Ponds from various sources

Source 4-1 Compiled from various sources by author

Detailed assessment was done for 106 ponds (union from all the sources so the common ponds are categories in one pond) by preparing the detailed inventory and the list is attached in the annexure. It is noted that the Common ponds were also vary with size and volume. Remote sensing (WBIS, NRSC) could be the other source apart from these 9 sources. Hence there is an ambiguity in document sources of the ponds/water bodies in the area.

As per master plan 2021, 5% land is kept for ponds and water bodies if layout plan is above 10 acres.

Map 4-1 Ponds locations



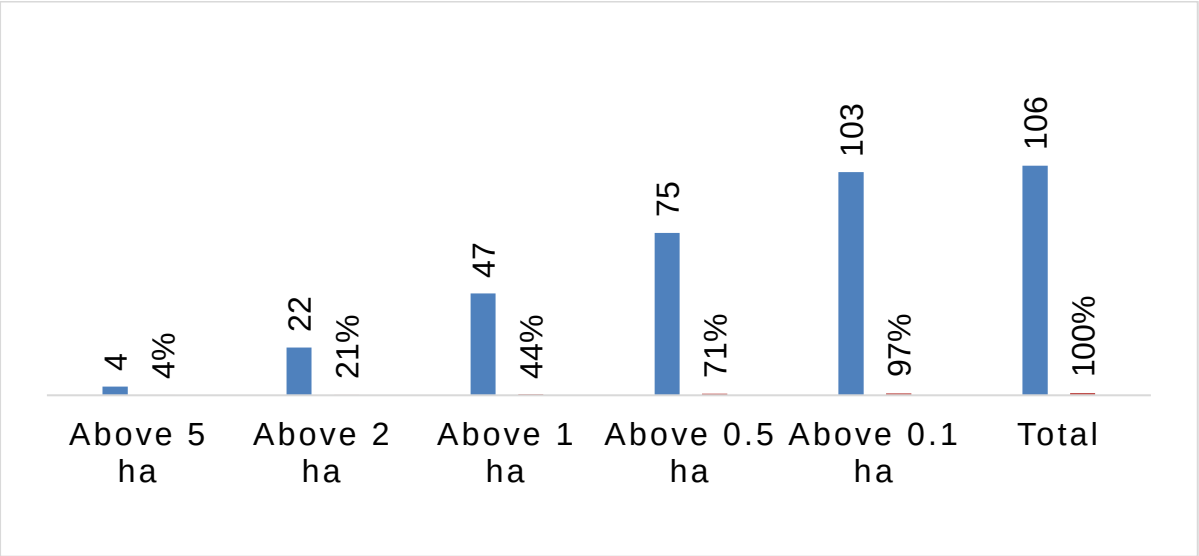
Source 4-2 (Author, 2022) mapped from various sources

Detailed Inventory Parameters

Area, Water Quality parameters like bad odor, Solid waste in ponds, Probable polluting activities, Water hyacinth, Transparency, **Surrounding area parameters like** Accessibility, Strategic Location, Land use Mix, **Governance parameters like** Development control regulations (Area changes), Ownership (Government, Private, Multiple), Presence in Number of sources, **Potential for development parameters like** Interaction with GW, Cultural Importance, Recharging Potential, Presence of biodiversity.

The major output of the inventory

Chart 4-1 Ponds classification based on area (post monsoon)



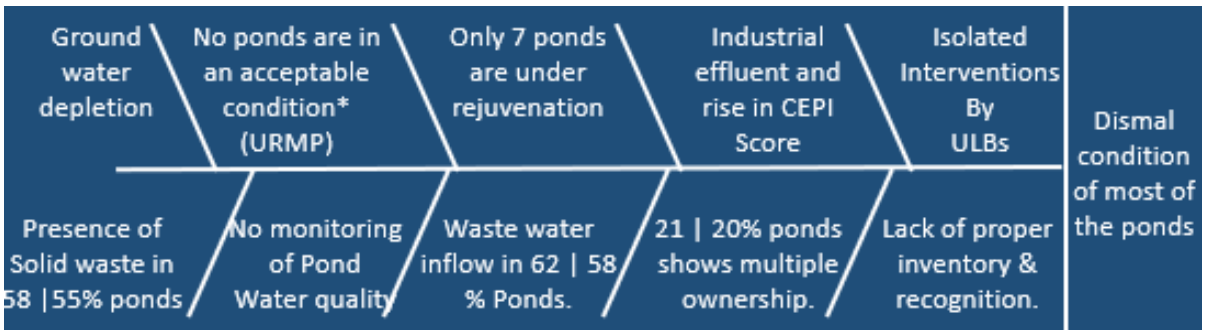
Source 4-3 (Google Earth, 2022)

The author visited total 80 (75%) ponds and Rest are In-accessible (the route was unclear) and not accessed the same. No ponds are in an acceptable condition. Acceptable condition has 6 parameters under the URMP (C6.1.3) Indicator 3: water body revival score.

- Presence of solid waste in or around the water body/pond
- No discharge of untreated wastewater in the water body/pond
- Presence of a boundary protection around a water body/ pond
- No visible eutrophication in the water body/ponds
- Minimum DO of 4 mg/l
- No reduction in volume of water from previous year.

There are following various causes of degradation of ponds-

Figure 4-2 Cause of Degradation



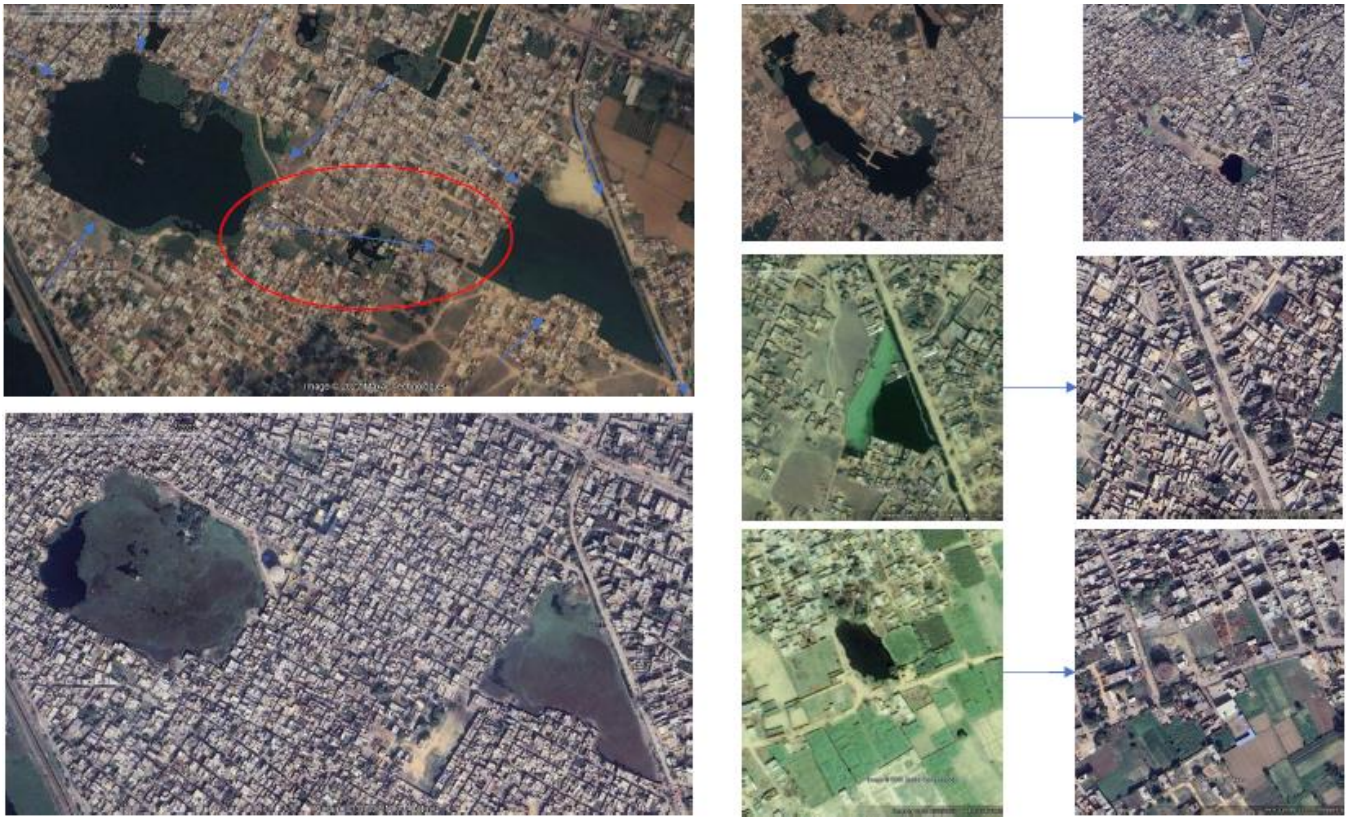
Source 4-4 (Author, 2022)

Out of it 62 (58%) shows Runoff and Rain water as a main source of water and 17 (16 %) shows Residential land use nearby and rest are surrounded by more than 2 land uses. 60 (57

%) are Perennial in nature. Only 12 (11%) showing Space availability at the edge/nearby. Almost all i.e., 58 (55%) are having Encroachment/Development around/in the ponds. 5 ponds will be developed as a Aadarsh pond and 2 are already in rejuvenation process. 62 (59%) ponds are having pakka road i.e., Quality of approach road. Probable sources of pollution are Domestic waste water, Solid waste dump, Cattle wading, Storm water for 30 Ponds (28 %). The sources of pollution also include industrial effluent, agriculture runoff etc. for other ponds as well. All Ponds have aquatic plants. 61 (58%) Ponds don't have Fish as per the primary survey 2022. Birds are present almost in 58 (55%) Ponds.

Through Sechhi disk, Transparency was checked for the ponds and 25% of the ponds are showing that only few cm sun light can penetrate in to the water. 16 % ponds bottom were not visible at all. 25% ponds have no odor however for 2% of the pond's odor can be smelt up to 100 m. Multiple ownerships are observed in 20% Ponds. And 53% Ponds are accessible by private transport. From the 2003 to till now, some of the water bodies got converted into built-up and some are used as a service for piped water supply to the nearby areas. Some of the water bodies are connected to a natural channel and now by a concrete drain and so on.

Map 4-2 The disconnection observed



Source 4-5 (Google Earth, 2022)

Non representation of most of ponds in master plan and Multiple ownership resulting in dispute and causing Encroachment and disappearance of Ponds. Concretization of ponds led to water logging in nearby areas and the interaction between ground water got hindered.

4.2 Natural Drains

Mapping has been done based on the SOI Toposheets for the drains. Almost all the Natural drains are channelized/rerouted and inner city drain (Once a ditch/Maut) is converted into concrete drain. 3 degraded canals are found out because of city growth

Table 4-1 Drains in different sources

Aspect	SOI 2005 (1995)	Master plan 2021 (2003)	City GIS 2019	Primary Survey 2022
Drains	Aligarh Drain, Jafri drain	Various water channels	13 drains (mostly are nala/minors/Jafri drain)	Walk on some portions of each Aligarh drain, Jafri drain

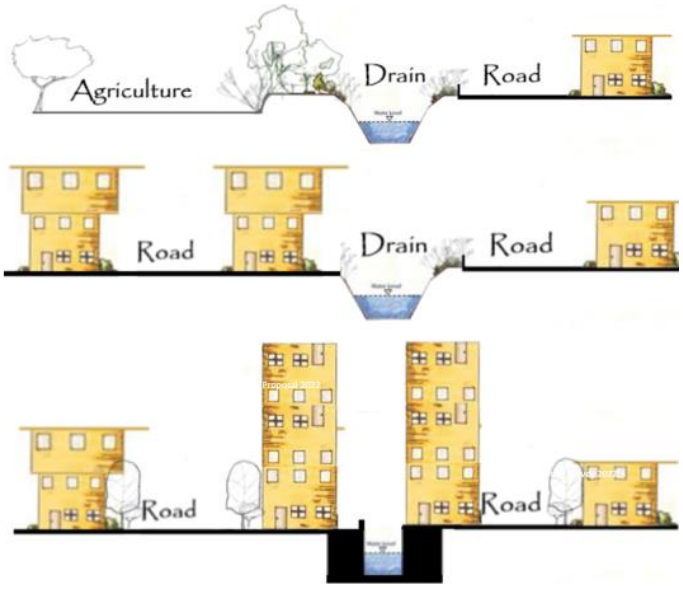
Source 4-6 (Author, 2022)

Total numbers of stretches identified for study, were 12.

Figure 4-3 Gadrana minor acting as a nala near Etah Chungi

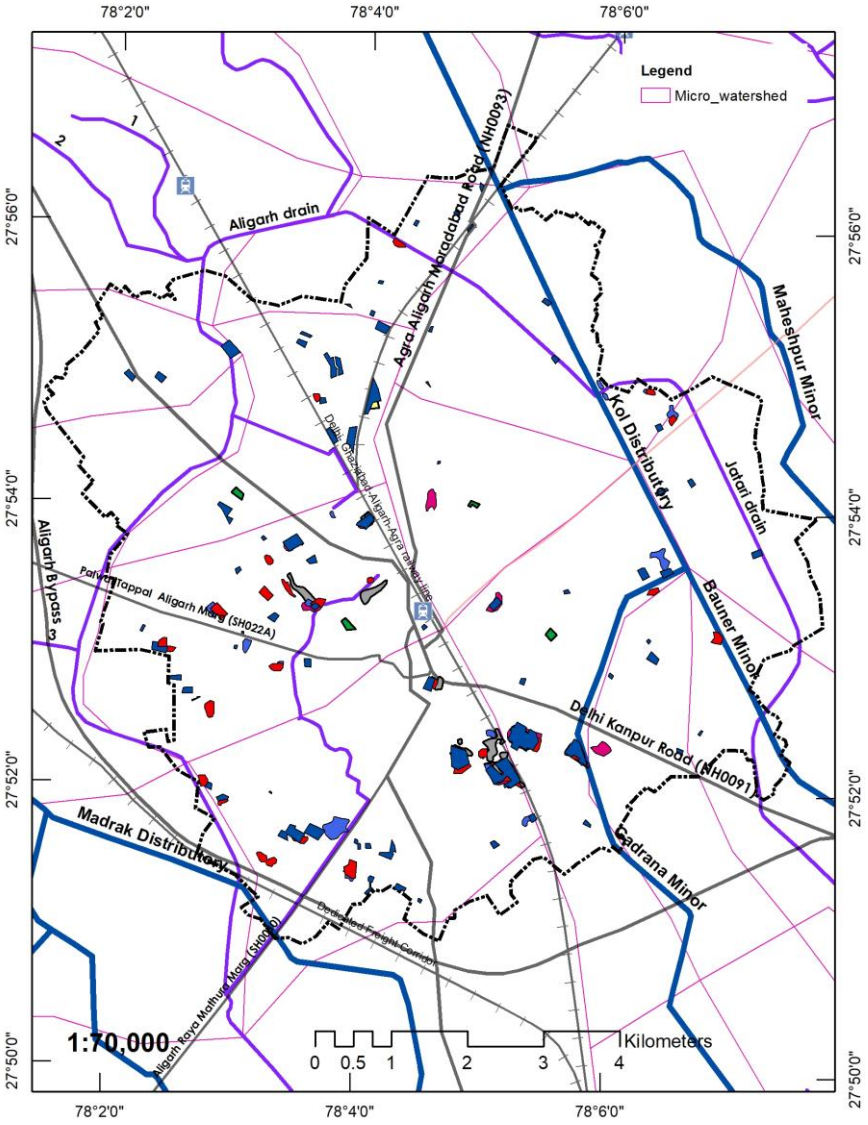
Source 4-7 (Author, 2022)

Figure 4-4 Section through drains (Upstream, downstream and In densely populated area)



Source 4-8 (Author, 2022)

Map 4-3 Drains map



Source 4-9 (Author, 2022) mapped from (Survey of India Toposheet, 2005)

Figure 4-5 Drain in Aligarh Muslim university

Source 4-10 (Author, 2022)

The detailed inventory parameters include Drain position, Capacity, Presence in Master plan, Nearby land use, Pollution potential, Ongoing works, Proximity to Urban area that are useful for identification of critical stretch for conservation. The parameters like flow, Width, Pollution load are useful for the recommendation as per NGT Order. 12 stretches of 5 drains and only unlined ones were studied. The findings from the inventory are discussed here. All drains are acting as a mix type of drain carrying domestic and industrial waste water. Aligarh drain leading towards Yamuna River and all other drains in the area heading towards Sengur river. Average width of the drains: 12 m. Average depth of the drains: 1.3 m. 4 stretches show the domestic waste water, Industrial effluent, Solid waste dump, Agriculture runoff, Cattle wading, Storm water are the probable pollution sources. 6 stretches are almost inside the municipal limit.

Some of the parameters are also list down considering their hydrological characteristics namely, flow, pollution load and physical characteristics, which can influence selection of drain wastewater treatment technology. Based on flow drain can be classified as, <20MLD – Minor Drain; 20 – 50 MLD – Medium Drain;>50 MLD – Major Drain. Based on pollution load in terms of BOD concentration, drains can be classified as <50 mg/l – Low Pollution Load; 50-100 mg/l – Modern Pollution Load; >100 mg/l – High Pollution Load. Based on channel width, drains can be classified as, <3m – Narrow Drain; 3 – 15m – Wide Drain >15m – Broad Drain.

Table 4-2 Drain parameters overview.

Drain	Flow	Width	Pollution load (mg/l)
Aligarh Drain	118 MLD	18m	220 (High)
Jafri drain	55 MLD	9m	Below 250 (High)

Source 4-11 (Author, 2022)

4.3 Prioritization and Detailed Assessment for ponds and drain

4.3.1 Ponds:

First and foremost, 1st Prioritization is from the area above 2 ha. This would allow the ponds to have a financial resource under various schemes such as RRR.

