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Assessing Land Use and Land Cover Variations in PehowaTehsil of District Kurukshetra, Haryana Through Landsat 8 Imagery: A February 2020 Perspective

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Abstract:
Land is one of the most basic and important natural resource (Petrson 2006). This study examines the Land Use and Land Cover (LULC) dynamics in Pehowa Tehsil, Kurukshetra District, utilizing data from Landsat 8 and various other sources. Predominantly agricultural, the tehsil's landscape reflects its agrarian economy, but also poses challenges in terms of land sustainability due to extensive bare land. The study notes the increasing trend of urbanization, emphasizing the need for sustainable planning. Vegetation cover is sparse, indicating a need for conservation efforts. Water bodies, although limited in area, are crucial for ecological balance. The LULC classification, incorporating water bodies, vegetation, cropland, bare land, and built-up areas, reveals the predominance of agriculture, with implications for ecological conservation and sustainable development. The findings highlight the need for a balanced approach to land management, integrating agricultural productivity, environmental conservation, and urban development to ensure long-term regional prosperity.

Keywords: Land Use and Land Cover (LULC)**,** Agricultural Landscape**,** Urbanization, Environmental Conservation**,** Sustainable Planning

Introduction:

Land is one of the most basic and important natural resource (Petrson 2006). Land use (LU) and land cover (LC) are pivotal yet distinct concepts crucial for comprehending terrestrial transformations. LU refers to human modifications or utilizations of land, encompassing residential, agricultural, commercial, industrial, recreational, conservation, and infrastructural applications. It involves strategic planning for land allocation for specific human activities. In contrast, LC describes the Earth's surface's physical and biological cover, including natural and artificial elements like vegetation, water bodies, bare soil, urban areas, and snow or ice, indicating the surface's physical state. Land Cover is defined as observed physical features on the Earth's Surface. When an economic function is added to it, it becomes Land Use. (FAO, 2005).

For identifying the land use and land cover classes the classification scheme developed by NRSA in 1995 is used. On the basis of this Scheme 8 land use and land cover classes are created. However five LULC classes have been adopted for the present paper. These land use and land cover classes are: 1 Forest 2. Agricultural Land 3. Barren Land 4.Settlements 5. Water Bodies (source: NRSC, LULC classification, 1995).

Dimple, Singh Ravinder (2000) Land Use and Land Cover Change along Shivaliks between River Ghaggar and Yamuna summarized that LULC is an intricate interplay of cultural, economic and physical factors in a space-time continuum.

The differentiation between LU and LC is essential in environmental monitoring, urban planning, resource management, and assessing human environmental impact. LU emphasizes human land utilization, while LC focuses on the physical state of the land. Studying LU is vital for optimal resource allocation, fostering economic development, aiding environmental conservation, enhancing social well-being, reducing disaster risks, mitigating climate change, and informing legal and policy frameworks. It strives for a balance between human needs and environmental sustainability.

The classification of LU and LC is complex and subjective, often tailored to specific user needs. The U.S. Geological Survey's "Land Use and Land Cover Classification System" (LULC) is a hierarchical system providing detailed categorizations, ranging from broad categories at Level I (e.g., urban, agricultural, forest) to more specific classifications at Level IV.

In the current context, the world, with India as a prime example, is witnessing rapid shifts from natural landscapes to human-modified environments due to population growth and urban expansion. These changes necessitate a deeper understanding of LU and LC for effective urban and regional planning, environmental conservation, and climate impact assessment. Knowledge of these concepts is also crucial for sustainable resource management, biodiversity conservation, and the provision of ecosystem services.

Traditional LU data sources, such as government revenue records and topographical maps, often lacked spatial accuracy or were not regularly updated. Soil maps, while useful, were limited in scope. Remote sensing has emerged as a leading method for acquiring LU and LC data, offering precise, current, and comprehensive classifications through detailed, multi-spectral images from satellites and aerial platforms. Geographic Information Systems (GIS) complement this data by enabling detailed spatial analyses and intricate map creation.

This study focuses on exploring LU and LC at hierarchical Level I using remote sensing technology. Modern technologies, particularly remote sensing and GIS, have significantly enhanced our ability to accurately track and analyze these changes, offering insights into LU and LC dynamics in a rapidly changing world.

Study Area:

Pehowa Tehsil, located in the Kurukshetra District of Haryana, India, forms an integral part of the northern state. Geographically positioned approximately 30 kilometers from Kurukshetra and 160 kilometers from Chandigarh, the state capital, Pehowa occupies a significant place in the region. It encompasses an area of 548 km², with 528.08 km² designated as rural and 19.50 km² as urban.

