Spatial Study of Changing Pattern of Land Use in Prayagraj District

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ARTICLE DETAILS	ABSTRACT
	In this research paper will present spatial land use cover over the period of time, micro and macro changes in land use pattern, land use pattern management, facilitating sustainable development by balancing developmental interests and conservation measures in Prayagraj district last 15 year of changes. Examine behavioural aspect of human in aspect of expansion of urban-town-rural areas, infrastructural construction, industrial development and new land found for agricultural purposes. These paper analyses the data of major variables and resulting LULC pattern and create blue print for future development, The study reveals that marginal changes have occurred in all land use categories.

INTRODUCTION

In earth one-fourth (29.2%) part are in form of land although 'Land' is the major but limited natural resource among water and air for humankind, also Precious for human because of most of activities are proceed in land directly or indirectly ways. Human intakes arrangement of the uses of the land is known as "land use pattern". In other words, what kinds of activities are placed where? The geographical distribution of human activities is referred to as the land use pattern. The terms land use and land cover

(LULC) are often sound similar in performance, but each term has its own unique meaning. 'Land cover' refers by physical structure on surface of the earth, like vegetation (forest, grassland), Water bodies (river, lakes and pond), Barren land, Urban and residential areas (city, village, road) human infrastructure that mean describe what is actually on the surface of land. On the other hand, 'Land use' define the totally focus on human activity or human utilization on land- such as industries, residential, agriculture activities and recreation the infrastructure on land. That is LULC are related to geography, environment and urban planning interchangeable the following elements. Land use and land cover change (LULCC), also known as land use change, is a general term for the human modification of Earth's terrestrial surface (changes in geographical and environmental aspects). Land use is a product of interactions between human interest like cultural backgrounds, states of political needs and physical needs of the society with the natural potential of land (Karwariya & Goyal, 2011)[1]. Most of the land are used under the socio-economics activities primary categories typically include **agricultural, residential, commercial, industrial, recreational, cultural domain and transportation** that's why Land use is a major issue of global environment changes.

OBJECTIVES

The objectives of the study are as follows:

1. To study spatial land use pattern in Prayagraj District.
2. Evaluation of changing pattern of land use pattern in the Prayagraj District.
3. Examine the behavioural aspect of human being related to land use pattern.
4. Give the suggestion and management of land use pattern.

TOOLS AND TECHNIQUES

This study utilizes a comprehensive approach with spatial analysis, quantitative data, and qualitative case studies, to examine the urban expansion, agricultural and non-agricultural uses and its effects on the Prayagraj district. This methodology guarantees a thorough comprehension of the spatial, environmental, and socio-economic consequences of swift urban expansion. The analysis of land-use in this paper is based on secondary data compiled from various published sources. The Data were taken from different sources like *zila sankhyikiya patrika Publish by Uttar Pradesh Government and Economic & Statistics Division State Planning Institute Planning Department, Uttar Pradesh. Land-use in India is classified into nine broad categories.* We analyse changes in land-use pattern in different time scales to identified

Prof. Akhilesh Kumar Pandey, and Ashish Kumar Mishra

Page | 312

the how LULC impact of our surrounding, society and environment. This paper analyses the different types of variables to summarise the spatial patter of LULC.

1 *Urban city includes*- Forest area, Agricultural uses, Agricultural useless**,** Current fallows and other fallows, Barren and unfit for cultivation land, Land for use other than agriculture, Pasture, Area of gardens/ trees/ bushes.

2 Rural area- Forest area, Agricultural uses, Agricultural useless**,** Current fallows and other fallows, Barren and unfit for cultivation land, Land for use other than agriculture, Pasture, Area of gardens/ trees/ bushes.

STUDY AREA-

Prayagraj, formerly known as 'Allahabad' is metropolis district in Uttar Pradesh. Geographically, Prayagraj Is located at latitude 24°49'55" N to 25°40'46" N and Longitude 81°08'58" E to 82°21'55" E in the southern part of the state. To its southeast is the Bagelkhand region, to its east is middle Ganga's Velly, in north Purvanchal, to its southwest is the Bundelkhand region and it's east Kaushambi. The total geographical area of the district is 5482 Km² and divisions are 8 Tehsils, 23 Development Blocks and 2858 Villages. The length from east to west is 117 km and from north to south about 101 km. The population of the district is 5954391 (Census data 2011). Sex ration at 901 females per 1000 males. The literacy rate is more than 75%. Population density is1087/ Km², major population live in village but urban population of the city is 1420873 (Growth rate 24.74%). Prayagraj city as the 32th most populous city of India (Census data 2011). Administratively, the district divided into 8 sub-division, namely Karchhana, Koraon, Phulpur, Bara, Meja, Sadar, Soraon and Handia and comprises 23 development blocks, including Chaka, Karchhana, Kaundhiyara, Koraon, Bahariya, Phulpur, Bahadurpur, Sahson, Jasra, Shankargarh, Uruwa, Meja, Manda, Kaurihar, Holagarh, Mauaima, Soraon, Shringverpur Dham, Bhagwatpu, Pratappur, Saidabad, Dhanupur, Handia. Prayagraj lies at the confluence of the Ganga, Yamuna, and mythical Saraswati rivers, known as the Triveni Sangam. The district is part of the Gangetic Plain, characterized by flat, fertile alluvial soil.

The district divided into four different Agro-ecological situation AES.

