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Geospatial studies in assessing the Environmental Conditions in most diverse block (Puranpur) of Pilibhit District,Uttar Pradesh

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ABSTRACT

Terai region of the state is full with bio diversities and varying environmental conditions. One of the most prominent blocks i.e. Puranpur of the district Pilibhit in this region is experiencing changing environmental conditions over the last several decades. The changing environmental conditions in this area have given rise to changing bio diversities. Due to depleting natural resources ,the great loss in environmental conditions has been noticed in the area.One of the most affected place i.e. *Fulhar lake,* which is the origin point of Gomti River, exhibits a decreasing trend in its spatial extent over the period of time has been noticed.To understand the spatial and temporal variations in the lake water, space borne Remote Sensing technology has been found very much useful.

The Lake holds significant ecological and socio-economic importance for the local communities and surrounding areas. Despite, its ecological significance, Fulhar Lake faces numerous challenges such as degradation, pollution and encroachment. Satellite borne dataclearly indicates a significant decrease in its spatial extent of this lake. In**1972** the spatial extent of the lake was **6.07 ha**, which has been reduced to **3.97 ha** in **2003**, Further poor management and developmental activities for tourism purposes has been increased the spatial extent of the lake to **4.15 ha**(1.73 ha wet part and 2.40 ha as dry part). Subsequently once again area of the lake has been reduced to **3.02 ha** in **2017**which has finally remained only**3.0 ha** in **2023**.Now this significant reduction and variation in the spatial extent of Fulhar Lake is throwing an adverse effect on Gomti River.Due to less amount of inflow of water from lake to Gomti river, is continuously making the river dry.

1.1 INTRODUCTION:

Water, a true universal cure, the Panacea of life nurture, nourish and replenish all living organisms on our planet. Water is pervasive as it covers the 70% of earth's surface with water. Water plays a crucial role in shaping different kinds of ecosystem either terrestrial or aquatic. It is one of the precious resources that encourage, endure and sustain life in all forms distribution across the earth is uneven, with some water provinces regions facing shortage of water while others have abundance. Factors such as climate, geography, and human activities influence this distribution. Climate change and population growth further stress water resources, making sustainable management crucial. Efforts like water conservation and management, efficient irrigation, and international association are essential to address global water challenges. Because of changing scenario of water resources, the land resources are also affected.

India has a miscellaneous surface water scenario, with major rivers like the Ganges, Yamuna, and Brahmaputra forming widespread and extensive river systems. However, numerous

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water bodies face challenges such as pollution, contamination, over-extraction and encroachment. According to [1], around 70% of India's water supply is contaminated. The leaching of several types of harmful contaminants is contaminating not only surface water but also ground water [2].According to [2] industrial effluents have an impact on ground water pollution.

According to [3] concluded that river got highly polluted downstream of Lucknow due to human interference and input of municipal and industrial wastewater.Rapid urbanization, growth, expansion and industrialization contribute to deteriorating of water quality. Conservation initiatives, pollution control measures, and sustainable water management are crucial for maintaining the health of surface water bodies in India. Most Indian rivers are contaminated as a result of urbanization, civilization, population pressure, and other developmental activities in the watershed area [4]. On the other hand Uttar Pradesh, being a large and populous state in India, has a varied surface water landscape. The Ganges and Yamuna, two major rivers, flow through the state. In spite of the presence of these significant water bodies, Uttar Pradesh faces challenges like pollution, industrial discharge, and over-extraction. Efforts to address these issues include pollution control measures, river conservation projects, and encouraging sustainable water use to ensure the well-being of surface water bodies in the state.

One of the oldest river Gomti flowing in the state of Uttar Pradesh, is a ground water fed river. The River Gomti has long been reversed as a lifeline for millions of people which is flowing through the heart of the Pilibhit District of Uttar Pradesh. **The Gomti, or Gomti River** is a tributary of the Ganges River and it is a ground water fed river. The Gomti River originates from Gomat Taal (which formally is known as **Fulhar Lake**) near **Madho Tanda, Pilibhit**, (Uttar Pradesh), India**.**

The surface water scenario in the Puranpur block of Pilibhit district is influenced by local geography and hydrological features. Community-driven conservation and protection efforts, along with government support, are crucial for nourishing and enlightening the health of surface water bodies and in managing the land resources as changing vegetation cover is responsible for many adverse effects.