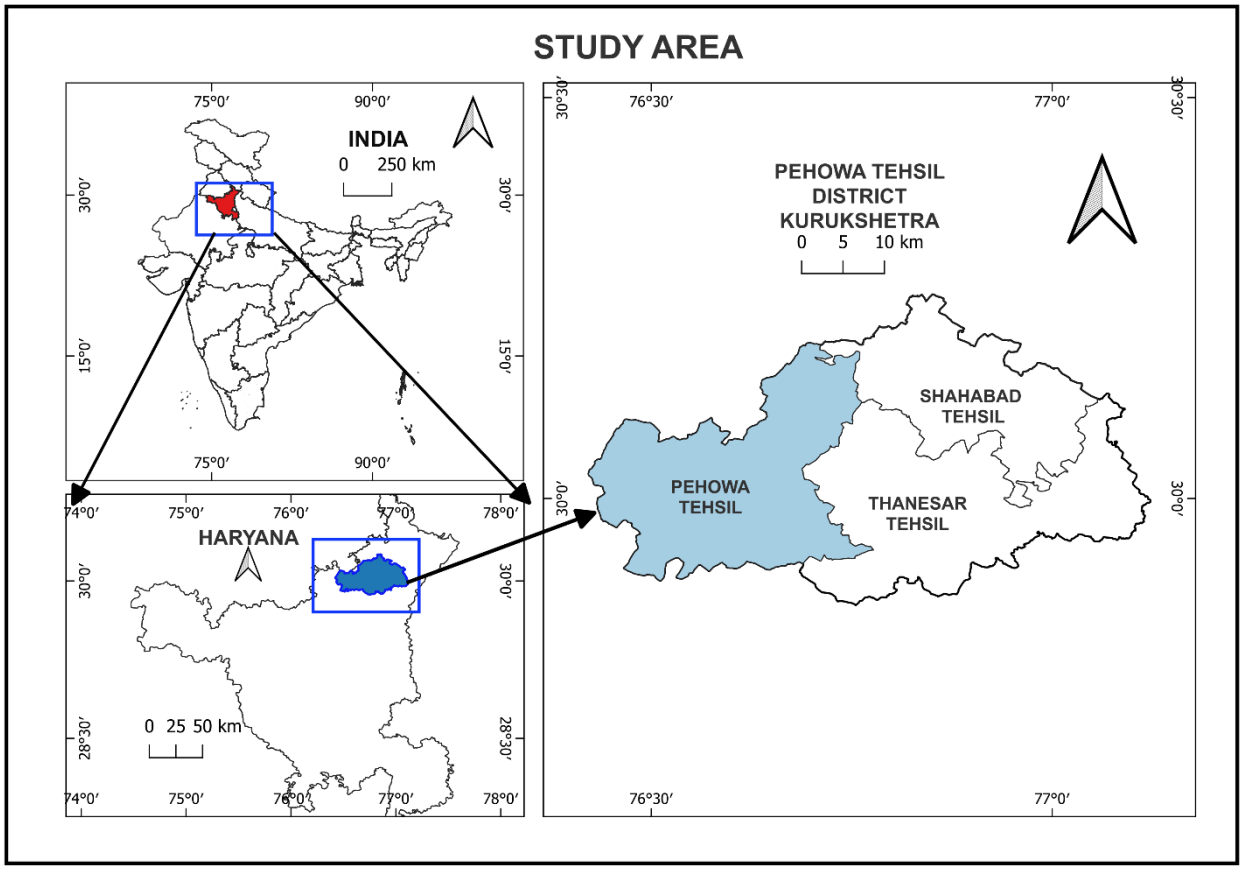
Characterized by a flat topography, Pehowa lies within the fertile Indo-Gangetic plain, known for its rich alluvial soil, favorable for agriculture. The Ghaggar-Hakra and Markanda rivers enhance the region's irrigation, supporting the primary agricultural occupation. Key crops include wheat, rice, sugarcane, cotton, and various fruits and vegetables.

The climate of Pehowa is typical of North India, with hot, dry summers, cold winters, and a monsoon season critical for agriculture. Despite the dominance of agricultural land use, the area maintains limited natural vegetation and bird species diversity, particularly migratory birds in wetlands and river areas.