2nd Prioritization: Based on 4 criteria and 15 sub criteria (1: Lower value and 5 higher value)-

Water Quality

- Presence of bad odor

How far odor is going
5: beyond 100 m
4: up to 100 m
3: up to 50 m
2: up to 10 m
1: No odor

- Presence of Solid waste in ponds

Solid waste visible on water body
Less than 5% area: 1
5 to 10% area: 2
10 to 50% area: 3
Above 50% area: 4
100% area: 5

- Presence of Probable polluting activities

No of activity
above 5=5
4=4
3=3
2=2
1=1

- Presence of Water hyacinth

water hyacinth visible on water body
Less than 5% area : 1
5 to 10% area : 2
10 to 50% area : 3
Above 50% area : 4
100% area : 5

- Transparency

Checked through Sechhi disk
Can't see bottom : 5
Can see up to 100 cm:4
Can see up to 50 cm:3
Can see up to 10 cm:2
Can see bottom: 1

Surrounding area

- Accessibility

Transport

availability
Public Transport: 5
Pt+walking : 4
IPT : 3
Private : 2
Walking : 1

- Strategic Location

Presence of no. of these location
nearby Imp areas
developed areas
commercial streets
imp junctions
Public and semipublic spaces

- Land use Mix

more than 5 land use=5
4 land use=4
3 land use=3
2 land use=2
1 land use=1

Governance

- Development control regulations (Area changes)

Reduction in area rating
1 to 10 - 1
11 to30 - 2
31 to 50-3
51 to 70- 4
Above 71 - 5

- Ownership (Government, Private, Multiple)

Govt=5
Govt+NGO-4
Govt+ Private=3
Private=2
Multiple=1

- Presence in Number of sources

More than 5 sources=5
4 sources=4
3 sources=3
2 sources=2
1 source=1

Potential for development

- Interaction with GW

Deeper Aquifer : 5
Less Deeper : 3
least deeper : 1

- Cultural Importance

Presence of these Belongingness
History
Religious and spiritual values
People engagement
Recreational space
Aesthetic and Emotional values

- Recharging Potential

Perineal and dredging works : 5
Perineal: 3
Dredging : 1

- Presence of biodiversity

No of Species (birds, fishes)
above 5=5
4=4
3=3
2=2
1=1

Another parameter could be socially driven. And these 22 ponds have been evaluated since 5 ponds were not visited hence not documented the same.

Table 4-3 Score obtained by various ponds

Pond 3	**43**	**57.3%**
Pond 4	29	38.7%
Pond 12	45	60.0%
Pond 46	49	65.3%
Pond 47	35	46.7%
Pond 48	19	25.3%
Pond 53	38	50.7%
Pond 54	47	62.7%
Pond 66	29	38.7%
Kalideh lake	63	84.0%
New basti Pond	50	66.7%
Chautal	49	65.3%
GSI 9	16	21.3%
GSI 17	17	22.7%
GSI 2	13	17.3%
GSI 6	12	16.0%
GSI _geomorph_10	14	18.7%

Source 4-12 (Author, 2022)

Hence 2 ponds Kali deh and New basti ponds have been selected for the interventions. It is noted that New basti pond is already been selected as a AMRUT Sarovar. That is why Kali deh pond will be selected for the interventions.

4.3.2 Drains

There are 4 criteria in which priority has been decided for conservation. Scoring has given 1 is for lower value and 3 is for max value

- Proximity to city,
  (Outside planning area=1
  planning area to municipal limit=2
  inside municipal limit=3)
- Pollution potential,
  Presence of Industrial area, Drain stretch position with respect to topography, Probable sources of pollution (low=1, Medium=2, High = 3)
  (Total below 3 (low) =1, between 4 to5 (Medium) =2, above 6 (High) = 3)
- Recharging Potential,
  (Below 75000= lower =1
  75000 to 500000= medium=2
  Above 5lac = High=3)
- Ongoing works and Proposals.
  (1= 1 work/proposals/tenders
  2= 2 works/proposals/tenders

3= More than 3 works/proposals/tenders)

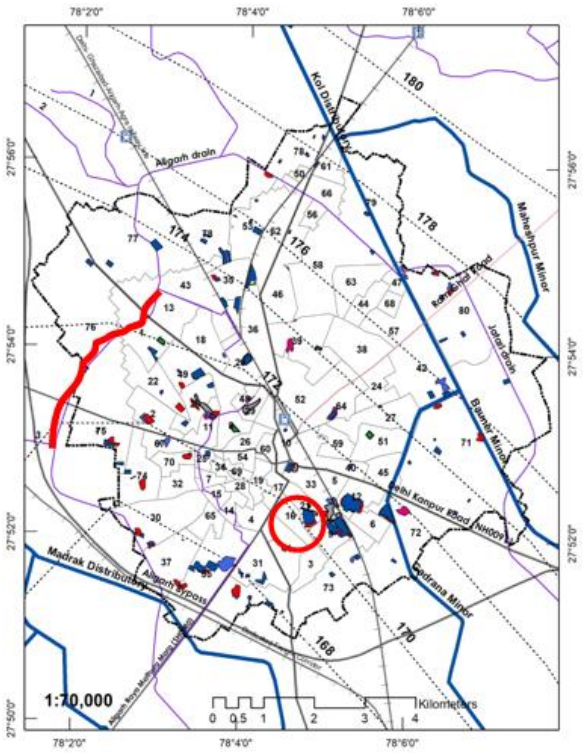
Table 4-4 Score obtained by stretches

Stretches	Marks obtained	Selection
Origin to Planning area entering point	7	Selected because of having 90% of length in the city
From planning area entry point to diversion point	7	
From diversion to type 1-2 drain meeting point	8	
type 1-2 drain meeting point to ITI Nala point	10	
ITI Nala point to type 3 drain meeting point	10	
type 3 drain meeting point to chhahari drain	10	
chhahari drain to Yamuna river (Outside Juridiction of Aligarh District)	8	
Jafri drain till last municiple limit	7	
Last municiple limit to end point	4	
Koil Distributry (planning area to break)	5	
Gadrana minor	8	
Boner minor	7	

Source 4-13 (Author, 2022)

Hence a stretch of Aligarh drain (ITI Nala point to type 3 drain meeting point) is identified for rejuvenation.

Map 4-4 Location of identified pond and drain for rejuvenation



Source 4-14 (Author, 2022) mapped from (Survey of India Toposheet, 2005)

4.4 Ecosystem Services identification

The Ecosystem services of these two ponds is identified as per the toolkit of per the toolkit developed by SPAD and NMCG named as Urban wetland/water bodies management guidelines 2021.

Table 4-5 Ecosystem services evaluation

			Kali deh lake	**New basti pond**
Provisioning	Food (1)	Production of fish	1	1
		Production of fruits and grains	1	1
	Fresh water (1)	Storage and retention of water	1	1
		Provision of water for irrigation		
		Provision of water for drinking		
	Fiber and Fuel (1)	Production of timber		
		Production of fuelwood		1
		Production of peat		
		Production of fodder		
		Livestock rearing	1	1
	Biochemical Products (1)	Extraction of materials from biota		
	Genetic Material (1)	Medicine		
		Genes for resistance to plant pathogens		
		Ornamental species		1
	Total Provisioning Services Value		4	6
Regulating	Climate Regulation (1)	Regulation of greenhouse gases		
		Regulation of temperature/micro-climate	1	1
	Hydrological Regimes (1)	Groundwater recharge and discharge	1	1
		Storage of water for agriculture		
		Storage of water for industry		
	Pollution control and detoxification (1)	Nutrient Retention	1	1
		Removal of excess nutrients	1	1
		Removal of pollutants	1	1
	Erosion Protection (1)	Retention of soils and prevention of structural changes (such as erosion, bank slumping and so on)		
	Natural Hazard (1)	Flood control	1	1
		Storm Protection	1	1
	Total Regulating Services Value		7	7
Cultural	Spiritual and Inspirational (1)	Personal feelings and well-being	1	1
		Religious significance	1	1

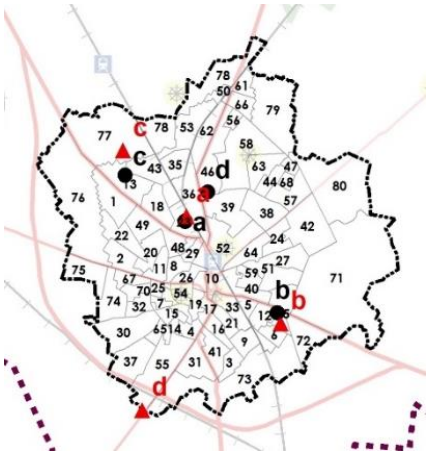
	Recreational (1)	Opportunities for tourism	1	1
		Opportunities for recreational activities	1	1
	Aesthetics	Appreciation of natural features	1	1
	Educational (1)	Opportunities for formal and informal education and training	1	1
	Total Cultural Service Value		6	6
Supporting	Biodiversity (1)	Habitats for residents or transient species	1	1
	Soil Formation (1)	Sediment retention		
		Accumulation of organic matter	1	1
	Nutrient Cycling (1)	Storage, recycling, processing and acquisition of nutrients	1	1
	Pollination (1)	Support for pollinators		
	Total supporting Service Value		3	3
Total Ecosystem Service Value			20	22

Source 4-15 (Author, 2022)

4.5 Sample Quality assessment

There are 4 locations for surface water and 4 locations for ground water for the sampling. These locations have been selected based on the drain upstream and downstream position, The position near to the pond and drain and location of AMU. This will enhance the understanding of the interaction behavior between them in terms of Chemical Quality. As per the test results of the Samples taken by the author for the ponds, New Basti pond has 65 mg/l and Etah Chungi pond has 80 mg/l of BOD concentration which is quite high. Salinity is also observed high in the result. However, all the parameters are below the limits. The Aligarh drain downstream shows a bad quality water as compared to Upstream which shows that there is a need for the interventions in the Aligarh city. TSS, BOD, COD are above the acceptable limits for downstream od Aligarh drain and is also higher than the upstream Quality. Upstream BOD is 55 mg/l while Downstream BOD is 140 mg/l. However, the salinity is higher in the upstream.

Map 4-5 Sample location of Ground water and surface water

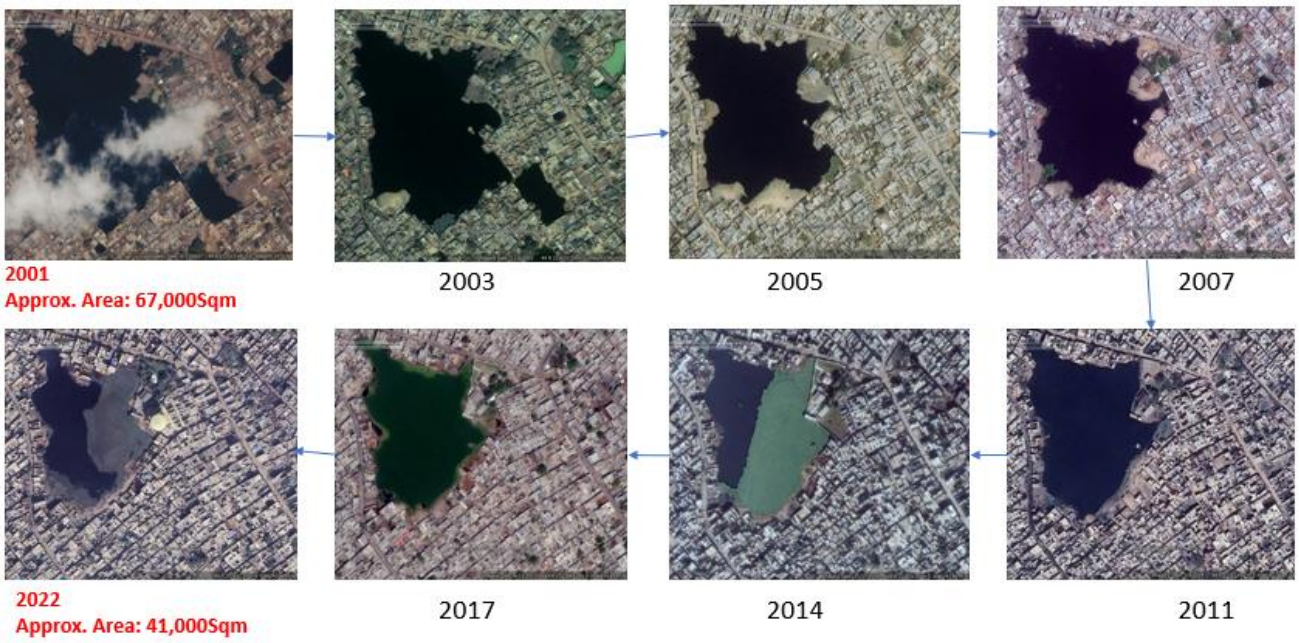


Source 4-16 (Author, 2022) mapped from (CityGIS Aligarh (ALIGARH SMART CITY LTD), 2022)

4.6 Area Change assessment

The google earth had been used to see the development of the ponds from 2003 onwards for post monsoon period.

Figure 4-6 Kali deh Lake change observed from 2001 to 2021



Source 4-17 (Google Earth, 2022)

Figure 4-7 New basti Pond change observed from 2003 to 2021

Source 4-18 (Google Earth, 2022)

4.7 100m Land-use Identification

The study has been carried out by visiting ponds& nearby areas up to 100m and it was observed that the ponds were very unhygienic condition. As per the wetland rule there should be a 50m buffer for the wetland. That is why for a detailed study,100 m was selected and marked the existing land use for the February 2022.

Map 4-6 Kali Deh lake 100m Existing land use plan 2022

Source 4-19 (Author, 2022)

Map 4-7New Basti Lake 100m Existing land use plan 2022

Source 4-20 (Author, 2022)

4.8 Ground water

Presence of the New Basti pond, the ground water quality crossed the acceptable limit of most of the parameter (TDS, Total hardness, Alkalinity, Mg) and few parameters (Calcium, Nitrate) are approaching the limit. That is why recharge of poor quality of water from the New Basti pond to GW is observed. The interaction was also observed in various research articles. The study shows a losing regime in the examined section of the Kali River, where the low connectivity between the two systems limits the mixing of river and groundwater. (Khan & Khan, 2019) Awas Vikas colony New Basti has the maximum TDS value i.e., 658 mg/l. Because of no habitation near Sarsol (near Aligarh drain), only 1 parameter i.e., alkalinity 277mg/l crossed the acceptable limit. Good quality of Ground water in the north area is observed. Ground water quality in the southern area of the city is contaminated and has crossed 3 parameters acceptable limit (TDS, Total hardness, Alkalinity) and approaching in 2 parameters (Mg, Fluoride). Some of the papers also indicates the contamination GW from heavy metals in Aligarh. It is revealed that the concentration of Cr, Cd, Ni, Pb, Fe and Mn is higher than the permissible limit prescribed by the Bureau of Indian standard (BIS) 1993 and World Health organization (WHO) 2004. (Ghasera, Rashid, & Gupta, 2018) So, before a crisis develops, logical actions must be taken to manage the water quality in the area.

Table 4-6 Location identified by local news paper for TDS and water level

Name of the Colony	Ward no	TDS	Water level (feet)
Sarai deen dayal (Sarai intezam ali)	10	500 to 700	200 to 250
Goolar road gali no. 7(Sarai lavariya) and Gulriyai gali sarai hakeem(Sarai lavariya)	8	500 to 700	200 to 250
Ghudiya bagh (Kanwariganj)	26	700 to 900	220 to 250
Sarai babu (Rasalganj)	29	600 to 800	200 to 250
Ghanshyampuri	40	600 to 800	150 to 200
Achal road Gandhinagar	33	600 to 800	220 to 250
Summer enclave colony (sudamapuri)	64		200 to 250
Pakki sarai	17	600 to 800	150 to 200
Nagla aashik ali road (saini loadge)	37	700 to 900	190 to 250
Gambhirpura	21	600 to 800	200 to 250
Durga nagar colony (Indira nagar melrose)	2	700 to 900	250 to 300
Makdoom nagar near hina public school	30	800 to 1000	200 to 250
Sanichari paith turkmaan gate	15	800 to 1000	250 to 300
Bhujpura road Bihari inter college	14	700 to 1000	200 to 250

Source 4-21 (PrimarySurvey, 2022)

The region's groundwater quality is steadily declining. Due to excessive removal from shallow tube wells, the upper aquifer is under a great deal of stress. (Khurshid & Kulshrestha, 2008). In the area, there are three levels of aquifer. The upper aquifer is located between 9 to 66 meters down and is extremely susceptible to microbiological and chemical pollution. (Umar, Umar, Khurshid, & Ahmad, 2001) This will lead to extra burden on the environmental health of the city specially for the slums where there is no facility. The health

of slum residents is significantly impacted by rising pollution. The results of the field study showed that the health of slum dwellers was poor. (Sadaf & Munir, 2015)

4.9 Governance

1952 year recorded water bodies on revenue records are assessing, mapping and photographical documenting by the government officials. The list is also available in website of Board of Revenue. Nagar Nigam Aligarh also mapping and establishing a notice board in all the ponds for protection from encroachment of land and start dredging the 30 ponds however the list in not in the public domain. Local government also proposing actions for ponds and canal to make a space in to a public place like 89 Ponds will be developed as Picnic spots and children park with greenery in district. Boating in the UCG Harduaganj in 200 m stretch and Ghat will be redeveloped. Removal of Encroachment from the ponds.

Figure 4-8The list availability with the government officials.

Source 4-22 Board of Revenue Website

Figure 4-9 Notice and Ongoing works by Municipal Corporation

Source 4-23 (Nagar Nigam Social Media Pages, 2022)

Table 4-7 Responsibility

Organization	Responsibility
Aligarh Nagar Nigam, District Administration	Ponds rejuvenation, Documentation, Upgrading new infrastructure, Implementation of local

	policies
Irrigation department	Drain cleaning, UGC, Minor water availability
Forest Department	Tree plantation, Shekha jheel management
Aligarh Development Authority (ADA)	Master plan
Block offices	Villages ponds
UPPCB	Pollution control
DIC and MSME office	Providing NOC and establishment of new
CGWB	NOC for borewell.

Source 4-24 (Author, 2022)

It is noted that Various urban local bodies working in Silos for the conservation of water resources. 5 ponds will be developed as AMRUT Sarovar. A pond near Chandania will be developed as GW Recharge area and through the research projects in the AMU, Aligarh fort Ditch/ Maut will be developed as a scenic spot. Nagar Nigam Aligarh prioritized citizen centric service delivery through use of technology-Integrated grievance redressal system ,UP Jan Sunwai,, Public Grievance Redressal (PGR), Nagriya suvidha samadhan diwas, tehsil divas for strengthening the communication.

The author tried to map the perception of different stakeholders during the interaction and meeting. For the Administration mostly said **"**We will try to do something good to revive the ponds. As of now we have no data for you." However, it is varied from dept to dept and person to person. NGO recommendation **"**We need to protect all our natural resources. Do provide Water Hyacinth Removal machine because manually, removal of water hyacinth is a tough task. Academia recommendation "Management of the water body is very bad by the district administration and forest department." Public recommendation "We don't want to visit an area where there is no facility also, we find odor in nearby area of the water body. Solid waste all around. It is good to visit a park." As per the Aligarh Residents responses, over the questionnaire form which was spread via social media and google form and interaction while ponds visit the following aspects is incorporated and understood-

- There were Residents from more than 21 locations.