1.2 STUDY AREA:

The district of Pilibhit is the north-eastern most district of Rohilkhand division which is situated in the sub Himalayan belt on the boundary of Nepal. It lies between the parallels of 28°6' and 28°53' north latitude and the meridians of 79°57'and 80°27' east longitude. On the north are the district UdhamSingh Nagar and the territory of Nepal, on the south lies the Shahjahanpur district, on the east the district is flanked for a short distance by district Kheri and for the remaining distance by the Shahjahanpur district and on the west the district of Bareilly.

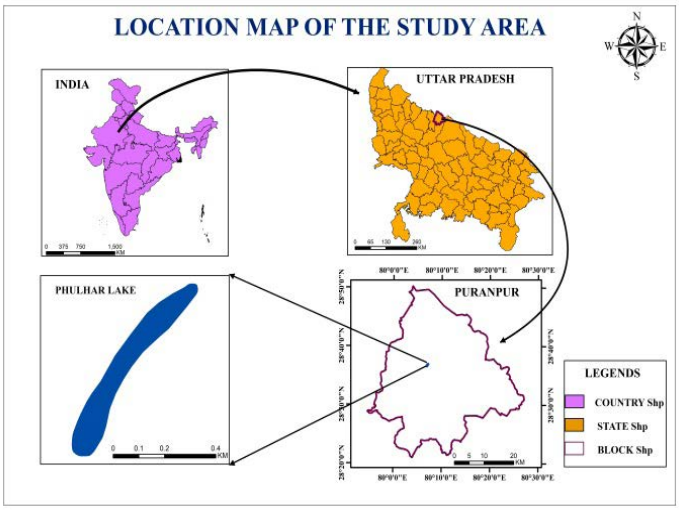

Figure1: Location Map of the Study Area

Major part of Pilibhit District is covered by dense forest. A Total of 78478 hectare is covered with forest. The Sharda canal is the main canal of the district, the others being its branches industry. There are four sugar factories at Majhola, Puranpur, Bisalpur and Pilibhit. Other major units are three solvent plants, one flour mill, one steel plant and one Alcohol Distillery. Small scale industries are Rice mills, engineering units, brick klins, candles and mainly bansuri (flute) manufacturing.

Pilibhit District which is one of the most prominent district of this State covering an area of **1712 Sq. Km** including seven blocks out of which Puranpur is one of the most essential block with its rich biodiversity and dynamic nature, particularly its diverse migratory birds which are the Centre of attraction. This area has been home to many migratory birds and residential as well which includes about 326 species different species which are continuously decreasing since last several decades. In last few decades this northern area is experiencing environmental conditions in a more rapid way. The changing environmental condition in this area has given rise to changing Bio diversities.

Fulhar Lake which is also known as Gomat Tal, which is the origin Point of Gomti River.It is located near Madho Tanda in Pilibhit District of Uttar Pradesh.This lake has experienced numerous challenges, adverse conditions since several decades.The lake is getting dried up.Figure :1 shows the location map of the study area.

Various natural and climatic changes, developmental activities and various other anthropogenic activities like deforestation, unplanned urbanization and industrial activities along with encroachment pose threats to ecosystems, human health and overall planetary sustainability. Due to depleting natural resources such as forests and water bodies the great loss in the environmental conditions has been noticed.

1.3 OBJECTIVES OF THE STUDY:

The major objectives of the study are here as under:

- To manage different water resources by assessing the status of Fulhar Lake through satellite borne data and GIS investigation to monitor fluctuations overtime and evaluate quality of water in Puranpur block in different time periods i.e. 1972, 2013 and 2023 by categorizing the types of waterbodies, number of waterbodies and to establish the statistical records.
- To understand the temporal changes in Plantation Cover pattern by using geospatial technology of Fulhar Lake.
- To study the impact of these changes on the environment.