Pehowa's economy revolves around agriculture and agribusiness, supplemented by trade, commerce, and small-scale industries. The area's settlements, including numerous villages and the towns of Pehowa and Ismailabad, are central to local governance and

administration, contributing to the tehsil's development. The region's infrastructure, including road connectivity via National Highway 44 and the nearest railway station in Kurukshetra, supports its economic activities.

As per the 2011 Census, Pehowa has a population of 2,55,307, with a density of 466 inhabitants per square kilometer, varying between rural and urban areas. Literacy stands at 62.82%, with a gender disparity in education levels. The tehsil's housing statistics reflect its rural-urban composition, with 49,651 houses distributed between 39,068 rural and 10,583 urban dwellings.



Data Used:

This research utilized data from the Landsat 8 Operational Land Imager (OLI), accessed through the Earth Explorer portal (https://earthexplorer.usgs.gov). The Landsat 8 OLI provides a rich dataset, crucial for the detailed analysis of terrestrial phenomena.

Band Specifications: The study employed specific OLI bands, each characterized by unique spectral properties and spatial resolutions. The bands and their respective specifications are detailed below:

1. Band 2 (Blue)
    - Wavelength Range: 0.450 - 0.51 µm
    - Spatial Resolution: 30 meters
2. Band 3 (Green)
    - Wavelength Range: 0.53 - 0.59 µm
    - Spatial Resolution: 30 meters

3. Band 4 (Red)
    - Wavelength Range: 0.64 - 0.67 µm
    - Spatial Resolution: 30 meters
4. Band 5 (Near-Infrared)
    - Wavelength Range: 0.85 - 0.88 µm
    - Spatial Resolution: 30 meters
5. Band 6 (SWIR 1)
    - Wavelength Range: 1.57 - 1.65 µm
    - Spatial Resolution: 30 meters
6. Band 7 (SWIR 2)
    - Wavelength Range: 2.11 - 2.29 µm
    - Spatial Resolution: 30 meters

Data Selection and Relevance: The dataset for this study was carefully curated, with a focus on ensuring both its relevance and the integrity of the data. Specifically, the study incorporated only cloud-free images from February 2020, a period that coincides with the culmination of the Rabi agricultural season. This strategic selection of data highlights the importance of temporal specificity and the necessity for unobstructed, clear satellite imagery in conducting rigorous and academically sound satellite-based research.

Methodology:

1. Satellite Imagery Preprocessing: The accuracy and precision of satellite imagery analysis are contingent on meticulous preprocessing. This stage addresses the inherent complexities associated with satellite data acquisition through the following strategies:

a. Radiometric Calibration: Satellite sensors detect terrestrial emissions as digital numbers (DNs). For an accurate representation of the radiative flux, these DNs are converted to true radiance values using the calibration constants provided in the satellite sensor's metadata.

b. Atmospheric Correction: As electromagnetic radiation passes through the Earth's atmosphere, it is subject to scattering and absorption, which can distort the spectral signatures captured by satellites. To mitigate these atmospheric distortions and obtain genuine surface reflectance values, advanced algorithms, customized for the specific satellite sensor and prevailing atmospheric conditions, are employed.

c. Spatial Subsetting: In the interest of computational efficiency and to focus the analysis on the specific study area - the Pheowa Tehsil within Kurukshetra District, Haryana - a spatial subset of the extensive satellite imagery is delineated. This procedure ensures that the ensuing analysis is both geographically pertinent and computationally efficient.

Rigorous preprocessing is imperative; it is the cornerstone that guarantees the subsequent land use and land cover (LULC) classifications derived from satellite imagery are both precise and meaningful.

2. **Supervised Classification Approach**: The demarcation of LULC through satellite imagery is fundamental for various applications, ranging from urban planning to

ecological conservation initiatives. In this regard, supervised classification, a technique that utilizes the analyst's prior knowledge of the area, is crucial.

At the heart of this approach is the Maximum Likelihood Algorithm (MLA). Based on statistical principles, the MLA determines the probability of a pixel belonging to a particular class by analyzing its spectral values. This calculation integrates the mean and variance of each band for every class, eventually assigning the pixel to the class with the highest probability. It is predicated on the assumption that pixel spectral values are normally distributed across bands for each class.

In this study, the MLA is employed to segment satellite imagery into fundamental LULC categories:

• Water Body: Identifying aquatic areas such as lakes, rivers, and reservoirs. • Vegetation: Covering green spaces, including tree canopies and shrubs. • Cropland: Regions utilized for agricultural activities. • Bare Land: Landscapes with scant vegetation. • Built-up Land: Areas comprising urban and rural settlements, along with man-made structures.