- Decrease of Ground water, Alcohol drinking and eve-teasing are the main problem in near water body (Pond) as per 70% response.
- 5% visits ponds in their free time.
- 70% will help in restoration of ponds (They will not throw solid waste into ponds, they will engage in awareness to educate people, they will support Nagar Nigam initiatives, they will attend Clean up drives.)
- 80% know the GW and ponds connection and the natural drain network.
- Almost all wants improvement like the Shekha jheel

4.10 Conclusion

A thorough inventory of the municipal area's ponds and natural drains was conducted as part of the baseline, and specific lengths of ponds and natural drains were identified based on chosen indicators, allowing for more in-depth investigation of the waterbody and its watershed. After analysis, poor condition of ponds and drains were identified. It is obvious that anthropogenic activities have had a negative impact on surface water and prompt action must be made to safeguard and conserve it.

4.11 Major Issues

1. Due to bad interaction of water bodies and GW, Quality of Ground water is affected.
2. Poor condition of most of the waterbody is observed. No screens, less infrastructure available, no treatment of water inlet at present and No demarcation of the boundary through suitable fences and Multiple ownership is observed.
3. Polluted drains are also recharging bad quality of water.
4. Less identified water bodies/ponds in the proposed land use 2021.

5

SHEKHA JHEEL

5 Shekha Jheel

5.1 Background

Shekha jheel is a bird sanctuary near the village of Shekha and Bhavan Kheda, 17 km east of Aligarh city. It lies in the watershed 2C2C6. It is wetland identified under the National Wetlands Conservation Programme (NWCP).

Figure 5-1 Shekha jheel Entrance

Source 5-1 (Author, 2022)

The IBA Site Code is IN-UP-21and the Area is 40.309 ha and the Depth ranges from 0.91 m to 1.22 m, Rain fall is 350 mm, Temperature varies from 2 to 45 degree Celsius, Humidity is 89% as per Forest Department. The migratory birds follow the Central Asian Fly way route and come to Shekha Jheel every year. As per the wetlands of India portal It has pH range from 5.5 to 7.4, water salinity is less than .5 g/l which shows the fresh water. Eutrophic nutrient is observed in the water.

Before the construction of Upper ganga canal, it was a water- logged area. UGC divided the area in to two parts then. Due time it became a popular destination of migratory birds and residents' birds for their nesting and breeding. However, it was a shooting ground for nearby people before 1970. The conservation approach is followed by local people and Beautification works from administration is stated on 2012. It got a status of Bird sanctuary on 2016. It is now an Important bird area and tourist spots for nearby people. IBA Criteria met- A1 (Threatened species), A4i (≥1% biogeographic population) and A4iii (Congregation: ≥ 20,000 waterbirds).

Table 5-1 Shekha jheel health report card

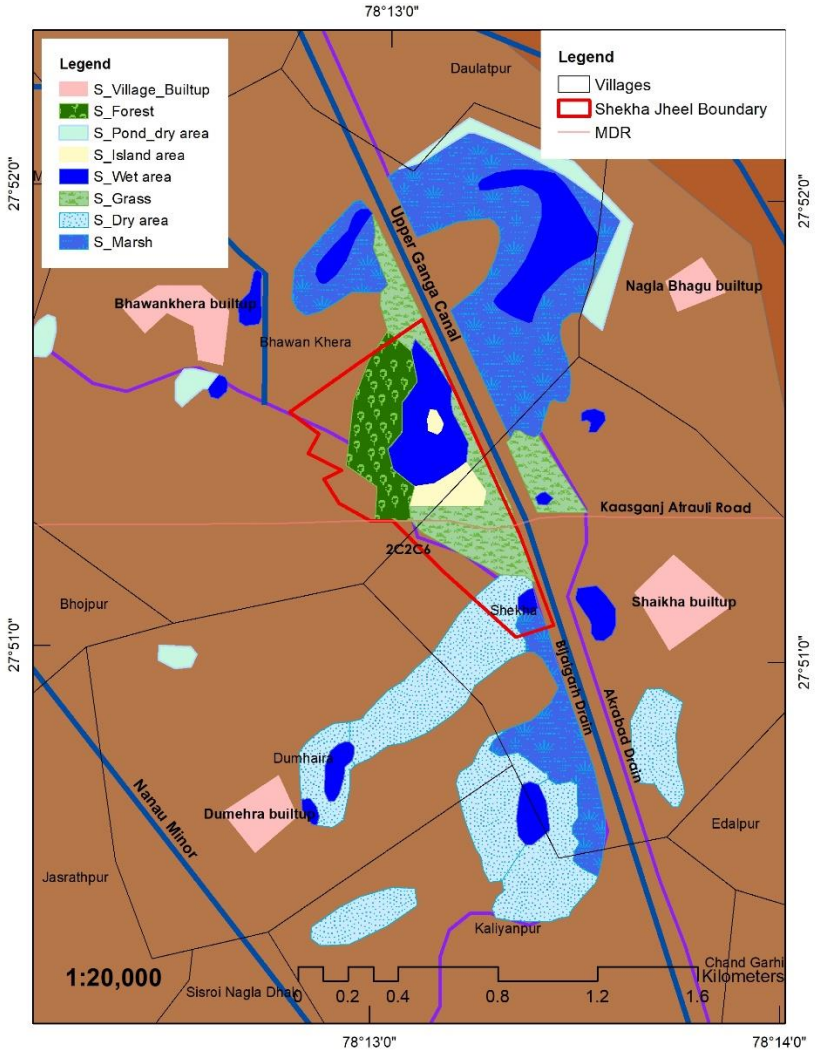
Sr. No.	Features	Category
1	Area	A
2	Hydrology and Catchment	A, A, Blank
3	Biodiversity	E, A
4	Governance	A, E, A

Source 5-2 (Wetlands of India Portal, 2022)

As per the health report card of Shekha Jheel from wetland portal, more than 40% of the wetland area covered by invasive macrophytes and there is no management plan that is why their parameters has been put in to the "E" Category. Rest parameters are in A Category. There Parameters such as % wetland converted to non-wetland use since 2000, Ratio of number of natural inlets choked and diverted to total number of natural inlets, Ratio of number of natural outlets choked and diverted to total number of natural outlets, Annual water bird count as a proportion of average count of last 5 years, clearly demarcated wetlands map, Wetland Notification, got the A category as mentioned in the table. However, %of samples conforming to desired BOD/DO/COD levels are left blank in the report card which indicated that there is no monitoring happening for the Jheel. (Wetlands of India Portal, 2022)

It is well connected to Aligarh city (17 km away) and Jalali NP and Aligarh mini airport (7km), Aligarh Railway station (Class A) (15 km), Charra bus stand (10km) It is somehow connected from public transport from E-bus service till Panethi (5 km away) and Intermediate PT via tempo and auto rikshaw, and Private Transport via own vehicle.

Map 5-1 Shekha Jheel

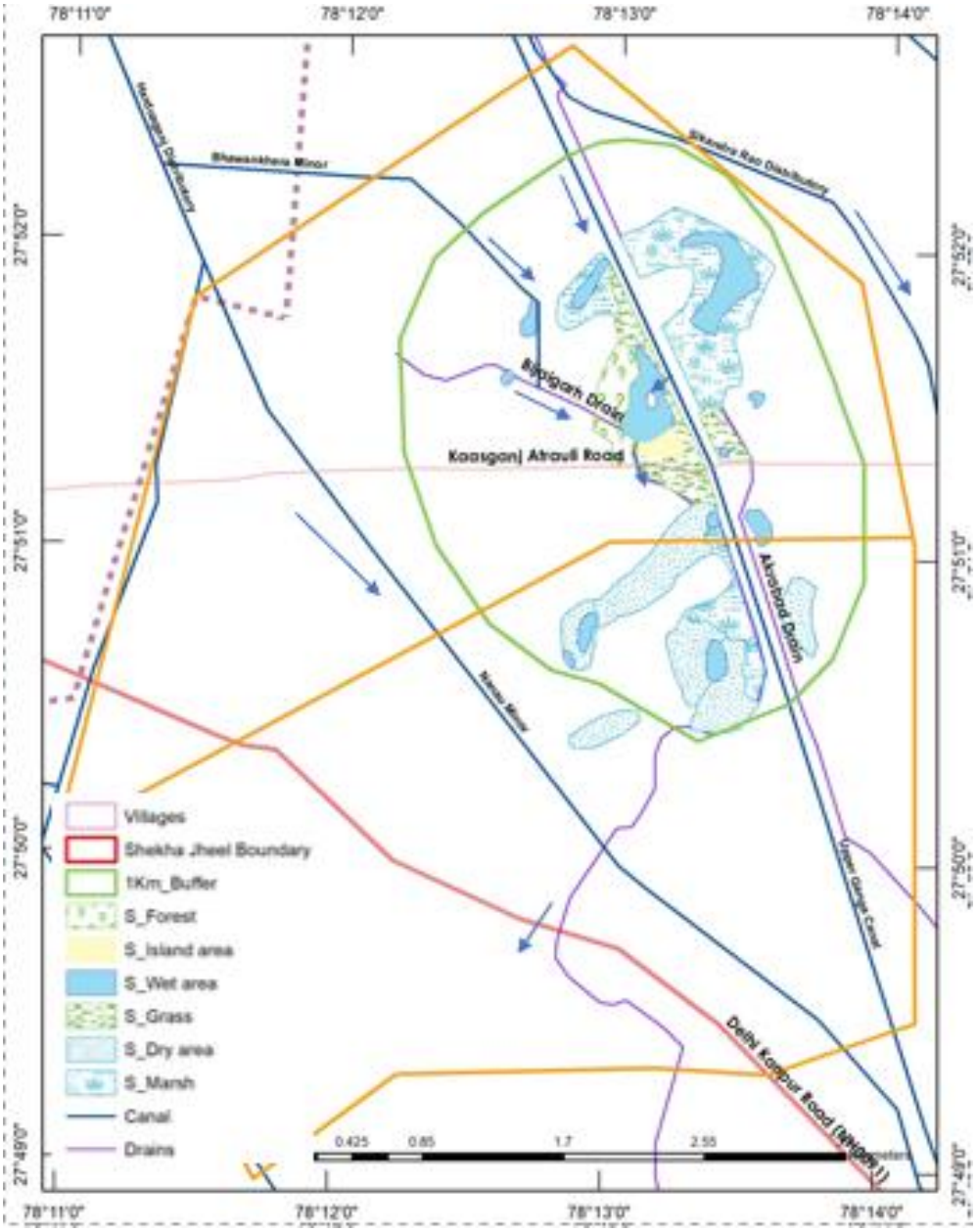


Source 5-3 (Survey of India Toposheet, 2005) mapped by (Author, 2022)

Some of the researchers also validated the issues and various aspects of the jheel in the past. This wetland exhibits characteristics that make it the perfect place for waterfowl to breed and overwinter. The region is home to a wide range of animal and plant species. The primary source of income for those who live close to Sheikha Lake is agriculture. The two main crops farmed here are wheat and paddy. In neighboring villages, there was a serious lack of understanding of the social benefits of wetlands and their ecological functions. Weed encroachment (31%), lopping (27%), grazing (20%) and wood cutting (12%) were found to be some of the major threats in the study site. (KIDWAI, 2015)

In Water environment, Canal, drains and water bodies are studied and mapped.

Map 5-2 Shekha jheel Water environment map



Source 5-4 (Survey of India Toposheet, 2005) and (SLUSI, 2022)

The area has Upper ganga canal and Harduaganj, Sikandrarao distributaries, Bhavan Kheda minors and escapes. The area has Bijaigarh drain which carry waste water from the Bhawan Khera village in to Shekha jheel. Main source of water of Shekha Jheel is UGC and Rainwater. In biotic Environment, various data sources validate the biodiversity, and species richness in the area. Some of them are also discussed in the next paragraphs.

Figure 5-2 Plants species in Shekha jheel

Hydrilla verticillata, Ceratophyllum demersum, Vallisneria spiralis, Potamogeton crispus, Najas spp., Salvinia spp., Azolla spp., Eichhornia crassipes, Nymphoides cristata and N. indica, Terminalia arjuna, Syzigium cumunii, Acacia spp., Dalbergia sissoo, Azadirachta indica, Ipomoea aquatica, Eichhornia crassipes, Lantana camara, Cassia tora, Murraya koenigii.

Source 5-5 (Wetlands of India Portal, 2022)

Figure 5-3 Animal species in jheel

Birds: Sarus Crane Grus Antigone, Oriental Darter Anhinga anhinga, Spotted owlet Athene brama, Bronze – winged Jacana Metopidus indicus, Black-necked Stork Ephippiorhynchus asiaticus, Grey Heron Ardea purpurea, Little Cormorant Phalacrocorax niger, Little Egret Egretta garzetta, Cattle Egret Bubulcus ibis, Greylag Goose Anser anser, Northern Pintail Anas acuta, Northern Shoveller A. clypeata, Gadwall A. strepera Spot-billed Duck Anas poecilorhyncha, Comb Duck Sarkidiornis melanotos, Lesser Whistling Duck Dendrocygna javanica, Common Shelduck Tadorna tadorna. Others: Bluebull or Nilgai Boselaphus tragocamelus, Blackbuck Antilope cervicapra, Indian mongoose Herpestese dwardsii, Black-naped hare, Rhesus macaque Macaca mulatta.

Source 5-6 (Wetlands of India Portal, 2022)

Figure 5-4 Conservation significance species

Sarus Crane Grus Antigone, Blackbuck Antilope cervicapra.

Source 5-7 (Wetlands of India Portal, 2022)

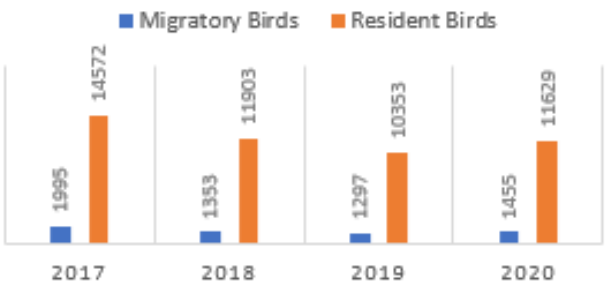
Some of the available fauna in the Shekha jheel has been listed as per IUCN Category.

1	Egyptian Vulture	Endangered
2	Indian Spotted Eagle	Vulnerable
3	Common Pochard	Vulnerable
4	Black-necked Stork	Near Threatened
5	Painted Stork	Near Threatened
6	Wolly-necked Stork	Vulnerable
7	Laggar Falcon	Near Threatened
8	Red-headed Falcon	Near Threatened
9	Sarus Crane	Vulnerable
10	Hodgson's Bushchat	Vulnerable
11	Black-headed Ibis	Near Threatened
12	Alexandrine Parakeet	Near Threatened
13	Oriental Darter	Near Threatened (Khan S. U., 2020)

The above information is as per A checklist of birds in agricultural landscapes of Aligarh, Uttar Pradesh, India, 2020 of Siraj Uddin Mazumder and Afifullah Khan (International journal of fauna and biological studies).

Recently in June there has been 2 eggs of Saras Crane spotted by the workers in jheel while managing which indicates the favorable condition for this state bird and need to include it in the management plan. However, Invasive Alien species is Eichhornia Crassipes in the Jheel. 166 Species (Residents and Migratory birds) are identified in the Jheel. Grey lag Goose Anser anser-500-Peak count are observed. Sarus Crane Grus antigone VU-25-Peak count are observed. Greater Spotted Eagle Aquila clanga VU – 12 - Peak count are observed as per Wetland International study 2009 report. Nilgai density was found maximum in and around the Shekha jheel i.e., 132 individuals per km2. (Khan & Khan, 2016). "The community uses the lake area for grazing, for fuel wood and fodder collection. Felling of trees on the canal banks which led to the vanishing of the wildlife from the jheel also indicated in a study." (Kalpavriksh, 2009)

Chart 5-1 Birds Population Trend

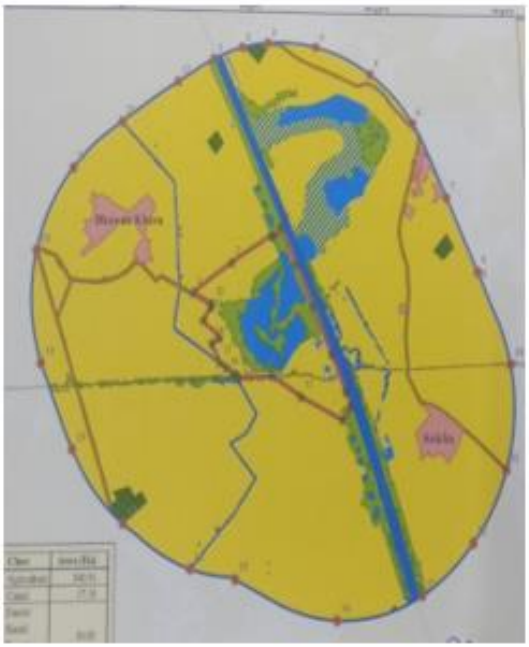


Source 5-8 (Forest Department, 2022)

Existing Land use 2020 around 1 km of Shekha jheel area as per the forest department Aligarh. The land use land cover has been studied from the BHUVAN portal ISRO. Key findings were observed such as Habitation of villages (rural built up) increased during the period 2005 to 2015, Excess water from the Shekha jheel is observed in downstream area (Inland water body has increased) and Barren land reduced.