1.4 DATA & MATERIAL USED

To accomplish the proposed objectives following data sets and material are used:

- Survey of India (SOI) Topo sheet
- Satellite Data
- ArcGIS Sofware

S.No.	Data Source	Year
1.	SOI (Survey of India)	1972
2.	Google Earth Pro (USGS)	2003,2013,2017,2023
3.	ArcGIS Software	10.8 Version

1.4.1 SOI TOPOSHEETS:

A toposheet is a shortened name for topographic sheet; they essentially exhibit information about an area like roads, railways, settlements, canals, rivers etc. According to their usages, they may be available at different scales (e.g. 1:25,000 and 1:50,000 etc., where former is a larger scale as compare to the latter). They are made on suitable projection for that area and contain latitude- longitude information.

Thus any points on it can be identified with its corresponding latitude- longitude depending upon the scale. The primary database of the study area has been generated with the help of Survey of India topographic maps on 1:50,000 scale. The Survey of India topographic maps, other than field investigations, are very useful to depict the primary and basic information of geomorphic and tectonic elements of this terrain. The 1:50,000 scale maps provide regional geomorphological setting and other relevant information such as spot height, transportation network, important localities etc. of the area. A total of seven toposheets on 1:50,000 scales cover the entire basin which is shown in table 1.1.

Table 1.1 Shows Total Number of Toposheets Used

S.No.	Toposheets Number
1.	62D/1
2.	62D/2
3.	62D/3
4.	62D/6
5.	62D/7
6.	53P/14
7.	53P/15

Fulhar Lake is falling under Survey of India toposheet number 62D/2.

1.4.2 SATELLITE DATA:

Google Earth Data in the form of Satellite Imagery from USGS is used followed by Georeferencing and Mosaicking.

1.4.3 GEOREFERENCING AND MOSAICKING:

Data usedwere georeferenced and mosaicked and desired area was clipped out using Arc/ GIS software. Georeferencing involves assigning geographic coordinates to an image so it can be accurately positioned on the earth's surface. The process typically involves matching control points between the image and a reference data set like GPS coordinates.
On the other hand, Mosaicking is the process of combining multiple images into a single seamless mosaic. Both Georeferencing and mosaicking are fundamental techniques in GISand Remote Sensing applications, enabling the creation of accurate and comprehensive spatial data.

1.4.4 DIGITIZATION:

Digitization is a significant process by which we can convert geographic data into digital format. In this study area river, canal, waterbodies, settlement, road and railways etc. have been digitized for base information in the form of Polygon, Polyline, point etc. Digitization helps in accuracy of data and helpful in making consistency and helpful in free up physical space. This is a very cost effective technique as it eliminated the need for printing and reprinting maps and allow for easy updates and maintenance of data. It is helpful in enhancing the accessibility and for easier collaboration.

1.4.5 ARC GIS SOFTWARE:

Eris's Arc GIS is a geographic information system for working with maps and geographic information. It is used for: creating and using maps; compiling geographic data; analysing

mapped information; sharing and discovering geographic information; using maps and geographic information in a range of applications; and managing geographic information in a database.

The system provides an infrastructure for making maps and geographic information available throughout an organization, across a community, and openly on the web. ArcGIS Desktop includes a suite of applications including Arc Catalogue, ArcMap, Arc Globe, Arc Scene, Arc Toolbox, and Model Builder. Using these applications and interfaces in unison, users can perform any GIS task, from simple to advance.ArcGIS Desktop is scalable and can address the needs of many types of users.

ArcGIS provides appropriate tools and services for mapping and spatial analysis so as to explore data & share location-based understandings. Here Arc GIS 10.8 Software is used to study and analyse the temporal assessment through Geospatial techniques.

1.5 METHODOLOGY:

Methodology is the collection and preparation of tools and data sets used to obtain desired results of any problem. In the present study, the methodology has been divided into **two parts**. It deals with the collection of basic information of the study area. After obtaining relevant information of the study area, preparation of various thematic maps is another important task. In the present study, the maps and figures have been prepared with the help of Survey of India topographic maps and satellite images. Methodology of the study area is shown in (fig.2) as flow chart diagram.