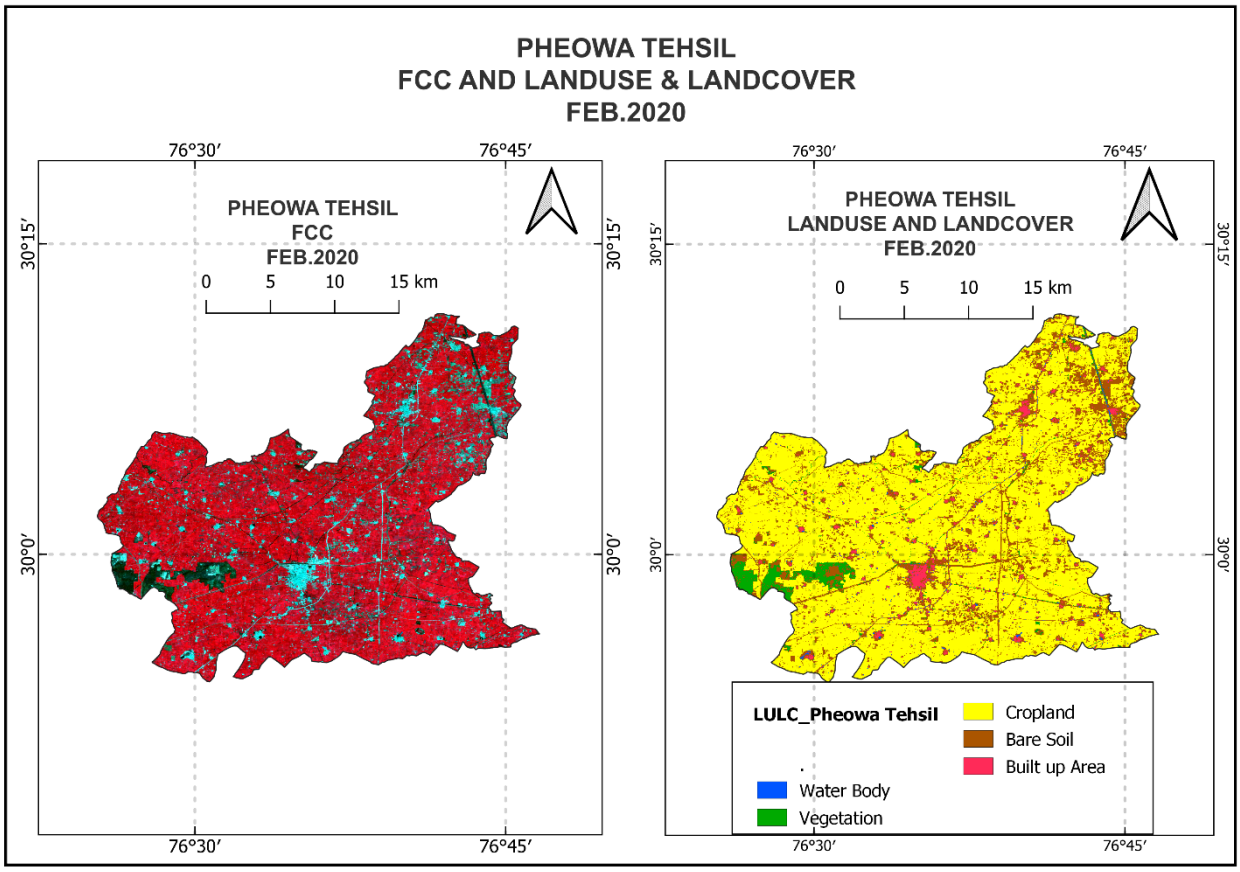
The efficacy of supervised classification, particularly the MLA, is intrinsically linked to the careful selection of training samples. The deliberate choice of these samples enhances the accurate translation of satellite-derived spectral signatures into relevant LULC categories.

Software Used: The analytical delineation of the Land Use and Land Cover (LULC) data, procured from the Landsat 8 satellite imagery, was conducted employing the Quantum Geographic Information System (QGIS) software suite. QGIS is an open-source geospatial platform, acclaimed for its comprehensive capabilities. It not only supports the visualization and alteration of geospatial data but also excels in performing complex spatial analyses. The open-source nature of QGIS significantly enhances its usability, as it liberates users from the limitations typically imposed by software licensing requirements.