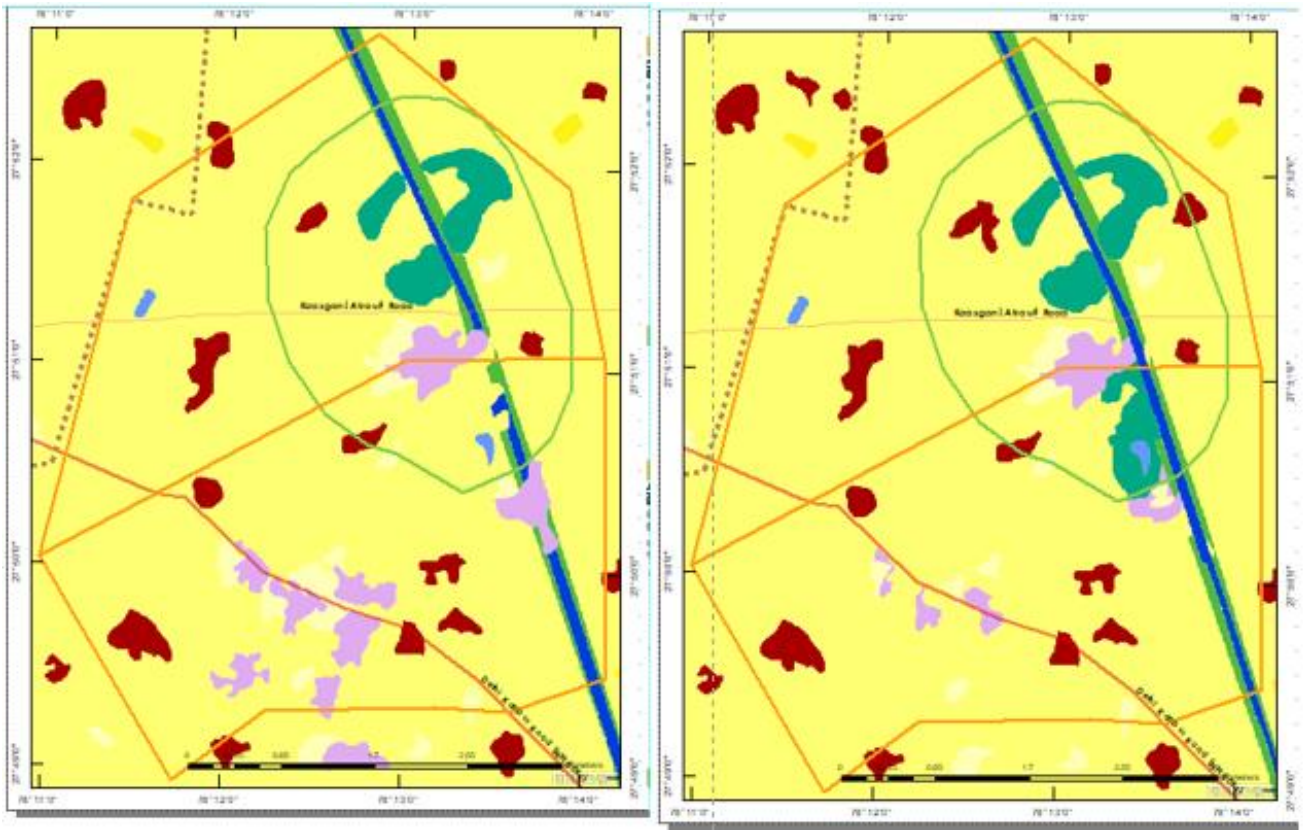
Figure 5-5 LULC around Shekha jheel and till 1 km

Class	Area (Ha)	%
Agriculture	540.91	82%
Canal	17.10	3%
Forest/Social forestry vegetation	30.83	5%
Grass	19.36	3%
Orchard	4.95	1%
Road	6.71	1%
Settlement	14.91	2%
Wetland	27.48	4%
Total	**662.26**	



Source 5-9 (PrimarySurvey, 2022) and (Forest Department, 2022)

Map 5-3LULC 2005 Vs LULC 2015



Source 5-10 (BHUVAN, 2022)

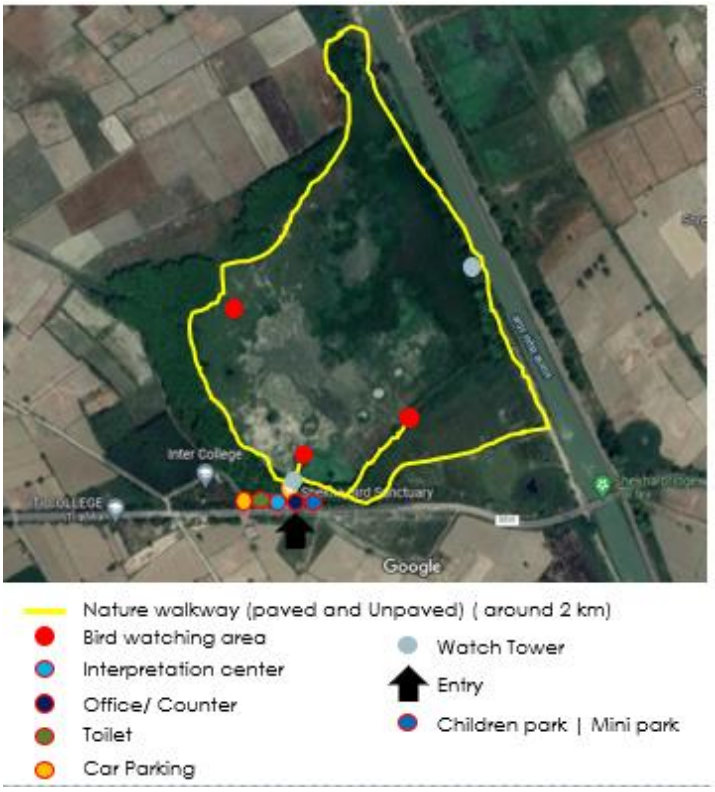
Religious Tourism, Nature tourism such as Scenic spots, Bird sanctuary and Art & Craft tourism such as Brass Craft and Locks Others like Road trips are observed in the Micro watershed in the Shekha Jheel area. The jheel also recognized in the Wildlife and Eco tourism Circuit (Western ornithology/Wetland Circuit) as per UP Tourism policy 2018. As per the forest department officials the following data is obtained.

Table 5-2 Table showing the tourist visits per year in Shekha jheel

Year	Tourists per year
2017	25044
2018	16272
2019	22221
2020	(Closed)

Source 5-11 (PrimarySurvey, 2022)

Figure 5-6 Shekha jheel Activities



Source 5-12 (Author, 2022) and (Google Earth, 2022)

Table 5-3 Infrastructure Assessment

Infrastructure	Sub-Type	Status	Description
Physical Infrastructure	Drinking Water availability	1	Ground water is the source with 2 taps available at the entry, however tourist use their own water bottles.
	Public toilets	3	Good hygienic condition
	SWM	2	No proper check for Tourist. However, the dustbins are there but solid waste can be seen on nature walks
	Signages	2	Proper signages need to upgrade as todays signages are in bad condition.
	Transport availability	2	IPT and Private transport is available. However, E-bus can be the potential.
	Parking	1	Parking is available from side entrance
Social Infrastructure	Medical Aid	0	No facility within 500 m
	ATM	0	No facility within 500 m
	Tourist Information Center	3	Interpretation center is there to educate the tourist.
	Food stall (Restaurant)	1	No facility however one open food restaurant is there. It is also serving the parking.
	Security	2	No Police chowky, however there is a regular check by Two/more constables in and around the jheel on bike.

Source 5-13 (Author, 2022)

5.2 Tourist perception and response

The author tried to map the perception of tourists during the interaction and online. As per the Tourists responses, over the questionnaire form which was spread via social media and google form and interaction while Shekha jheel visit the following aspects is incorporated and understood-

30% Female and 70% Male responded more than 22 questions. 67% Tourists came from the Aligarh city and 39% and 42% came to jheel for % leisure with friends and bird watching respectively. 54% Feels that the tourist count was average. 51% Feels that the space is safe for everyone. 72% said that they had a good experience in Jheel. Birds and Peace are the main attraction as per 71% response. 66% wants that biodiversity should be increase. Only 3% visits jheel regularly and 54% wants to come again.

5.3 Ecosystem Services

The basic 4 services has been studied i.e. Provisioning services (direct wetland products, eg: food, fiber, water), Regulating services (the ability of an ecosystem to regulate hydrological regimes, influence micro-climate, reduce disaster risk, groundwater recharge), Cultural

services (recreational values, cultural and religious norms and beliefs related to wetlands), Supporting services (Primary production and other ecosystem functions which enable wetlands to deliver all above ecosystem services).It is important for nearly 11 aspects out of 18 as per the wetland rule 2017 specified Ecosystem services.

Table 5-4 Ecosystem services of Shekha Jheel

Importance	Relevant for the site (please tick yes or no)	
Source of drinking water for people living and around	☐Yes	☐No ✓
Source of water for agriculture	☐Yes ✓	☐No
Fisheries	☐Yes	☐No ✓
Cultivation of aquatic food plants	☐Yes	☐No ✓
For buffalo wallowing and use of domesticated animals	☐Yes ✓	☐No
Medicinal plants	☐Yes ✓	☐No
Is a recreational site	☐Yes ✓	☐No
Buffering communities from extreme events as floods and storms	☐Yes	☐No ✓
Groundwater recharge	☐Yes ✓	☐No
Water purification	☐Yes	☐No ✓
Acts as a sink for sediments	☐Yes ✓	☐No
Has significant cultural and religious values	☐Yes ✓	☐No
Is a site for recreation and tourism	☐Yes ✓	☐No
Supports noteworthy plants species	☐Yes ✓	☐No
Supports noteworthy animal species	☐Yes ✓	☐No
Site of high congregation of migratory water birds	☐Yes	☐No ✓
Supports life cycle of fish or amphibians	☐Yes ✓	☐No
Mining	☐Yes	☐No ✓
Any other, please list		

Source 5-14 (Wetlands of India Portal, 2022) analyzed by (Author, 2022)

5.4 Conclusion

Shekha Jheel is a wetland and does not yet have a management plan and it supports a sizable number of species. For this reason, various protective measures were need to be taken into consideration for biodiversity when advertising Shekha Jheel as a weekend destination for the public by the authorities. It is clear that Shekha jheel has suffered as a result of anthropogenic

activity and various measures need to be taken immediately for the management of this wetland.

5.5 Major Issues

1. Management issues in the Shekha jheel area and Bhawan Khera minor and Bijaygarh drain carrying sewage in to the jheel.
2. Boundary not demarcated (Entry of villagers from nearby areas in to the jheel). Grassing and collection fire wood.
3. There is a less connect of public with the water bodies with respect to accessibility, infrastructure, and facilities in/nearby water bodies.

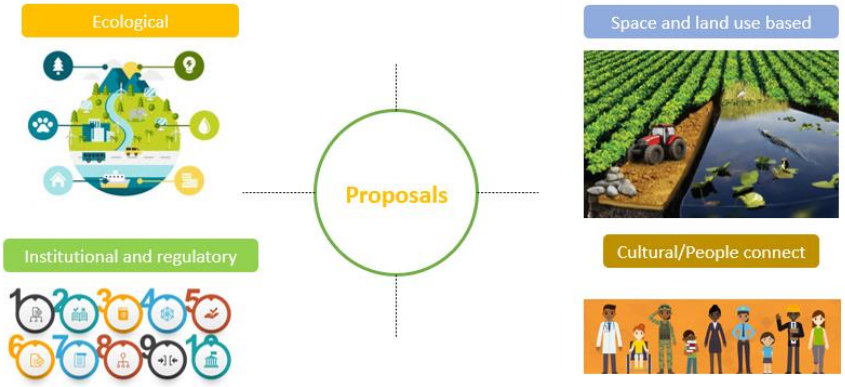
6

PROPOSALS

6 Proposals

The proposals are conceptualized with **Holistic & Harmonious Approach** having a multiscale view in mind following 4 aspects have been covered broadly

1. Ecological Aspects
2. Space and land use-based aspects
3. Institutional and Regulatory
4. Cultural/ People Connect



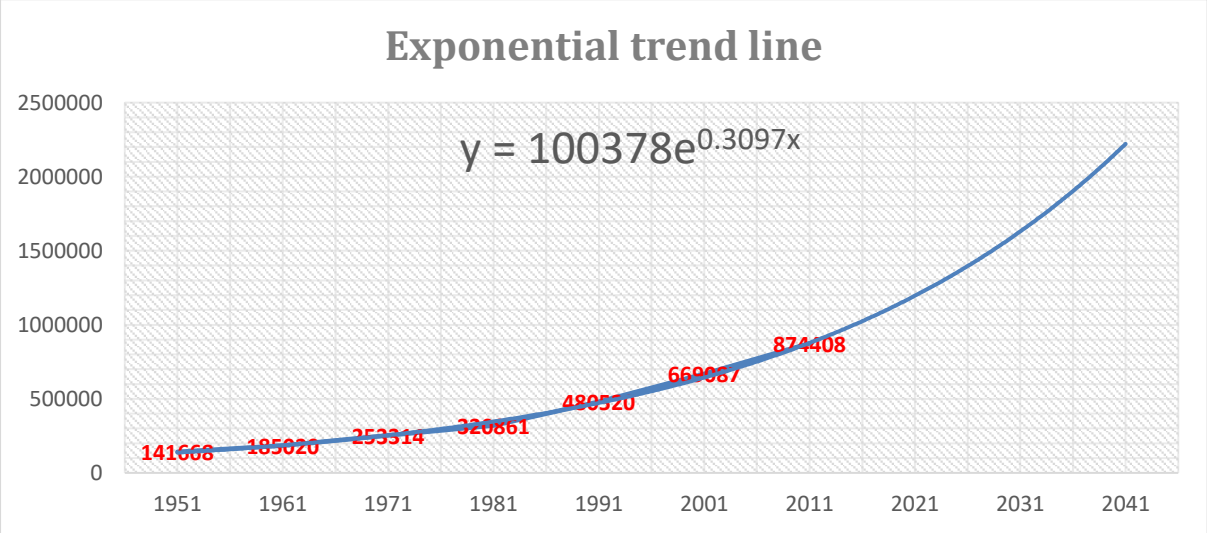
6.1 Vision

The Vision of the study is in line with the Vision of Ganga 2017 Report. The main VISION of the study is "Involving **Holistic & Harmonious Approach** to protect and rejuvenate water system by having the Uninterrupted, Unpolluted Flow in water bodies and sustainable management of Ground water in Aligarh". This study is also based on the vision of Aligarh smart city that is Mukammal Ashiyan, Alishan, Ali-e-Garh.

6.2 Population Projection

The trend of the population growth is observed from 1951.

Chart 6-1 Population Projection



Source 6-1 (Author, 2022) and (Census of India, 2011)

Overall, 3 methods like

1. Growth rate method (sub methods: Arithmetic, Incremental increase, geometric, exponential, Logistic)

2. Trend line method (sub methods: Linear, Exponential, Powerline)

3. Master plan Approach

are explored and from all the methods, exponential trend line method shows less deviation from the actual population while validating the method for last decades. That is why Exponential trend line method is adopted. It is estimated that 16,50,000 till 2031 and **22,00,000** till 2041 will be the population for the Aligarh City.

6.3 Ecological Aspects

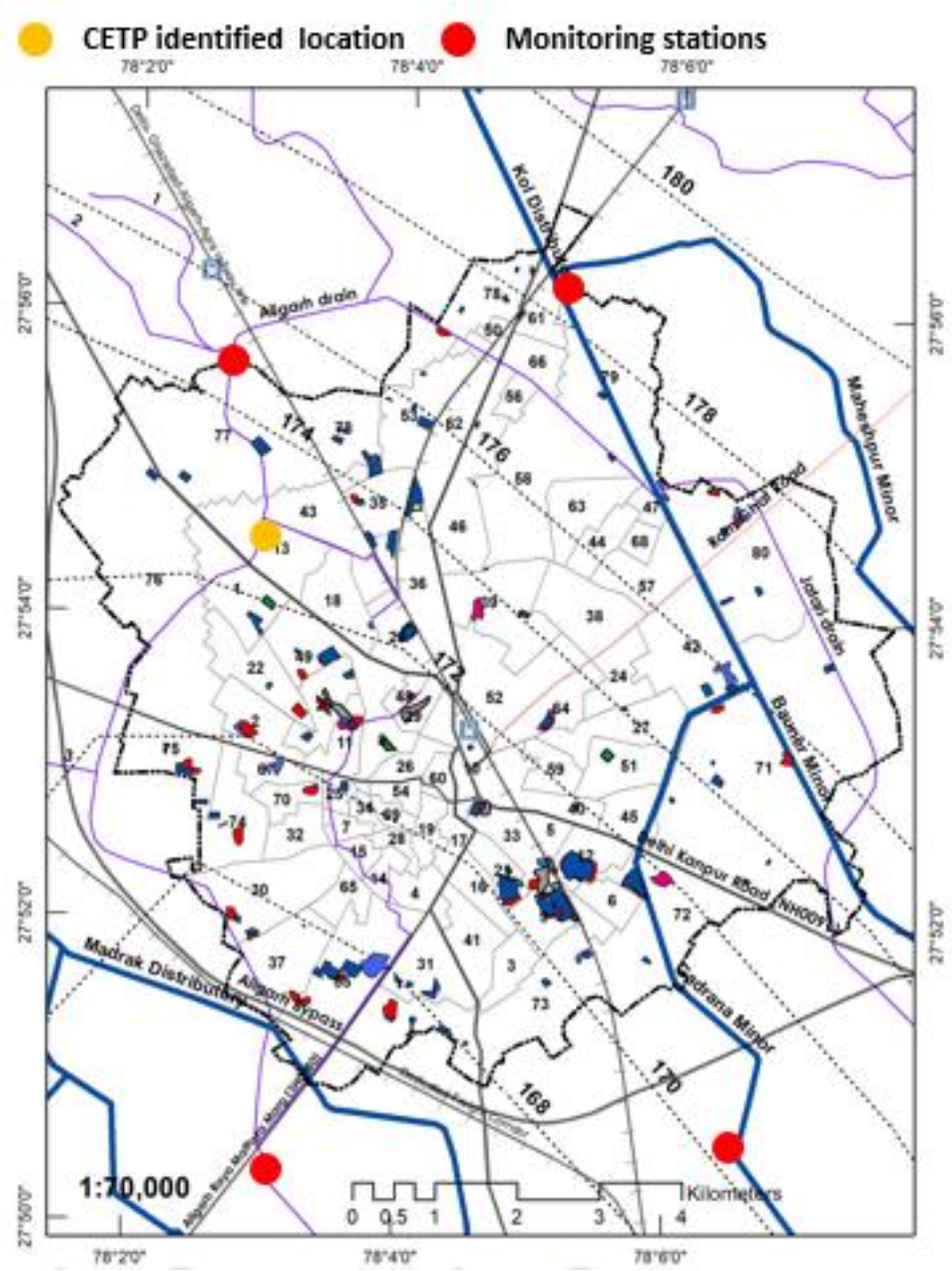
For the Aligarh City

- Assess the water quality status of the waterbodies and their capacity to support biodiversity
- Deepening of the ponds and drains for improving their water holding capacity
- Use of constructed wetlands and other nature-based solutions to reduce pollution load in ponds and drains
- Need for 1 CETP in ITI industrial area
- Periodic clearing of water hyacinth
- Rearing of non-invasive fish species that eat mosquito larvae in all ponds
- Soil erosion control through planting of native/fruit species of grasses, shrubs and trees and Urban forest/forest need to be grown in the suitable/depressions areas through Miyawaki technique.
- Monitoring stations (Should be connected to Central command and control center Aligarh)

For Shekha Jheel

- Bioremediation techniques in the Bijay-garh drain near jheel.