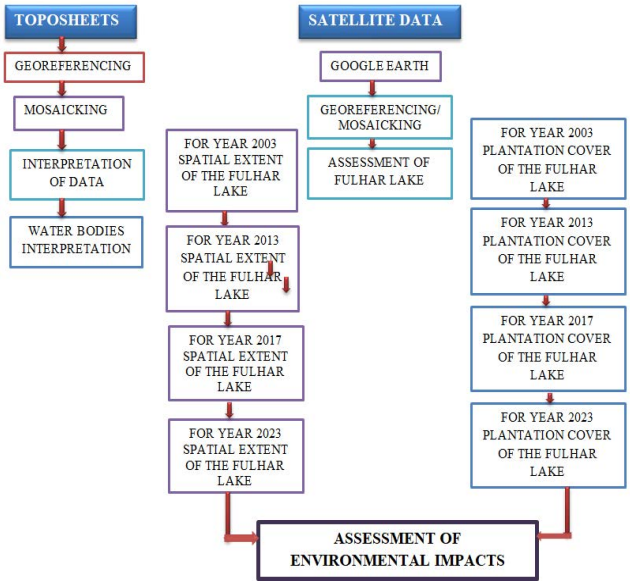

Figure2: Flow Chart of the Methodology

1.6 RESULTS & ANALYSIS:

1.6.1 Time Series Analysis of Fulhar Lake:

In the study area, Fulhar Lake is one of the major surface water body sources, which is experiencing a continuous decline in its spatial extent. A time series analysis of the spatial extent of Fulhar Lake has been conducted using high resolution satellite borne data for the period between 2003-2023.

Fulhar Lake faces numerous challenges such as degradation, pollution and encroachment. Satellite borne data clearly indicates a significant decrease in its spatial extent of this lake.In**1972** the spatial extent of the lake was **6.07 ha**, which has been reduced to **3.97 ha** in **2003**, Further poor management and developmental activities for tourism purposes has been increased the spatial extent of the lake to **4.15 ha** (1.73 ha wet part and 2.40 ha as dry part). Subsequently once again area of the lake has been reduced to **3.02 ha** in 2017 which has finally remained only **3.0 ha** in 2023.

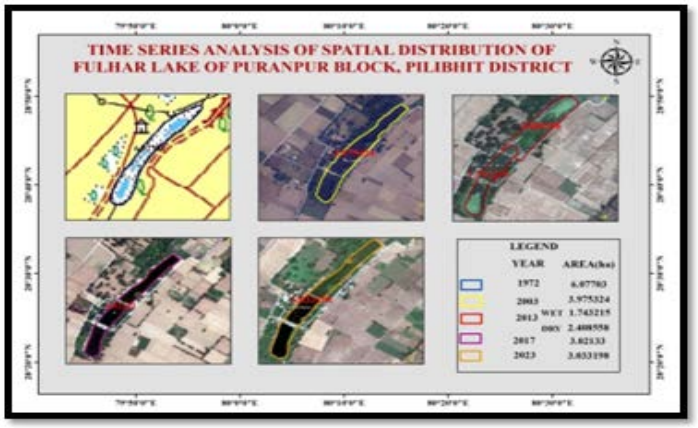

Figure3: Spatial extent of Fulhar Lake

This fluctuation in the water body has given rise a varying condition of the Environment, which ultimately has impacted the Ecology of the area.Changes in land use, such as deforestation, agricultural expansion, and urbanization, can contribute to water quality degradation in surface water bodies. Increased sedimentation, nutrient runoff, and pollution can harm aquatic ecosystems, reduce water clarity, and threaten the health of aquatic organisms and human populations dependent on clean water sources.(Table1.2 and Fig:3)

Sr.No.	YEAR	AREA(hc)	NATURE OF THE FULHAR LAKE
1.	1972	6.07	WET
2.	2003	3.97	WET
3.	2013	1.74	WET
		2.40	DRY
4.	2017	3.02	WET
5.	2023	3.03	WET