Results and Discussion:

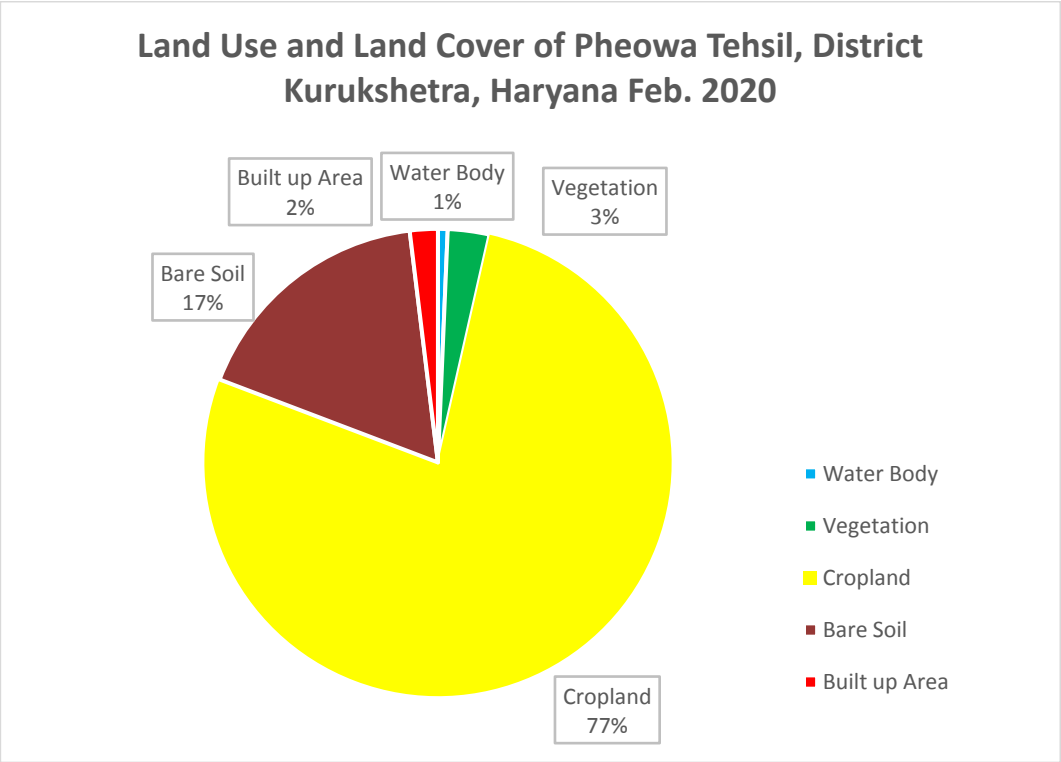
This research aims to analyze the patterns of land use and land cover within the Pehowa Tehsil of the Kurukshetra District. To achieve a comprehensive understanding, the study integrates data from multiple sources: the official Kurukshetra website (kurukshetra.gov.in), district boundary maps and data from the Survey of India, and satellite imagery from the Landsat 8 mission. This holistic approach is essential for elucidating the ecological and socio-economic dynamics prevalent in the region.

For analytical purposes, the study categorizes land use and land cover into five principal classifications: water bodies, vegetation, cropland, bare land, and built-up areas. This categorization is critical for assessing the ecological balance of the district and its capacity to support human activities. Furthermore, this classification framework is instrumental in comprehending the complex interplay between human development and environmental stewardship. It plays a pivotal role in the effective planning and management of land resources, ensuring sustainable development and conservation efforts within the region.



Land Use and Land Cover Analysis:

Land Use and Land Cover of Pheowa Tehsil, District Kurukshetra, Haryana Feb. 2020			
Class Code	**Class Name**	**Area in sq. km**	**Percentage**
1	Water Body	4.0797	0.67
2	Vegetation	17.4942	2.88
3	Cropland	469.0368	77.23
4	Bare land	104.9886	17.29
5	Built-up Area	11.7522	1.93
	Total Area	**607.3515**	



The land use and land cover of Pehowa Tehsil in the Kurukshetra District of Haryana as of February 2020 is categorized into five distinct classes:

1. **Cropland**: The most significant and dominant land use is cropland, which occupies 469.0368 square kilometers, making up a substantial 77.23% of the total area. This reflects the primary occupation of agriculture in Pehowa Tehsil, supported by fertile soil, abundant water supply, and favorable climatic conditions. Major crops include wheat, rice, sugarcane, cotton, and various fruits and vegetables.