Map 6-1Identified locations for the CETP and monitoring stations



Source 6-2 (Survey of India Toposheet, 2005)mapped by (Author, 2022)

6.4 Space and land use-based aspects

For Aligarh City

- Strategies for waterbody rejuvenation to be unique for each land use acknowledging the different requirements.
- Delineate the modified urban watershed of each pond and drain and assess the impact of the anthropogenic activities within.
- Creation of blue-green network, wherever possible Maintain urban greens in the North-Western part as a recharge zone for the city

- Adequate, well distributed green areas as per URDPFI guidelines, 2014 to be demarcated in the land use plans
- Buffer Zone of 30 m around ponds to be marked on the land use plan of the developable areas. Permissible, regulated and prohibited activities to be decided.
- Buffer zone of 3 to 9 m around ponds in the developed areas and Buffer zone of 15 m along natural drains. Provision of walking and cycle track wherever possible. Land may be acquired through TDR.
- Siting of landfill site to be 200 m away from any pond.
- Immediate WASH infrastructure provisioning to squatter settlements located at the edge of the ponds

For Shekha Jheel

- Notify all the other parts of Shkeha jheel.

6.5 Institutional and Regulatory

For Aligarh city

- GIS based mapping and inventory of waterbodies and have one comprehensive database that feeds into all official documents.
- Immediate preparation of a separate Blue-Green Infrastructure Master Plan that can be a base for future City Water Sensitive Master Plans or Urban River Management Plan
- **Establish a cell in the Nagar nigam** for coordination among various water and sanitation sector, industries stakeholders
- **Land ownership of ponds to be brought under one agency.**
- UPPCB to ensure monthly water quality monitoring of all waterbodies/ponds and groundwater in different parts of the city
- Groundwater extraction to be regulated. Implementation of UP GW (Management and Regulation), Act, 2019
- Economic instruments such as **volumetric pricing of domestic water, incentives for RWH to be explored.**
- UP Building byelaws to be modified to facilitate dual piping system for reuse of grey water
- Capacity building exercises in Aligarh Nagar Nigam, Forest department and Irrigation department to be taken up regularly

- Focused on Integrated Solid Waste Management & Sustainable management of GW and Sustainable Agriculture practices

For Shekha Jheel

- Preparation of Management plan for Shekha Jheel as per Wetland Conservation and Management Rules, 2017.

6.6 Cultural/ People Connect

For Aligarh city

- To promote a shift in mindset for considering drains as part of a larger river system and not just as a mode of wastewater disposal
- Waterfront to be promoted as a major recreational space in the city. Design of green spaces around the waterbodies to focus on inclusive and safe.
- Well Monitoring (GW) could be done by community
- Mohalla meeting
- Pani sanrakhshan Samvaad (पानी संरक्षण संवाद)
- Cleanup Drives
- Water Auditing (Annual)
- Educational institutions to be involved. E.g. Adopt a waterbody. To be financially supported by the Aligarh Nagar Nigam or CSR

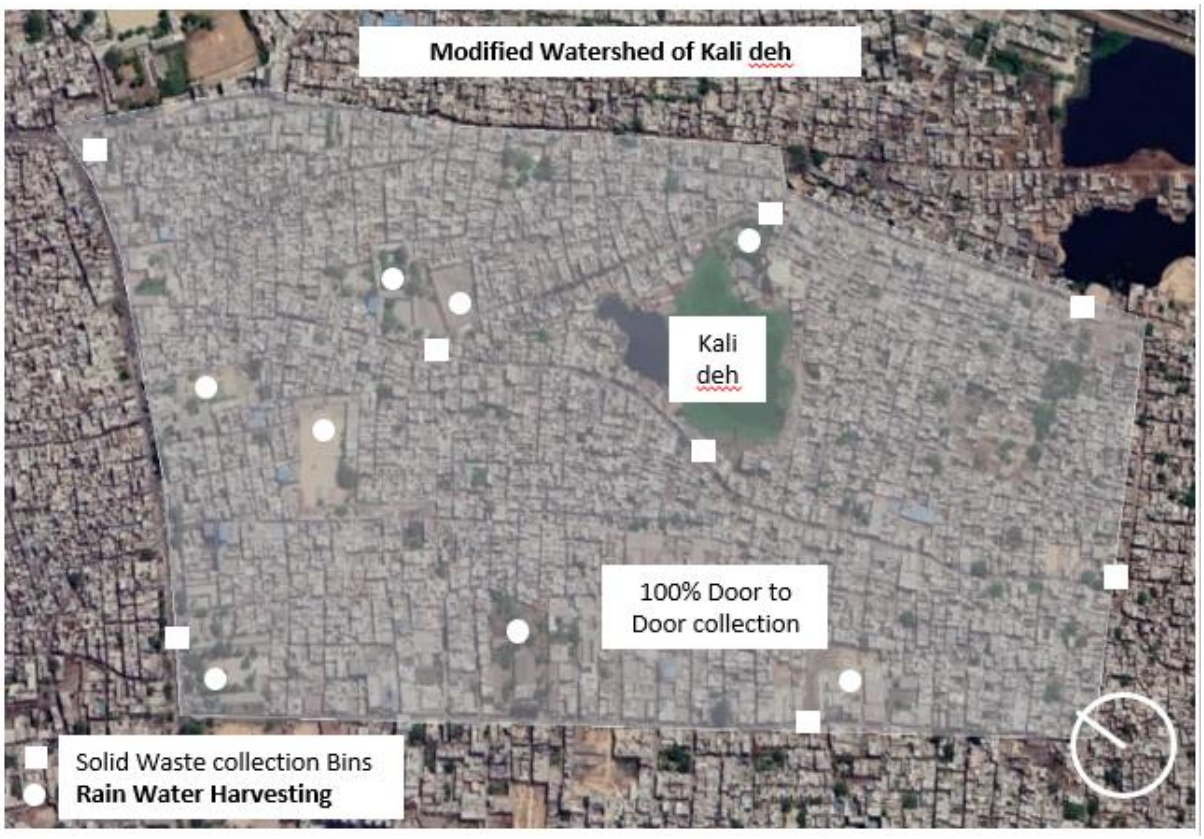
For Shekha Jheel

- Local guides training
- Cleanup Drives
- Educational tour and Yoga Instructions
- Various environmental days/week/months celebration

6.7 Detailed Project for Kali deh rejuvenation

In the Catchment Interventions there should be 100% D to D collection of solid waste through the small trolly (if inaccessible by the tata ace), RWH in open space to augment and dilute the quality of ground water. Solid waste collection-bins need to be placed around the pond with regular cleaning.

Map 6-2 Modified Watershed of Kali deh



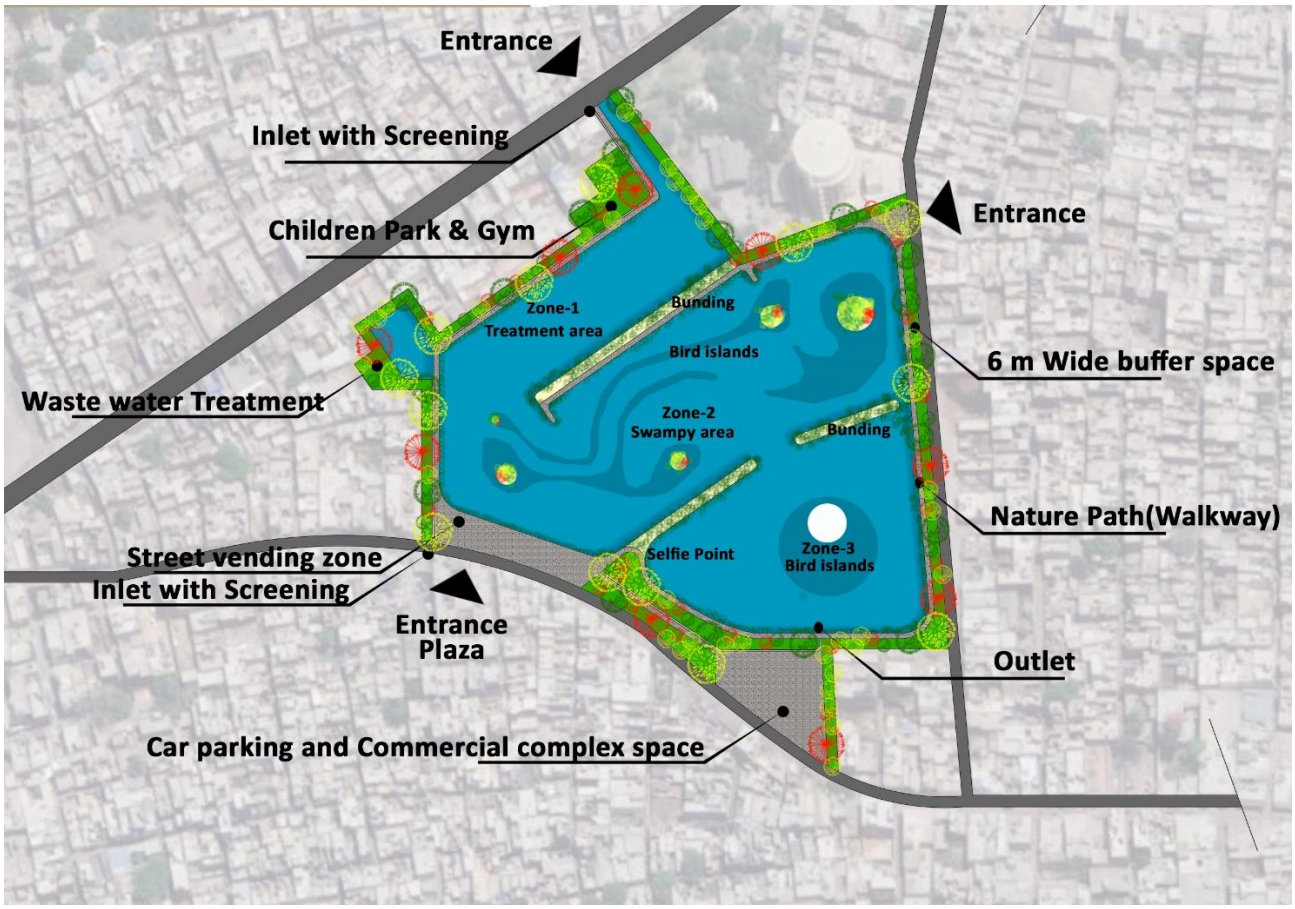
Source 6-3 (Google Earth, 2022) interventions by (Author, 2022)

Pond interventions

- For the Removal of encroachments (28 shops in to the small commercial complex),
- In situ measures (Bioremediation/DEWATS) and strengthening of fencing/boundary wall.
- A walking track and Notice boards should be displayed.
- Inlet and outlet identification and screening and treat water before letting in to the pond.
- Buffer space(6m) with tree plantation (Palash (Red), Amaltash (yellow), Neem, Peepal, Bargad, Ashok, Bamboo(Green), Plumeria Alba(white),), grasses and shrubs and declared as No development zone.
- Weekly Monitoring
- A separate tank in zone-1 built for religious/cultural festivals (Prohibition of idol immersion in the ponds)
- Street vendor zones in convergence with National Urban Livelihood Mission (DAY-NULM).

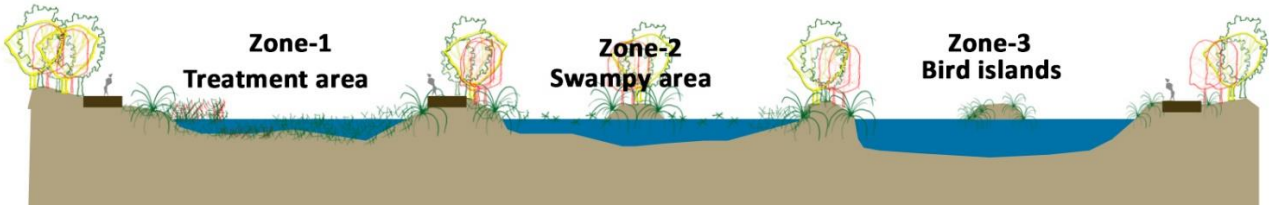
- Ecological Floating islands in suitable locations,
- CCTV based surveillance, De-weeding machines for regular clearing.

Map 6-3 Kali deh interventions



Source 6-4 (Author, 2022)

Figure 6-1 Section through Kali deh focused on graded landscape



Source 6-5 (Author, 2022)

6.7.1 Expected Outcome and main crux of the rejuvenation

Well Designed aesthetically appealing and efficiently functioning of pond will improved the biodiversity around the pond with ensuring adequate water levels in the pond throughout the year even in the dry seasons to support biodiversity.

Key feature of the rejuvenation of kali deh is the protection from encroachments and is the varying water depth in the pond will sustain various ecological species(flora and fauna) in the zones created. It will improve the water storage and biodiversity and microclimate of the area.It will also increased the tourism and public awareness and employment in the area. Convenience will increase in case of pedestrians and two wheelers.

6.7.2 Institutional arrangements

The rejuvenation will be done by Aligarh Nagar nigam in coordination of other local bodies but not limited to it. Community participation and people engagement will be beneficial. And A Cell will be a coordinating structure for implementation and O & M aspects.

6.7.3 Operation and Maintenance plan

The following table details out the operation and maintenance activity and the frequency at which they need to be performed.

Activity	Frequency
Cleaning of Screens	Once in 20 days
De-weeding and Desludging via machine	Once in 6 months before monsoon
Plantation on bunds and nearby area	Once in 6 months
Cleaning of drains	Once in 1 month

6.7.4 Cost estimation

Conceptual Cost for rejuvenate the Kali deh

Sr. No	Description	No	Rate	Amount
1	Construction SW collection bins	8	50,000	4,00,000
2	RWH system and recharge facility (Modular)	8	3,00,000	24,00,000
3	Man power with small carts to collect SW for achieving 100% D to D collection	10	5000 per month	50,000 per month
4	Construction of 1 storm water drain from out let to inlet point and 2 is from inlet to Waste water treatment area	3	2,50,000	7,50,000
5	Screening	3	5000	15000
6	Achieving sustainability by linkages with people and official capacity building		10,00,000	10,00,000
7	Formation of Constructed Wetland		2,50,000	2,50,000
8	Landscaping (walkways, park and islands)		10,00,000	10,00,000
9	Construction of Commercial complex		20,00,000	20,00,000
10	Waste water treatment and floating wetland		5,00,000	5,00,000
11	Monitoring stations (Real time water	2	35,00,000	70,00,000

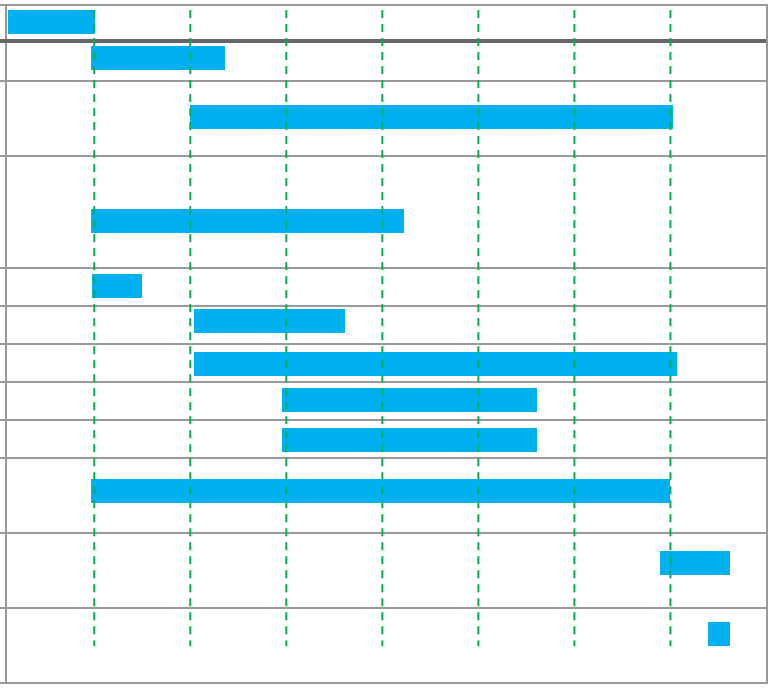
	quality)			
Total				1,53,65,000
O & M cost for 7 aspects only (25%)				6,41,300
Contingency (5%)				7,68,250
Documentation & Tenders (5%)				7,68,250
Amount for Financing required				1,75,42,800

However as per the Smart city cost estimates 33.59 and 22.4 crore are allotted to Achal and Lal diggi lake rejuvenation. The funds are proposed to be sourced from RRR scheme and smart city fund in convergence with funding from various other programs as well as Private sector (PPP)

6.7.5 Duration & Phasing of works undertaken

- Planning and DPR | 6 months
- Implementation | 36 months
- Management | after 36 months
- Monitoring | after 36 months

---1st year----- ----2nd year---- ---3rd year----

Planning and DPR(Documentation)	
Construction SW collection bins	
RWH system and recharge facility (Modular)	
Construction of 1 storm water drain from out let to inlet point and 2 is from inlet to Waste water treatment area	
Screening	
Formation of Constructed Wetland	
Landscaping (walkways, park and islands)	
Construction of Commercial complex	
Waste water treatment and floating wetland	
Man power with small carts to collect SW for achieving 100% D to D collection	
Achieving sustainability by linkages with people and official capacity building	
Monitoring stations (Real time water quality)	

6.8 Interventions details for Natural drains

Reconnect and notify all the discontinued drains in the proposed master plan with the name and their inventory. Bioremediation techniques in the identified stretch of Aligarh drain as per the compliance from the NGT 2016 which include 2 oxidation ponds+2 physical filters + Constructed wetland in the drain. Phyto remediation technologies along with the NGT 2016 recommendation for identified stretches of Aligarh drain can be proposed. Other drains can also be recommended in the next phase. The two oxidation units of 100 m long each are

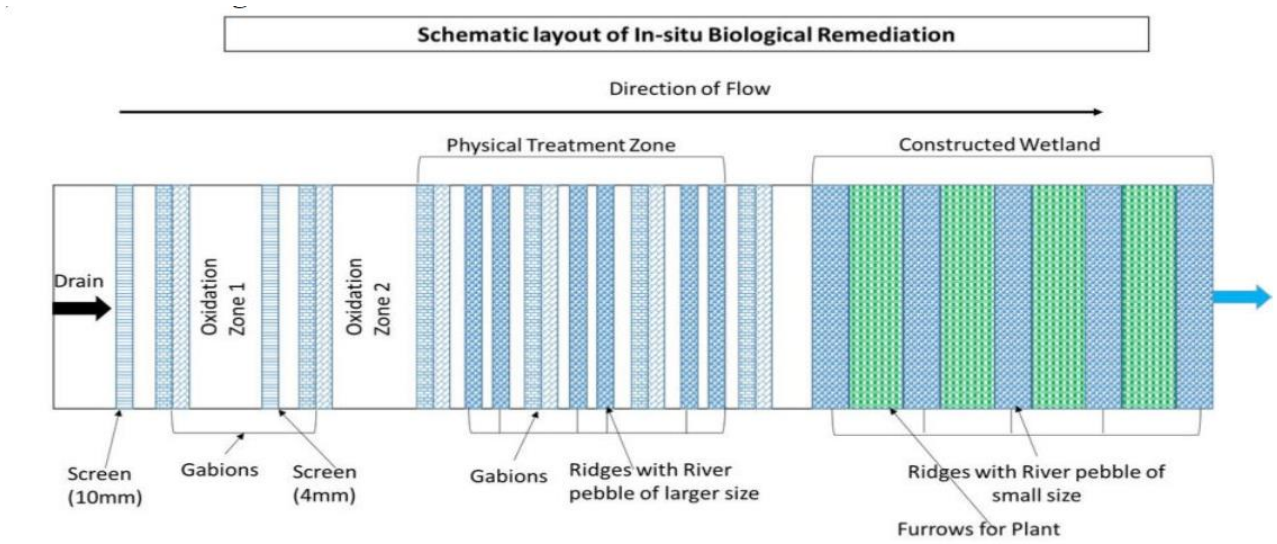
separated by three gabions; the two physical treatment units of 75 m long each and have vertical channels separated by gabions. The constructed wetland is of 150 m length and has 15 furrows of 8 m width, separated by 15 ridges of 2 m width can be proposed.