Table No1.2 Shows the Spatial extent of the Fulhar Lake

1.6.2 Time Series Analysis of Vegetative Cover of Fulhar Lake:

Time series analysis of the vegetative cover around Fulhar River has also been conducted. Due to rapid and continuous urbanization the outer rim of Fulhar Lake is facing many fluctuations and variations. Due to eventual developmental activities such as propagation of tourism in the vicinity of Fulhar Lake a lot of vegetative cover has been demolished over a period of time. During the Year 2003 the plantation cover around Fulhar Lake was 40156 hectares which got declined in 2013 up to a great extent covering an area of 3186 hectares. Due to rapid urbanization and encroachment, it further demolished in year 2017 and remains up to 31344 hectares. After covid period the area observed was 35632 hectares. It has also been observed that during the plantation period Eucalyptus are planted around the Lake. These trees are primarily of eucalyptuses which are prone to withdraw the groundwater up to great extent developing an area for housing or other urban purposes. Fig:4 illustrate the result of vegetative cover. Detailed Status of the Plantation Cover around Fulhar Lake is described:

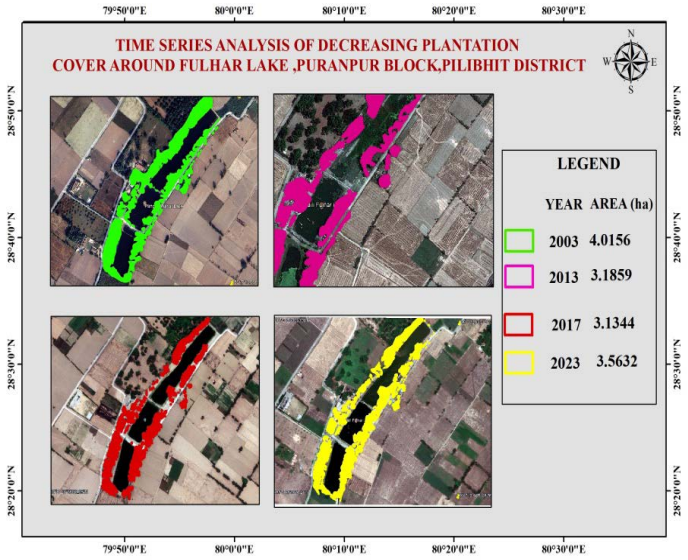

Figure 4: Showing Vegetative Cover around Fulhar Lake

1.7 CONCLUSION

The deterioration in water of Fulhar Lake, depletion of forest cover and the drying up of Lake are shade of concerning picture of environmental degradation. Crucial, urgent, intensive and concerted efforts are required to address these interrelated tasks through sustainable land management practices, replantation, reforestation initiatives and water management and conservation measures. Moreover, cooperative efforts among sponsors, investors or stakeholders including local people or communities, administrations an environmental organizations and Governments are essential for protecting the health and flexibility and resilience of the river ecosystem for present and upcoming generations Only through practical ,proactive ,positive and holistic approach we can expect to inverse the trend of degradation and re-establish the vivacity and vitality of these vital natural possessions or resources.

Changing Surface water condition/changing climatic parameters/changing land degradation may cause adversity in the environment and disturbances in ecology. Study area experiences a loss of water bodies, rapid increase in urban growth and increase in agricultural growth due to which quality of water is deteriorating.

Decreasing patterns in forests, increase in crop land with increase in agricultural land, decreasing water bodies causes threat to aquatic and terrestrial life (flora and fauna) which are continuously decreasing the environmental conditions. These changing situations may give rise to high frequency of occurrence of drought conditions. Through regular monitoring of water bodies (Time Series Analysis) with the help of space born technology and GIS is helpful in addressing the environmental nature and ecological disturbances occurring in the area.

Studies have got some limitations to conclude with rejuvenation of river system. A data based study generated for layer duration of time.

Hydrological investigations have to be carried out in a very detailed way as at many places discharge measured stations are not available. We must put an extra effort by applying some artificial recharge structures

A part from that anthropogenic activities have been increased along the river bed which has disturbed the natural flow of the river and a number of places situation of river encroachment have been arrived. Surface water bodies are decreasing in a significant way and on the other hand groundwater is also decreasing rapidly (as 298 bore wells or tubewells are constructed in village Madho Tanda.

Last but not the least the city of flute must advocate its rhythmic music by preserving its diverse ecology, therefore many of the drives related to afforestation, proper land use practices, proper dragging and cleaning of the canal system and proper utilization of surface and groundwater are mandatory. The Lake which is the origin of mighty river Gomti must be preserve in such a way so that it can replenish river Gomti in a sustainable way.

1.8 ACKNOWLEDEMENT:

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