2. **Bare land**: This category, encompassing 104.9886 square kilometers or 17.29% of the area, likely represents non-cultivated land which may include fallow fields, uncultivated land, or areas unsuitable for agriculture. It may partially encompass the land under sugarcane which had been harvested at the time of data incorporated by the satellites.

3. **Vegetation**: Vegetation areas span 17.4942 square kilometers, accounting for 2.88% of the total area. This includes grasses, shrubs, and small trees. However, the relatively small percentage suggests that natural vegetation is limited, likely due to extensive agricultural activities and human settlements.

4. **Built-up Area**: Urban and built-up areas cover 11.7522 square kilometers, which is about 1.93% of the total area. This includes towns like Pehowa and Ismailabad, as well as other smaller settlements. These areas serve as commercial, administrative, and residential centers.

5. **Water Body**: This category covers an area of 4.0797 square kilometers, constituting about 0.67% of the total area. This aligns with the presence of rivers and other water bodies in the region, which are crucial for irrigation and local ecosystems.

In summary, the land use and land cover of Pehowa Tehsil are predominantly dominated by agriculture, with a significant portion of the land dedicated to cropland. This is consistent with the region's characteristics, such as its location in the fertile Indo-Gangetic plain, the availability of irrigation from rivers like the Ghaggar-Hakra and Markanda, and a climate conducive to farming. The limited areas of vegetation and water bodies, along with the presence of bare land and built-up areas, reflect the human influence on the natural landscape, primarily driven by agricultural and residential needs.

Conclusion:

The Land Use and Land Cover (LULC) dynamics within Pheowa Tehsil in the Kurukshetra District are of considerable ecological and socio-economic importance. Characterized predominantly by its agricultural landscape, the tehsil serves as an emblem of its agrarian-based economy. Nevertheless, this heavy reliance on agriculture introduces potential risks to the sustainability of the land and the viability of agricultural resources. Notably, the extensive presence of bare land, arising from agricultural practices and urban expansion, poses significant challenges in terms of land management and ecological preservation.

Urbanization, albeit currently limited, is exhibiting a trend of growth, placing increasing demands on land resources and potentially instigating ecological imbalances. This trend of urban expansion emphasizes the imperative need for sustainable urban planning and judicious resource allocation strategies.

Moreover, the relatively limited vegetation cover within the tehsil represents a critical concern for environmental sustainability. It accentuates the pressing necessity for initiatives focused on forest conservation and tree plantation to counteract ecological degradation and enhance biodiversity.

The water bodies in the region, though modest in their overall expanse, play a vital role in the ecological health and sustainability of the rural landscape. Their conservation and efficient management are essential for maintaining ecological equilibrium, supporting agricultural activities, and ensuring water security in the region.

In summary, the LULC patterns in Pheowa Tehsil call for an approach that balances agricultural productivity with environmental conservation and sustainable urban development. Such a strategy is essential for securing the long-term ecological and socio-economic prosperity of the area.

Bibliography and References:

1. Kurukshetra District census handbook, 2011
2. Kurukshetra district Statistical Abstract, 2013
3. State Statistical Abstract of Haryana 2019-20
4. Economic Survey, Haryana, 2019-20
5. Dimple, Singh Ravinder (2000) Land Use and Land Cover Change along Shivaliks between River Ghaggar and Yamuna, Advances in Geographical and Environmental Sciences, Climate Change and Biodiversity, Proceedings of IGU, Rohtak Conference, Vol-I, pp 139-155.

6. LULC classes (1995)-land use and land cover classes : 1 Forest 2. Agricultural Land 3. Barren Land 4.Settlements 5. Water Bodies (NRSC, LULC classification, 1995).
7. Petrson JH (2006) Land Work and Resources- an introduction to economic Geography, Adward Arnold, London.
8. NRSC (2014), Land Use / Land Cover database on 1:50,000 scale, Natural Resources Census Project, LUCMD, LRUMG, RSAA, National Remote Sensing Centre, ISRO, Hyderabad
9. The land use/land cover classification scheme of 1:50,000 scale consists of Level-I: 8 classes, Level-II: 31 classes and Level-III: 54 classes (NRSC, 2012).
10. Land Use / Land Cover Database for Dissemination through Bhuvan, June 2019
11. Central Ground Water Board Ministry of Water Resources Government of India North Western Region, Chandigarh 2013
12. Sudhakar, S., & Rao, S.V.C. Kameshwara. Land use and land cover analysis. *Remote Sensing Applications*. National Remote Sensing Centre.
13. Personal observations, ground verification, peer group discussion of the study area etc.