1. Oxidation Pond: Depth: Gabions of 4m width with height of 2.5 meter; Width: As per availability (15-90 meter), Length: 100 meters, Number of Oxidation Pond: 02

2. Physical Filters: Vertical channels: Width up to 8-meter, height 1-5 meter, length 75-100 meter and number of channels varies as per width of drain. Depth: Gabions of 2m width with height of 1.5 meter; Number of Physical Filters: 02

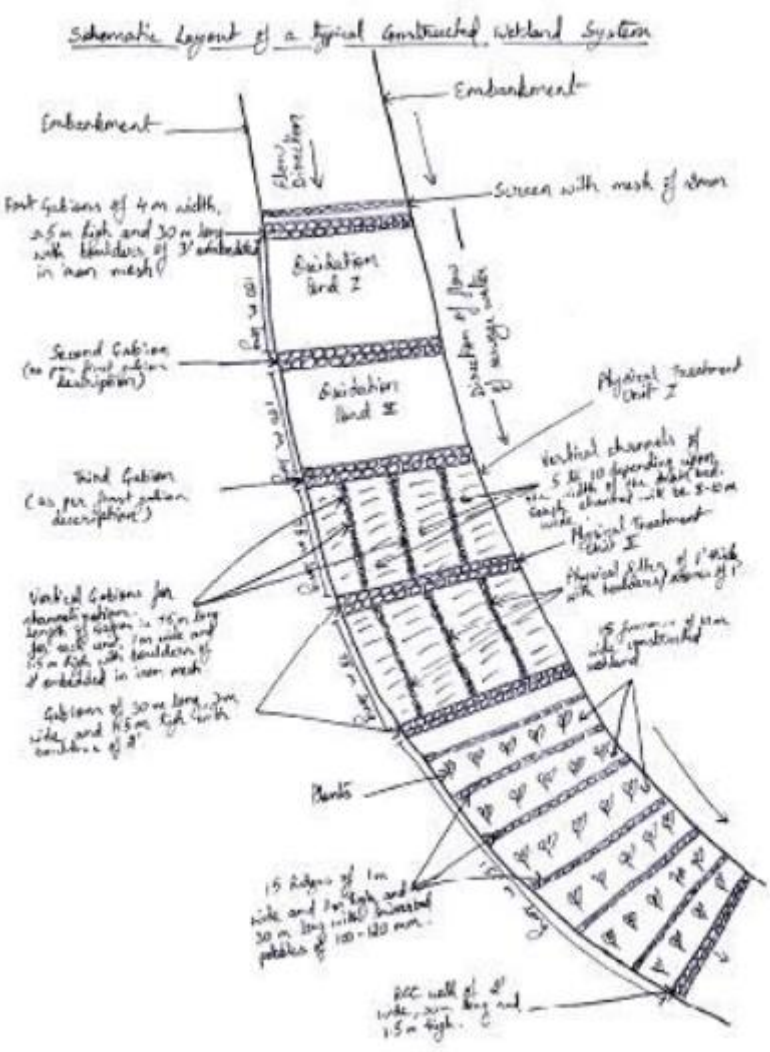
3. Constructed Wetland Systems Depth: Gabions of 2m width with height of 1.5 meter; Length- 150 m long, 15 furrows of 8 m wide separated by 15 ridges of 2 m wide

Figure 6-2Layout of in-situ biological remediation



Source 6-6 (ALTERNATIVE TREATMENT TECHNOLOGIES FOR WASTEWATER TREATMENT IN DRAINS, 2020)

Figure 6-3Layout diagram

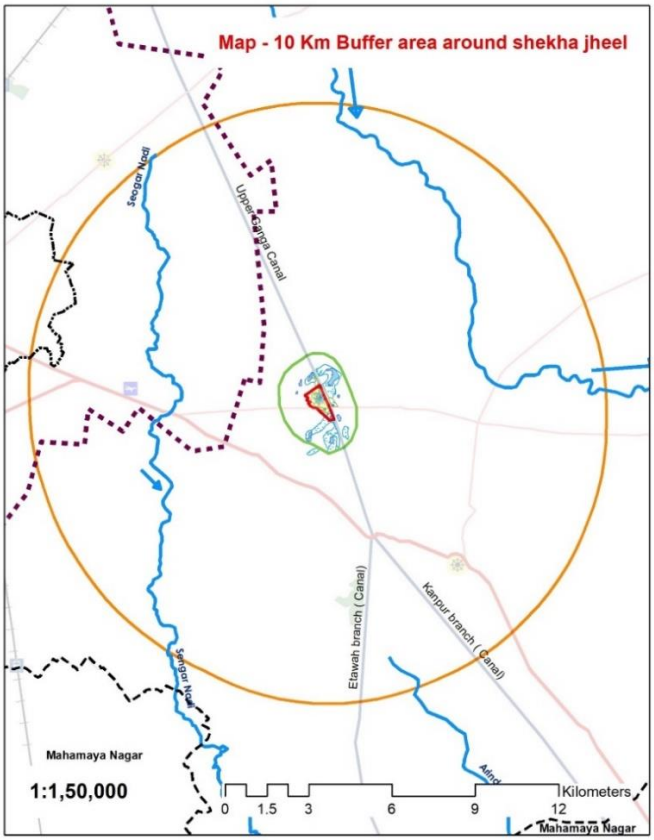


Source 6-7 (ALTERNATIVE TREATMENT TECHNOLOGIES FOR WASTEWATER TREATMENT IN DRAINS, 2020)

6.9 Interventions details for Shekha Jheel

Notify the left other part of the Shekha jheel in to the jurisdiction of forest department by land acquisition act 2013.

Map 6-4 Ten Km Buffer area around Shekha jheel for ESZ



Source 6-8 mapped from (Survey of India Toposheet, 2005)

Strengthening the proposals for Eco Sensitive Zone and 10 km buffer is identified for the jheel. Adopting the approach of Integrated wetland management plan as per 2017 rules.

6.10 Tentative Action Plan for overall proposals

Table 6-1Tentative action plan

Sr no.	Proposals	Implementing agency	Time frame	Impact/Result	Scheme
1.	Surface water body rejuvenation	Nagar Nigam/ Administration	6 months for each water body	Reestablished the water cycle. Improve micro climate. Could be act as another source of water supply.	Budget. RRR, Jal Shakti Abhiyan: Catch The Rain
2	Surface water drains (Unlined) rejuvenation Including	Nagar Nigam/Administration /irrigation dept.	2 years	Reestablished the water cycle. Improve micro climate.	Budget, Smart city mission

	bijagarh drain				
3	Monitoring Stations	UPPCB	6 months	Real time monitoring will help to take decisions for the next step.	National Water Quality Monitoring Programme (NWMP)
4	Industrial Pollution remediation (CETPs establish)	UPPCB	2 Years	Water pollution will be less and CEPI score will fall down.	
5	Ground water Pollution Remediation / RWH and recharge structure	ADA/ CPCB/UPPCB may monitor remediation work undertaken by responsible party and submit progress report to CPCB from time to time	5 years	Helpful for the public health and Ground Water level will be better.	
6	Infrastructure Facilities Augmentation	ADA/UPSIDC/Nagar nigam/ Individual builders	5 years	Quality of life will increase	Budget, Smart city mission
7	Land acquisition for Shekha jheel	Forest department, revenue department	5 years	Jurisdiction in the hand of forest dept.	
8	Master plan 2031	ADA	10 years	Official document for implementation	AMRUT
9	Monitoring	Environmental monitoring cell of Administration, UPPCB, Nagar Nigam	Every year	Monitoring and documentation will increase	Budget

Source 6-9 (Author, 2022)

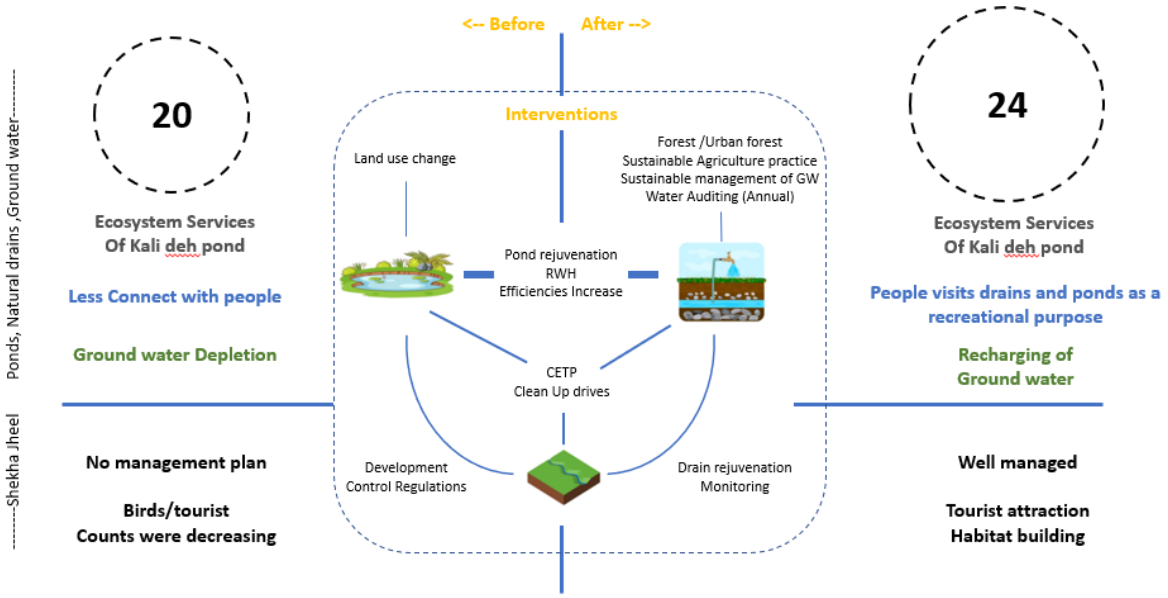
6.11 Plantation advisory note

Plantation like Delbergia sisso, Butea monosperma, Tectona grandis, Saraca asoca in roadside, Nyctanthes arbortristis, Bougainvillea species, Magnolia champaca, Hibiscus rosasinensis in dividers and Eucalyptus globulus, Shorea robusta, Haldina cordifolia, Ficus religiosa in Greenbelt/buffers. Some of the villages like Khandi, Ghana, Jaraiya, Jau/Jhau, Shikar, Arni, Jamun, Karil, Dhak, Mahua, Imli, Siris, Kadali are in the name of the tree. So, it is also recommended to plant the respective trees in the respective Villages Such as Mahua tree can be planted in Mahua Khera village.

6.12 Conclusion

Based on the analysis, proposals were worked out with focus on spatial planning and environmental planning approach and management. That is why, by incorporating the suggestions in to the practice, good water cycle and Good Hydrological balance could be obtained.

Figure 6-4 Illustration after adopting the proposals



Source 6-10 (Author, 2022)

6.13 Recommendations

Localizing national/state policies and initiatives such as 1. (Draft) Uttar Pradesh state water policy 2020, 2. State ground water conservation mission 2017, 3. Policy for ground water management, rain water harvesting and ground water recharge in Uttar Pradesh 2013, 4. Uttar Pradesh Groundwater Regulation Act, 2019., 5. Model Bill for the Conservation, Protection, Regulation and Management of Ground water, 2016, 6. Guidelines to regulate and control ground water extraction in India, 2020, Ministry of Jal Shakti, Government of India. Water body should be notified based on but not limited to- 1. Ecologically sensitive wetland area, 2. Water body with economic potential. Dedicated land use category and use zones with Prohibited activities, Permissible activities, Regulated activities can be provided while formulation of the master plan. Land use W1: Water bodies/wetlands/ponds/synonyms and Land Use W2: Riparian buffer. Through the special projects, student and consultants can take initiatives and give their recommendation like Rejuvenating an iconic/ historic water body in Aligarh.

6.14 The way forward

The thesis project can help city administration for prioritizing the ponds and the drains stretch in a holistic and systematic way. It can be beneficial for Urban Water body Diagnostic tool 2.0. A model study that can be replicated in almost 25 districts across doab of Ganga and Yamuna. It can be beneficial for development of standard operating procedure for restoration and rejuvenation of ponds of NITI Aayog upcoming project. It already helped in giving

suggestions for the Master plan 2031 of Aligarh (Submitted). Enhancement of Ecosystem Services offered by various ponds and drains. Since all the SDGs are connected to each other, However The study is aligned with the following SDGs directly-

Reinvention of the Lost Trilogy

as a pathway to

Reimaging Urban River

(Integrated Urban water Management)

References

About IWRM. (n.d.). Global Water Partnership. https://www.gwp.org/en/gwp-SAS/ABOUT-GWP-SAS/WHY/About-IWRM/

Aligarh smart city Ltd. (n.d.). Aligarh Smart City Ltd. https://gis.nnaligarh.in/GIS/Home/GISPortal

Atkinson, E. T., & Provinces, N. (1875). *Statistical, descriptive and historical account of the Aligarh district.*

Bhukosh. (n.d.). Bhukosh. https://bhukosh.gsi.gov.in/Bhukosh/MapViewer.aspx

Bhuvan | Thematic data dissemination | Free GIS data | OGC services | Clip and ship. (n.d.). https://bhuvan-app1.nrsc.gov.in/thematic/thematic/index.php

Census of India. (2011).

(2014). *City Sanitation Plan.* Aligarh.

Children test natural resources- Water monitoring event, Neer Foundation, western UP and NCR | *India water Portal*. (2022, June 28). | India Water Portal. https://www.indiawaterportal.org/articles/children-test-natural-resources-water-monitoring-event-neer-foundation-western-and-ncr

CPCB | Central pollution control board. (n.d.). CPCB | Central Pollution Control Board. https://cpcb.nic.in/index.php

(n.d.). Home | NIUA. https://niua.in/

Designing buildings. (2022, January 10). Retrieved from https://www.designingbuildings.co.uk/wiki/Sustainable_urban_drainage_systems_SUDS

Extreme Weather Events and Climatological Table Period: 1981-2010. (2022). Retrieved from IMD: https://city.imd.gov.in/citywx/extreme/JUN/aligarh2.htm

Final report on the Revision of Settlement in the district of Aligarh 1982. (n.d.). https://indianculture.gov.in/reports-proceedings/final-report-revision-settlement-district-aligarh

Ifsadmin. (2021, June 28). *Virtual water quality resource center | Water research project | Project description | Materials | Learn more*. Virtual Water Quality Resource Centre. https://water.edu.lk/beira-lake/

Irfan, A., & Khurshid, S. (2018). Heavy metal pollution in groundwater of Kali River, sub-basin, aligarh city, u.p. (India). *International Journal of Advanced Research*, 6(6), 520-529. https://doi.org/10.21474/ijar01/7241

Khan, S. (2017). *Aquifer Mapping And Ground Water Management Plan.* Aligarh.

Khan, H. H., & Khan, A. (2019). Groundwater-surface water interaction along river Kali, near Aligarh, India. *HydroResearch*, 2, 119-128. https://doi.org/10.1016/j.hydres.2019.12.001

Khan, K. A., & Khan, J. A. (2016). Status, abundance and population ecology of nilgai (Boselaphus tragocamelus Pallas) in Aligarh district, Uttar Pradesh, India. *Journal of Applied and Natural Science*, 8(2), 1080-1086. https://doi.org/10.31018/jans.v8i2.924

Khan, S. U. (2020). A checklist of birds in agricultural landscapes of Aligarh, Uttar Pradesh, India. *International journal of fauna and biological studies* .

Khurshid, S., & Kulshrestha, P. (2008, January 01). Groundwater resource and development potential in parts of Central Ganga-Basin, Aligarh (U.P.), India. *Bulletin of Pure & Applied Sciences-Geology*.

KIDWAI, Z. (2015). CONSERVING SHEIKHA LAKE :A REVIEW. *Life Science Journal*.

Master plan Aligarh. (n.d.). Aligarh Development Authority. https://adaaligarh.in/master-plan-aligarh/

(n.d.). National Atlas & Thematic Mapping Organisation. https://www.natmo.gov.in/

Sadaf, & Munir, P. A. (2015). Environmental conditions and health status of slum dwellers in civil line area of Aligarh city, UP. *Journal of Current Research*.

Siddiqi, J. M. (1981). *Aligarh District: A historical survey (From ancient times to 1803 AD).* Munshilal Manoharlal Publishers Pvt. Ltd.

Sheikha Jheel. (2020, September 13). Kalpavriksh. https://kalpavriksh.org/sheikha-jheel/

Sponge cities: What is it all about? (2016, July 4). World Future Council. https://www.worldfuturecouncil.org/sponge-cities-what-is-it-all-about/

(2017). *Smart City Challege Stage-2 (Smart City Proposal).* MoUD.

Survey of India Toposheet. (2005).

Sustainable urban drainage systems SUDS. (n.d.). Designing Buildings Wiki. Retrieved July 1, 2022, from https://www.designingbuildings.co.uk/wiki/Sustainable_urban_drainage_systems_SUDS

Umar, R., Umar, A., Khurshid, S., & Ahmad, I. (2001). Microbial Contamination in the Groundwater of Aligarh City. *Journal of Geological Society of India*.

Up Pollution Control Board, Lucknow. UP Pollution Control Board, Lucknow. (n.d.). Retrieved March 1, 2022, from http://www.uppcb.com/

Directorate of Economics And Statistics Government Of Uttar Pradesh. UPDES. (n.d.). Retrieved March 1, 2022, from https://updes.up.nic.in/

UPSIDA. (n.d.). UPSIDC. Retrieved February 2022, from https://gis.onlineupsidc.com/

USGS.gov | Science for a changing world. USGS. (n.d.). Retrieved February 2022, from https://www.usgs.gov/

Weather archive in Aligarh (India). Wind rose in Aligarh. (n.d.). Weather in the world - Weather forecast for cities the world for 3 days, for week and 14 days. https://world-weather.info/archive/india/aligarh/

Wetlands of India Portal. Wetlands of India Portal. (n.d.). Retrieved March 1, 2022, from https://indianwetlands.in/

भारतीय मृदा एवं भू-उपयोग सर्वेक्षण. SLUSI. (n.d.). Retrieved March 1, 2022, from https://slusi.dacnet.nic.in/

Annexure

Annexure 1: RTI Responses and Interaction with local stakeholders

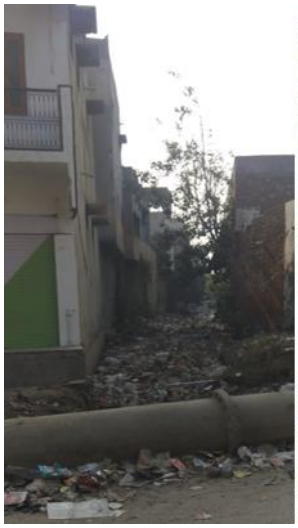
RTI	Reply	Ans	Department
To get the water body details	Responded	Will not provide	Tehsil Koil
To get the water body details	Not responded	-	Tehsil Gabhana
To get the water body details	Not responded	-	Aligarh Municipal Corporation
Industries list and CEPI Action plan	Responded	7 and 12 pages of reply	UPPCB Regional Office
Locations specific	Responded	No locations	Post office

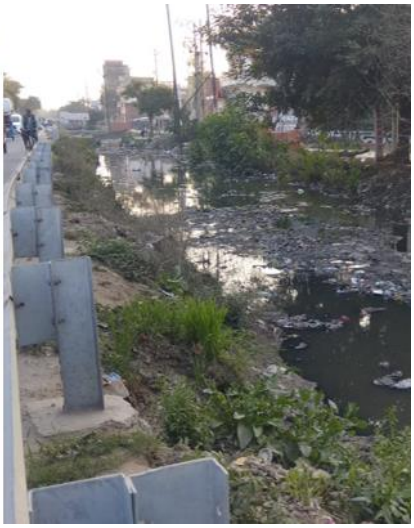
Local stakeholders include Abhishek Kumar, Satish Kumar (SDFO), Divakar Vashisth (DFO), Arvind Kumar (Forest Range Officer), Mukesh and Ishaq Mohammad of forest Department. Gyanendra Mishra (President) of Udaan Society. Anwar Khwaja (GM), Arun Kumar Gupt (Deputy Commissioner) of Aligarh Municipal Corporation. JP Singh and R K Singh of UP Pollution control Board. Girraj Singh and Yatendra Singh of Irrigation Department Aligarh. Brajesh Yadav (Assistant Manager) of District Industrial Center. Subodh Nandan Sharma Environmentalist. Bhoop Singh (Horticulture Inspector) of Horticulture Department. Arun Singh Ganga Repository of Maulana Azad Library, AMU. Dr. Orus Ilyas Associate Professor of Dept of Wildlife Sciences AMU. Dr. Rizwan Ahmad Guest Faculty in Interdisciplinary Department of Remote Sensing and GIS Applications AMU. Praveen Arya Awas vikas colony, Miss Tanvi (District Youth Officer) Nehru Yuva Kendra and nearly 100-120 people.

Annexure 2: Photos of Some of Aligarh Pond and Drains

All the photos are taken by the author during October to June 2022.


2022-2-4 15:15
2022-2-4 15:54





Annexure 3: Ponds Inventory

Sr. number	Mapping GIS Tagged Numbered	Ward No	Location	Main Source	Total sources
1	pond-01	31	Avas Vikas Colony (Iglas Road)	CityGIS	1
2	pond-02	31	Avas Vikas Colony (Iglas Road)	CityGIS	1
3	pond-03 (Chawni pond)	12	Chawni	CityGIS	4
4	pond-04	78	Ramgarh Panjupur	CityGIS	1
5	pond-05	73	Nagla Maansingh	CityGIS	2
6	pond-06	37	Nagla Ashiq Ali	CityGIS	1
7	pond-07	42	Ram Bagh Colony	CityGIS	1
8	pond-08	71	Ashadpur Quam	CityGIS	1
9	pond-09	76	North Ashraf Jalalpur, Alapur Gadia, Elampur	CityGIS	1
10	pond-10	67	Shah Jamal	CityGIS	1
11	pond-11	73	Nagla Maansingh	CityGIS	1
12	pond-12(Nagla masani/Near Numaish)	49	Ashok Nagar	CityGIS	3
13	pond-13	71	Ashadpur Quam	CityGIS	1
14	pond-14	71	Ashadpur Quam	CityGIS	1
15	pond-15	78	Ramgarh Panjupur	CityGIS	1
16	pond-16	74	Rorawar West	CityGIS	1
17	pond-17	73	Nagla Maansingh	CityGIS	1
18	pond-18	58	Dodhpur	CityGIS	1
19	pond-19 (Teen Talaab)	10	Sarai Deen Dayal	CityGIS	1
20	pond-20	22	Nagla Maulvi	CityGIS	1

21	pond-21	79	Dhorra Mafi	CityGIS	1
22	pond-22	11	Nagla Masani	CityGIS	5
23	pond-23	24	Kishanpur	CityGIS	1
24	pond-24	78	Ramgarh Panjupur	CityGIS	1
25	pond-25	1	Nagla Kalar	CityGIS	1
26	pond-26	46	Jamalpur	CityGIS	1
27	pond-27	73	Nagla Maansingh	CityGIS	1
28	pond-28	61	Hamdard Nagar	CityGIS	1
29	pond-29	53	Firdaus Nagar	CityGIS	1
30	pond-30 (AMU)	46	Jamalpur	CityGIS	1
31	pond-31	73	Nagla Maansingh	CityGIS	1
32	pond-32 (Gooler road)	20	Fire Brigade	CityGIS	1
33	pond-33	71	Ashadpur Quam	CityGIS	1
34	pond-34	30	Makdoom Nagar	CityGIS	2
35	pond-36 (Sankalp Vihar)	49	Ashok Nagar	CityGIS	1
36	pond-38	53	Firdaus Nagar	CityGIS	1
37	pond-39	78	Ramgarh Panjupur	CityGIS	1
38	pond-40	31	Avas Vikas Colony (Iglas Road)	CityGIS	1
39	pond-41	53	Firdaus Nagar	CityGIS	1
40	pond-42	53	Firdaus Nagar	CityGIS	1
41	pond-43	30	Makdoom Nagar	CityGIS	2
42	pond-44	71	Ashadpur Quam	CityGIS	1
43	pond-45	71	Ashadpur Quam	CityGIS	1
44	pond-46 (Etah chungi pond)	45	Sanjay Gandhi Colony	CityGIS	5
45	pond-47	78	Ramgarh Panjupur	CityGIS	1
46	pond-48	80	Quarsi	CityGIS	1
47	pond-49	80	Quarsi	CityGIS	1
48	pond-50	75	Ashrafpur Jalal South	CityGIS	2
49	pond-51	77	Sarsol, Baurola Jafrabad	CityGIS	1
50	pond-52	20	Fire Brigade	CityGIS	1
51	pond-53	36	Badar Bagh	CityGIS	1
52	pond-54 (Kali deh k aage)	9	Nagla Pala	CityGIS	6
53	pond-55	78	Ramgarh Panjupur	CityGIS	1
54	pond-56	78	Ramgarh Panjupur	CityGIS	1
55	pond-57	75	Ashrafpur Jalal South	CityGIS	1
56	pond-58	73	Nagla Maansingh	CityGIS	1
57	pond-59	80	Quarsi	CityGIS	1

58	pond-60	74	Rorawar West	CityGIS	1
59	pond-61	75	Ashrafpur Jalal South	CityGIS	1
60	pond-62	2	Indra Nagar Khair Road	CityGIS	1
61	pond-63	78	Ramgarh Panjupur	CityGIS	1
62	pond-64	25	Delhi Gate	CityGIS	1
63	pond-65	42	Ram Bagh Colony	CityGIS	1
64	pond-66	55	Sasni Gate	CityGIS	2
65	pond-67	77	Sarsol, Baurola Jafrabad	CityGIS	1
66	Achal Lake	33	Gandhi Nagar	CityGIS	3
67	Surendra Nagar Lake	40	Ghanshayampuri	CityGIS	1
68	Kalideh lake	21	Ghamibirpura	CityGIS	6
69	New basti Pond	23	Nai Basti	CityGIS	4
70	Chautal	36	Badar Bagh	CityGIS	3
71	Gandhi Eye Hospital Pond	64	Sudamapuri	CityGIS	2
72	Lal Diggi	39	Malkhan Nagar	CityGIS	1
73	Loco Pond	35	Bhamola	CityGIS	2
74	Aalam B Pond	35	Bhamola	CityGIS	2
75	2	29	Rasal Ganj	GSI(Geology)	2
76	4	21	Ghamibirpura	GSI(Geology)	2
77	6	33	Gandhi Nagar	GSI(Geology)	1
78	7	9	Nagla Pala	GSI(Geology)	1
79	10 (Vaishnodham)	72	Dhanipur	GSI (Geomorphology)	1
80	1 (Nagla tikona taalab)	51	Nagla Tikona	Primary survey	2
81	2(Ameer Nisha Tikona Pond)	39	Malkhan Nagar	Primary survey	2
82	3 (Pariyon wala talab | melrose byepass)	1	Nagla Kalar	Primary survey	1
83	4(Sabit khan tank | Nashit talkies)	8	Sarai Lavaria	Primary survey	1
84	4	33	Gandhi Nagar	Master plan	1
85	6	73	Nagla Maansingh	Master plan	1
86	9	55	Sasni Gate	Master plan	1
87	11	30	Makdoom Nagar	Master plan	2
88	12	74	Roravar West	Master plan	2
89	16	70	A.D.A. Shanti Niketan Colony	Master plan	1
90	17	2	Indra Nagar Khair Road	Master plan	1

91	18	22	Nagla Maulvi	Master plan	1
92	20	48	Shivpuri	Master plan	1
93	23	20	Fire Brigade	Master plan	1
94	24	49	Ashok Nagar	Master plan	1
95	30	78	Ramgarh Panjupur	Master plan	1
96	32	80	Quarsi	Master plan	1
97	33	80	Quarsi	Master plan	1
98	34	71	Ashadpur Quam	Master plan	1
99	35	71	Ashadpur Quam	Master plan	1
100	5	33	Gandhi Nagar	SOI	1
101	9 (SWM & STP plant)	55	Sasni Gate	SOI	1
102	10	67	Shah Jamal	SOI	1
103	17	42	Ram Bagh Colony	SOI	1
104	66	80	Quarsi	SOI	1
105	67	80	Quarsi	SOI	1
106	110 (Lal tal, Exhibition)	18	Chuharpur	SOI	1

Annexure 4: Natural Drain Inventory

Sr. number	Drain Name	Stretches	Capacity (kl)
1	Aligarh drain	Origin to Planning area entering point	90000
		From planning area entry point to diversion point	45000
		From diversion to type 1-2 drain meeting point	38880
		type 1-2 drain meeting point to ITI Nala point	77760
		ITI Nala point to type 3 drain meeting point	150480
		type 3 drain meeting point to chhahari drain	540000
		chhahari drain to Yamuna river (Outside Juridiction of Aligarh District)	2970000
2	Jafri drain	Jafri drain till last municiple limit	129600
		Last municiple limit to end	64800

		point	
3	Koil Distributry	Koil Distributry (planning area to break)	64800
4	Gadrana minor	Gadrana minor	100800
5	Boner minor	Boner minor	21000

Annexure 5: Shekha Jheel Photos

All the photos were taken by the author during October to June 2022 and others photos have been sourced. However the majority of them were in the January month.

Annexure 6: Report of Water samples taken from Aligarh city

Samples are collected by the author and the test has been taken up in the Min Mec R& D laboratory, New Delhi.

An ISO 9001 : 2015 approved company

Min Mec R&D Laboratory
(A DIVISION OF MIN MEC CONSULTANCY PVT. LTD.)
A-121, Paryavaran Complex, IGNOU Road, New Delhi-110030
Phone: 29532236, 29535891, 29532568
Email: lab.minmec@gmail.com; Website: http://www.minmec.com
Recognised by MOEF&CC (Sl. No. 97 of S.O. 3744 (E) Dated 17/10/2019)

Page 1 of 1
Test Report No. : MMW/05-22/32
ULR Number : TC633722000000053F

1. Ground water Samples

Parameters	Drinking water limits (IS: 10500:2012, Amendment 3, 2021)		Protocol	TEST RESULTS			
	Acceptable	Permissible		Awas Vikas Colony Near New Basti	Ram Snehi dham Colony, Etah Chungi	Sarsol, Near Bus Stand	Naqvi Park, Near AMU
pH value	6.5 - 8.5	No relaxation	IS 3025 (Part 11): 1983, RA 2017	7.3	7.5	7.3	7.4
Specific Conductance, µS/cm	-	-	IS 3025 (Part 14): 2013, RA 2019	1054	819	486	1108
Total Dissolved Solids, mg/l	500	2000	IS 3025 (Part 16): 1984, RA 2017	658	500	306	628
Total Suspended Solids, mg/l	-	-	IS 3025 (Part 17): 1984, RA 2017	8	10	14	10
Total Hardness as CaCO3, mg/l	200	600	IS 3025 (Part 21): 2009, RA 2019	360	232	196	360
Alkalinity, mg/l	200	600	APHA 23rd Ed. 2320 B: 2017	396	436	277	569
Calcium as Ca, mg/l	75	200	IS 3025 (Part 40): 1991, RA 2019	66	53	46	69
Magnesium as Mg, mg/l	30	100	IS 3025 (Part 46): 1994, RA 2019	47	24	19	45
Fluoride as F, mg/l	1.0	1.5	APHA 23rd Ed. 4500-F- D: 2017	0.75	0.96	0.50	0.54
Nitrate as NO3, mg/l	45	No relaxation	APHA 23rd Ed. (4500-NO3- B): 2017	28.27	7.93	0.63	14.39

2. Surface water Samples

Parameters	Drinking water limits (IS: 10500:2012, Amendment 3, 2021)		Protocol	TEST RESULTS			
	Acceptable	Permissible		New Basti Pond (Aksari Lake)	Etah Chungi Pond	Aligarh Drain (Up Stream)	Aligarh Drain Near Mathura Road (Down Stream)
pH value	6.5 - 8.5	No relaxation	IS 3025 (Part 11): 1983, RA 2017	6.9	7.2	8.0	7.5
Specific Conductance, µS/cm	-	-	IS 3025 (Part 14): 2013, RA 2019	1950	1748	4590	2420
Total Suspended Solids, mg/l	-	-	IS 3025 (Part 17): 1984, RA 2017	42	82	86	112
Dissolved Oxygen, mg/l	-	-	IS 3025 (Part 38): 1989, RA 2019	N.D	N.D	N.D	N.D
Biochemical Oxygen Demand (BOD), mg/l	-	-	IS 3025 (Part 44): 1993, RA 2019	65	80	55	140
Chemical Oxygen Demand (COD), mg/l	-	-	APHA 23rd Ed. 5220 D: 2017	155	169	147	316
Nitrate as NO3, mg/l	45	No relaxation	APHA 23rd Ed. (4500-NO3- B): 2017	5.48	4.23	1.13	4.21
E. Coli	-	-	APHA 23rd Ed. 9221 F: 2017	Present	Present	Present	Present

N.D: Not Detected

Annexure 7: Residents Questionnaire

In which colony / ward do you reside? Family members in your Family? What is your sex ? Age? How many years have you been residing here? What is the source of your domestic water supply? If Borewell, What is the depth of it? What type of water do you drink? Any water treatment method for your drinking purpose? If Ground water, then what is the taste of water? Any Ground water related issue? Is your House connected to sewerage network? Is your area has Door to Door collection facility of solid waste from nagar nigam? How do you dispose the household garbage? What do you do in your free time / spend quality time with family, friends? Do you want to go Shekha Jheel ? If yes, why you want to go shekha jheel? Do you want that there should be improvement in each water bodies in Aligarh like shekha jheel? Does your area/ward have any Ponds/natural drains/water body? If yes, Name of that water body/pond? If No, what is the name of the nearest water body/pond from your area? What is the Distance in km of your residence from the waterbody? How often do you visit the water body/pond? If not, Major reason for not visiting water bodies? If you visit, Major Reason for visiting water body? What do you think about the waterbody? What type of Accident/Problem have you observed/heard of here? Does the water from the waterbody overspill during monsoons? What have you observed in terms of quality of water and surroundings? Have you seen water birds in this water body? Is there any problem of Mosquitos in your vicinity? If yes, what do you think is responsible? What is responsible for poor condition of waterbody? Do you want any change in this Water body? If improvement, what is your suggestion for improvement of water body? How can you contribute to restoration of the Water body? Do you think waterbodies are important? If yes, what is the reason? Is there any one waterbody in the city that you really like visiting except shekha jheel? If yes, Name and why? Do you think groundwater and waterbodies are connected? Do you think that there were a network of water bodies in the past through natural drains? Your suggestions/comments? Name and details? If you want to share!

Annexure 8: Tourists Questionnaire

What is your Age? What is your sex? How many persons are there with you? From where are you coming? What is the reason for your visit to Shekha jheel? How much time have you taken for your trip in shekha jheel ? Is Entry fees reasonable? What is your experience in shekha jheel? If bad why? If good, What did you find attractive about shekha jheel? Have you visited Shekha jheel before? If yes, When did you visit last? If yes, What is your feeling about the change of the shekha jheel wetland area? What is your perception about the major problem in shekha jheel area? What kind of improvement do you want to suggest? What is your perception about Tourist count? Do you want to

do boating in shekha jheel? How do you feel about safety and security in Shekha jheel ? Do you want to come again? If yes, In which season, do you prefer to come? Your suggestions/comments? Your name and details? If you want to share?

Annexure 8: Comments submitted to ADA, Aligarh for 2031 (Draft) Master Plan

पर्यावरण को ध्यान में रखते हुए नमामि गंगे तथा NIUA ने Strategic Guidelines for MAKING RIVER-SENSITIVE MASTER PLANS 2021 गाइडलाइंस बनाए हैं उनको , जहां तक हो, फॉलो किया जाए |

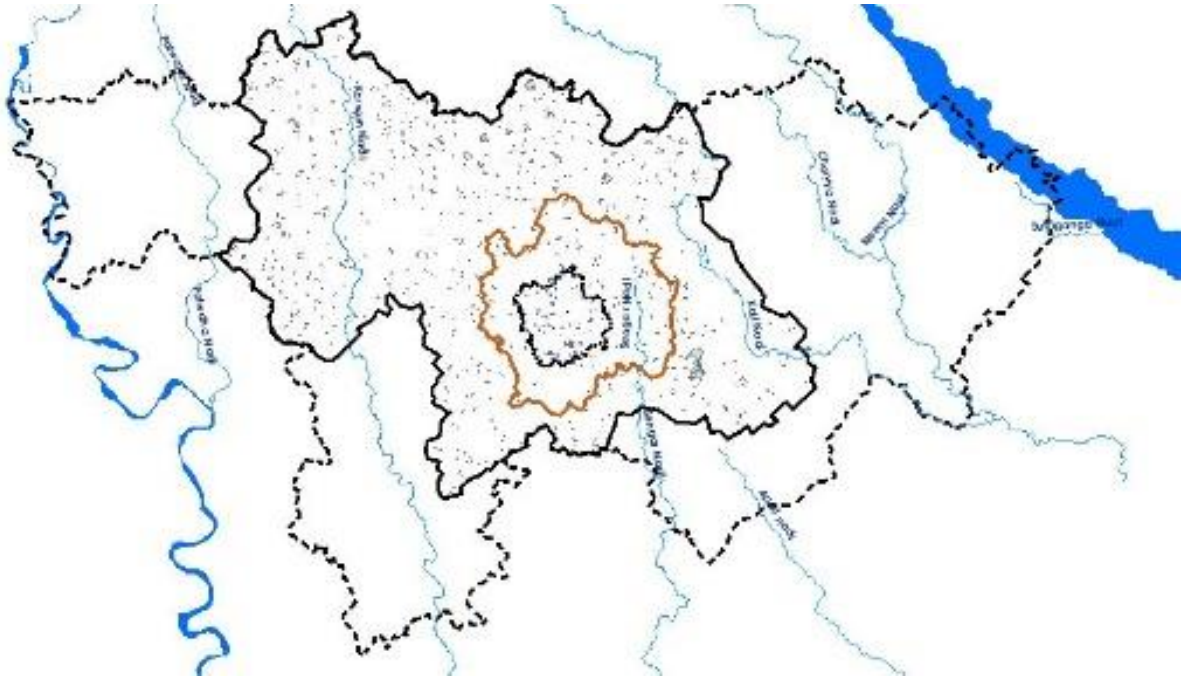
अलीगढ़ महायोजना 2031 प्रारूप में 4.10 के अनुसार, अलीगढ़ विकास क्षेत्र (2031) में करीब लगभग 753 तालाब है जबकि सर्वे ऑफ इंडिया की Toposheets के अनुसार अलीगढ़ विकास क्षेत्र (2031) में 934 के करीब तालाब/water bodies/tank है | इसीलिए बाकी बचे तालाबों को भी मैप पर अंकित करने की आवश्यकता है जिससे इनका संरक्षण किया जा सके| इन तालाबों के किनारे बफर देना आवश्यक है जिससे प्राकृतिक संतुलन बना रहे | बफर का सुझाव-

Water bodies/ponds Above and equal to 5 ha= 3 to 9 m
Water bodies/ponds Above and equal to 1 ha= 3 to 6 m
Water bodies/ponds Below and equal to 0.5 ha= 3 m
Canal = 15 m and drains= 15 m

तथा यह भी ख्याल रखना है कि तालाब का पानी का स्टोरेज कम ना हो | बफर का प्रयोग अगर तालाब के किनारे ना हो सके, तो बफर के स्थान पर Slope stabilization area (3 m) डिवेलप किया जा सकता है | अगर तालाब के आसपास जगह है तो 50 मीटर बफर देना आवश्यक है | इस प्रकार बफर मै Dense shrub अथवा Native trees लगाए जा सकते है | इस प्रकार तालाबों के स्वरूप को बचाया जा सकता है |

UPECP पोर्टल के अनुसार अलीगढ़ जिले में वेटलैंड की स्टडी हुई है जिसमें इन्हें चयनित किया गया है कृपया इनको भी (जो भी गांव मास्टर प्लान में आते हैं) मास्टर प्लान में अंकित किया जाए |

इस मुद्दे को अपनाया जाना बहुत जरूरी है क्योंकि Aligarh CEPI score (Water category) में 48 to 61.88 की वृद्धि 2008 to 2018 में देखी गई है | विडंबना यह भी है कि एक बार सर सैयद अहमद खान द्वारा अलीगढ़ मुस्लिम विश्वविद्यालय की स्थापना के लिए अपने 'आबो-हवा' के कारण चुना गया शहर बड़े पैमाने पर शहरीकरण के कारण जल संसाधनों की कमी और गिरावट के कारण पीड़ित है।



Above map: Water bodies locations and Source: Survey of India Toposheets Mapped by Pranav Varshney, SPA New Delhi M.Plan thesis.

अलीगढ़ महायोजना 2031 प्रारूप में 4.10 में शीर्षक सतही जल निकाय होना चाहिए जिससे तालाब, प्राकृतिक बहाव/Drains/Nala, विभिन्न प्रकार के डिस्ट्रीब्यूटरी, कैनाल ,एस्केप, माइनर को अंकित किया जा सके | इन सब की डीटेल्ड इन्वेंटरी बनाने की जरूरत है तथा डिटेल इन्वेंटरी को अनुलग्नक में जोड़l सकता है | पानी की गुणवत्ता को मापने के लिए मॉनिटरिंग स्टेशन की लोकेशन भी चिन्हित की जाए, ऐसा सुझाव दिया जाता है | महायोजना क्षेत्र में ऐसे बहुत से local depressions हैं जहां पर पानी इकट्ठा होता है अर्थात वॉटर लॉगिंग होती है ऐसे डिप्रेशन को चिन्हित किया जाए और इनका land use - water body में change करने की सलाह दी जाती है |

अलीगढ़ महायोजना 2031 प्रारूप में 4.10 के अनुसार, काली नदी कारवां नदी और सिंगर नदी में बफर क्षेत्र कुछ जगहों पर दिया गया है पर यह कितने मीटर का बफर है? यह बताया नहीं गया है| इसीलिए सलाह दी जाती है कि सभी जगहों पर बफर दिया जाए | तथा RIVER CENTRIC URBAN PLANNING GUIDELINES 2021 के अनुसार river regulation zones have been divided into three, depending upon the permission granted to carry out developmental activities:

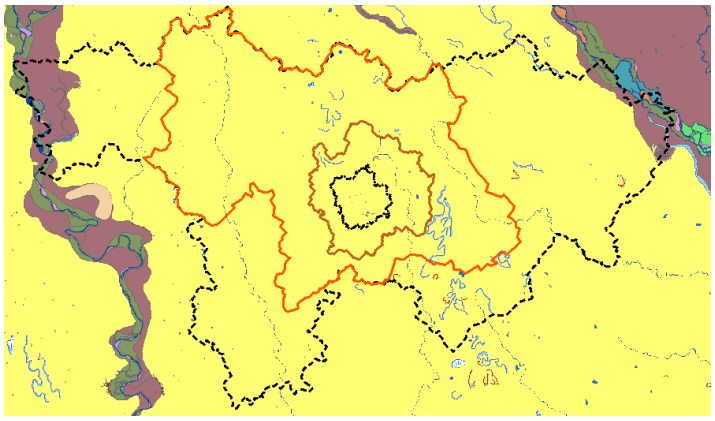
Prohibited activities zones: up to 500 meters from the highest flood level in the past 25/50/100 years

Restricted activities zone: Outer limit of the prohibited zone to 1 kilometer

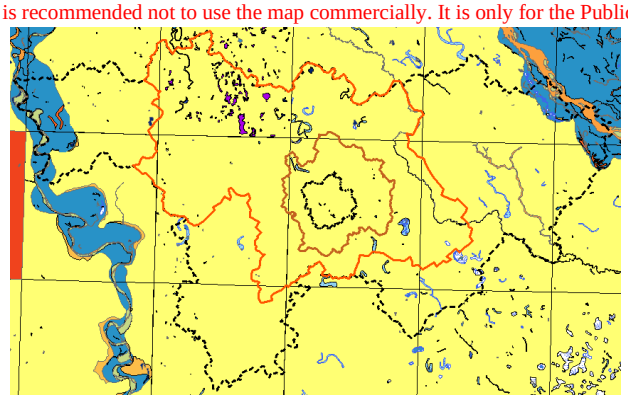
Regulated activities zone: Outer limit of the restricted zone to 3 kilometers.

बफर देने का उद्देश्य नियोजित तरीके से शहर का विकास होना है |

Geology and Geomorphology के अनुसार अलीगढ़ एरिया में ऐसी बहुत सी Ox-Bow lakes, Swamp / Marsh, Meander Scar तथा Palaeochannels हैं जिनको Conserve करने की जरूरत है | इसीलिए इनकी बाउंड्री को water body land use किया जाना आवश्यक है |



Above Map: Geomorphology landform and Source: Bhukosh Geology Survey of India as of 12/02/2022 downloaded by Pranav varshney for SPA New Delhi M.Plan thesis. It is recommended not to use the map commercially. It is only for the Public suggestion for Master Plan 2031



Above Map: Morphological element and Source: Bhukosh geology survey of India as of 12/02/2022 downloaded by Pranav varshney for SPA New Delhi M.Plan thesis. It is recommended not to use the map commercially. It is only for the Public suggestion for Master Plan 2031

जहां तक हो सके सर्वे ऑफ इंडिया से drains को मास्टर प्लान में अंकित किया जाए | जैसे Chhahari drain Mark नहीं की गई |

अलीगढ़ महायोजना 2031 प्रारूप में Slums के ऊपर कुछ भी नहीं किया गया जबकि 2011 की जनगणना के अनुसार अलीगढ़ शहर में लगभग 42% आबादी Slums की थी |

महायोजना क्षेत्र में कृषि भूमि बहुत है तथा पिछले वर्षों में ऐसा देखा गया है की भूजल पर कृषि की निर्भरता बढ़ती जा रही है, योजना में इसका भी एसेसमेंट होना चाहिए | क्योंकि विकास के लिए कृषि भूमि पर ही Land use बनाया जाता है यह सलाह दी जाती है कि LULC भुवन के डाटा से बैरन लैंड का पता लगाया जा सकता है, उपजाऊ भूमि को ना लेकर, बैरन लैंड को विभिन्न Land use में बना देना चाहिए |

Zone 14 : शेखा झील और उसके आसपास का क्षेत्र के अनुसार ,क्षेत्र की बाउंड्री बिल्कुल सीधी है और पानी की स्टडी कभी सीधी दिशा में नहीं होती इसलिए जरूरत है शेखा झील के watershed/ Zone of Influence की स्टडी की जाए और उस बाउंड्री को Zone 14 बनाया जाए | आर्द्रभूमि (संरक्षण और प्रबंधन) नियम , 2017 के अनुसार शेखा झील और उसके आसपास का क्षेत्र की स्टडी की जाए तथा इंटीग्रेटेड वेटलैंड मैनेजमेंट प्लान बनाने का सुझाव दिया जाए | जिससे भविष्य में इसके ऊपर काम किया जा सके| भवन खेड़ा माइनर को अंकित नहीं किया गया है जिससे उसका एंक्रोचमेंट हो सकता है | एक तो पहले से ही अलीगढ़ जलाली रोड से शेखा झील का प्राकृतिक संतुलन बिगड़ा हुआ है अतिरिक्त रोड प्रस्तावित करके उसका संतुलन और बिगड़ सकता है इसलिए सलाह दी जाती है कि ऐसी प्रस्तावित सड़कों को हटाया जाए | गंगा नहर की वजह से शेखा झील दो भागों में विभाजित हुई थी एक तरफ के हिस्से पर ज्यादा विकास हुआ और दूसरी और विकास नहीं हुआ | ऐसा सुझाव दिया जाता है कि दूसरे तरफ की झील को भी शेखा झील का दर्जा मिले और मैप किया जाए | जिससे जैव विविधता को बढ़ाया जा सके | ESZ सुझाव में लाया जा सकता है जिससे

शेखा झील का संपूर्ण विकास हो सके तथा 10 किलोमीटर का बफर दिया जाना उचित रहेगा जिसमें Prohibited activities zones: up to 500 meters
Restricted activities zone: Outer limit of the prohibited zone to 1 kilometer
Regulated activities zone: Outer limit of the restricted zone to 10 kilometers मार्क किया जा सकता है |

गिरते भूमिगत जल को देखते हुए page 49 पर जलाली की पानी की आवश्यकता 2031 में 4.81 एमएलडी हो जाएगी इसीलिए शेखा झील के पास 5 एमएलडी का डब्ल्यूटीपी देने का सुझाव है जिससे जलाली के लोग भूमिगत जल पर कम निर्भर होंगे तथा झील में स्वच्छ पानी का प्रवाह ही बना रहेगा |

अलीगढ़ महायोजना 2031 प्रारूप में 4.6 के अनुसार,भौतिक अवसंरचना में केवल शहर के ऊपर स्टडी की हुई है गांव के ऊपर कोई स्टडी नहीं है सुझाव यह दिया जाता है कि योजना में स्थित सभी गांव की स्टडी की जाए|

अलीगढ़ महायोजना 2031 प्रारूप में 4.6 के अनुसार, ग्राउंड वाटर के संरक्षण तथा रिचार्जिंग हेतु महायोजना में कोई भी ऐसी स्थल अंकित नहीं किया गया है जिससे यह पता चले कि यहां रिचार्ज किया जाए| ब्लॉक असेसमेंट 2020 के अनुसार अलीगढ़ शहर ओवरएक्सप्लोइटेड कैटेगरी में आया हुआ है इसीलिए सुझाव दिया जाता है कि Safe रिचार्जिंग हेतु जगह का चुनाव किया जाए |

अलीगढ़ महायोजना 2031 प्रारूप में 4.11 के अनुसार, 14 एएसआई द्वारा मान्यता प्राप्त स्थल है यह सुझाव दिया जाता है कि भारतीय पुरातत्व सर्वेक्षण की अधिसूचना संख्या 1764 के अनुसार संरक्षित स्मारक से 100 मीटर दूरी तक किसी भी प्रकार का निर्माण अनुमन्य नहीं किया जाएगा तथा 100 मीटर के पश्चात 200 मीटर दूरी तक क्षेत्र में निर्माण नियंत्रित होगा जिसमें पुरातत्व विभाग की अनापत्ति प्राप्त करने के पश्चात निर्माण कार्य अनुमन्य होगा | अलीगढ़ प्लानिंग एरिया में ऐसे बहुत से बिल्डिंग या भवन है जो कि बहुत पुराने हैं उनको कंजर्व करने की जरूरत है ऐसे बिल्डिंग और भवन को Map करने की आवश्यकता है और भविष्य में architectural conservation plan बनाने की आवश्यकता है| का सुझाव दिया जा सकता है |

उद्योगों तथा ताले , हार्डवेयर के लिए प्रसिद्ध अलीगढ़ की योजना में उद्योगों से होने वाले प्रदूषण पर कोई बात नहीं की गई है तथा यह सुझाव दिया जाता है कि अलीगढ़ क्षेत्र के तीन इंडस्ट्रियल क्लस्टर - Chherat, तालानगरी तथा आईटीआई में 3 CETP तथा 1 CETP South western City ,जहां कड़ीघर की संख्या ज्यादा है, एरिया में लगाना चाहिए जिससे पानी का प्रदूषण कम हो सके | नई योजना के अनुसार जहां-जहां उद्योगों के लिए जगह दी गई है वहां उचित रूप से CETP की व्यवस्था की जाए |

इब्न बतूता के अनुसार अलीगढ़ शहर एक खूबसूरत गार्डन /Forest हुआ करता था लेकिन समय के साथ वह गार्डन / फॉरेस्ट एरिया कम होते गए हैं | Some of the Aligarh villages like Khandi, Ghana, Jaraiya, Jau/Jhau, Shikar, Arni, Jamun, Karil, Dhak, Mahua, Imli, Siris, Kadali are in the name of the tree. ऐसी सलाह दी जाती है कि इन गांवों में उन्हीं trees का plantation/Forest development किया जाना चाहिए जिनके नाम पर वह गांव आ रहे हैं| जैसे Mahua गांव में Mahua (Madhuca longifolia) का forest लगना चाहिए | जिससे एरिया की हाइड्रोजी और संपूर्ण जिले की हाइड्रोजी में विकास हो सकता है | ऐसा सुझाव मास्टर प्लान में दिया जा सकता है जिससे भविष्य में इस पर काम किया जाए |

अलीगढ़ तहसील स्तर पर और डेवलपमेंट अथॉरिटी स्तर पर ऐसी नीति को अमल में लाया जाए जिससे तहसील स्तर पर अस्वीकृत कॉलोनी/कृषि भूमि पर के प्लॉटों का बैनामा ना किया जाए तथा स्वीकृत कॉलोनी के प्लॉटों पर ही प्लॉटों का बैनामा किया जाए | तथा ऐसा सुझाव दिया जाता है कि कृषि भूमि पर कम से कम लैंड यूज चेंज हो | अगर बड़े स्तर पर कृषि भूमि पर लैंड यूज चेंज होता रहा तो cumulative assessment मैं इसका प्रभाव दुष्परिणाम साबित हो सकता है | अगर ऐसा सुझाव मास्टर प्लान में दिया जाता है तो भविष्य में योजना बनाई जा सकती है |

अलीगढ़ के लिए पर्यावरण बहुत आवश्यक है इसीलिए Vision Document, एनवायरमेंटल इंप्रूवमेंट प्लान, Heat एक्शन प्लान आदि बनाए जाने की आवश्यकता है को भी अध्याय 4 में जोड़ा जा सकता है जिससे भविष्य में योजना बनाई जा सकती है

CERTIFICATE OF COMPLETION

This is to certify that this thesis project titled "**Reinventing the Lost Trilogy of Ponds, Natural Drains and Groundwater with Focus on Shekha Jheel: A Case study of Aligarh**" was carried out by **Sh. Pranav Varshney**, a student of M. Plan (EP), at the Department of Environmental Planning, School of Planning and Architecture New Delhi. The research for this project was undertaken under the guidance of the afore-mentioned institute and completed during the period of 1st Jan 2022 to 25th July 2022.

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This report has been submitted by the student as a final deliverable under the competition. All parts of this research can used by any of the undersigning parties.

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IT IS A BEGINNING OF THE LEARNING

अप्स्वन्तरमृतमप्सु भेषजम्।। ऋग्वेद.1-23-19

There is a nectar in water, there is medicine in water.

जल में अमृत है, जल में औषधि है|