1. Black and Coarse-grey land.
2. Jamuna khaddar and alluvial
3. Ganga low and Sodic

Prof. Akhilesh Kumar Pandey, and Ashish Kumar Mishra

Page | 313

4. Ganga plain.

The Prayagraj district's landscape, shaped by the Ganga River and its right bank tributaries, the Yamuna and the Tons, is characterized by three primary geomorphic units: the Ganga alluvial plains, the Yamuna alluvial plains, and the Vindhyan plateau. Within the alluvial plains, further distinctions exist between older alluvial plains, predominantly located in the elevated northern parts of the district, and newer alluvial plains, which are confined to the present-day flood-prone zones along the rivers. Notably, the Yamuna region lacks substantial alluvial deposits. The alluvial plains themselves exhibit a variety of landforms, including back swamps, meanders, scrolls, and point bars.

Prayagraj can be broadly divided into three physiographic regions: -Gangetic Plain Region: The most fertile and agriculturally productive, due to rich alluvium deposited by rivers. continuously shifts its channel within its wide bed (known as kachhar), Tons River also part of this region.
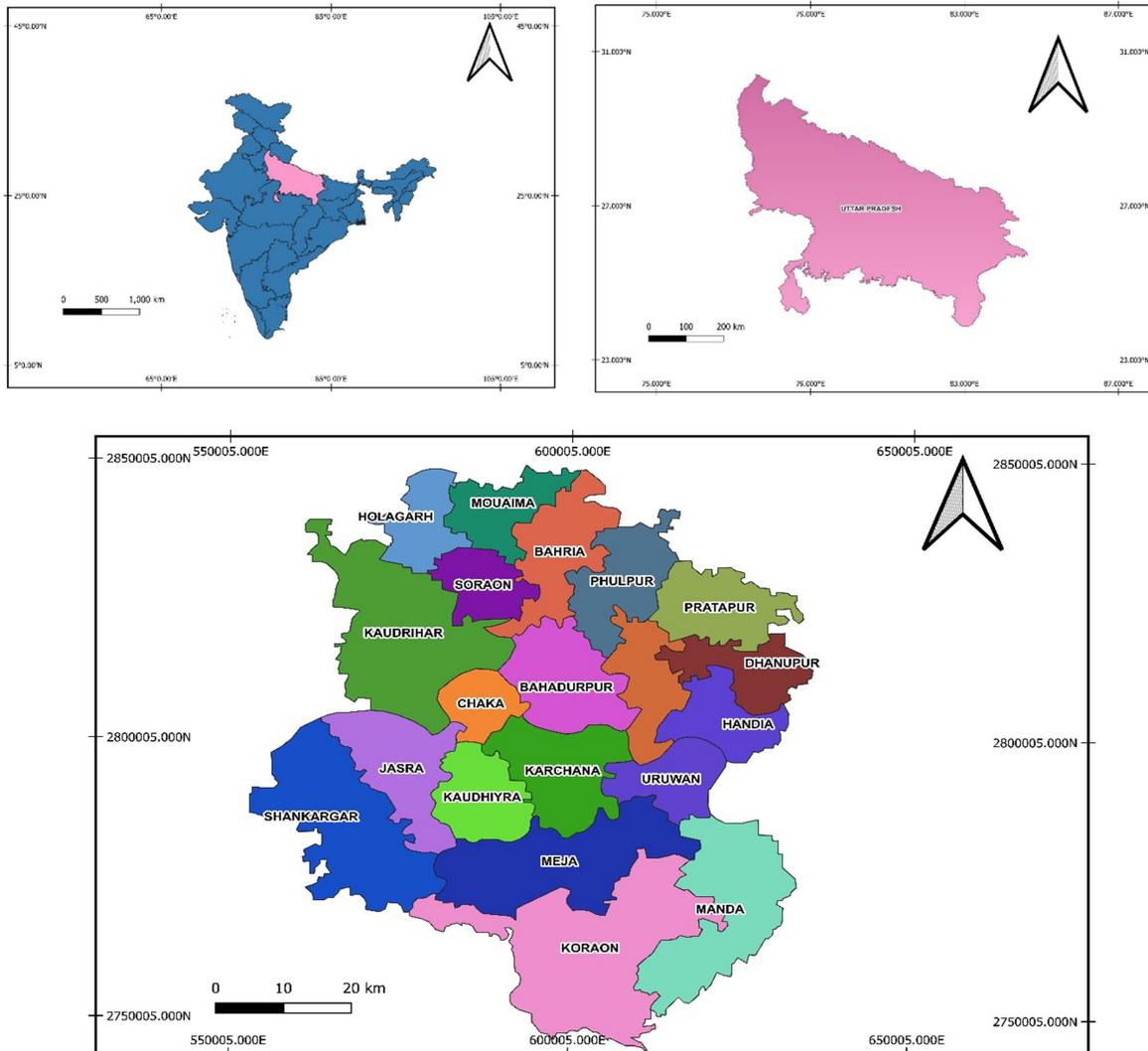
The river Ganga Middle Ganga plain India's reach fertile land all across the region. Although Yamuna and Tons are major tributary of Ganga meet near Sangam and Sirsa.

Yamuna Plain: Slightly elevated and less fertile compared to the Gangetic belt. Vindhyan Plateau (Southern Part): Hilly terrain with rocky soil, part of the northern edge of the Vindhyan range. This area is less suitable for agriculture. Prayagraj exhibits a classic humid subtropical climate, a common characteristic of north-central Indian cities. The city experiences a distinct cycle of three seasons: a hot and dry summer, a cool and dry winter, and a warm and humid monsoon. Summer prevails from April to June, during which peak temperatures typically fluctuate between 40∘C (104∘F) and 45∘C (113∘F). The monsoon season commences in early July and extends until September. Following this, the winter season sets in, lasting from December to February[2].

ANALYSIS

Analysing the evolution of Land Use and Land Cover (LULC) provides vital understanding of how human activities and the environment interact and change over time[3]. For Prayagraj district, a region rich in history, culture, and unique geography, examining these dynamics is crucial for ensuring sustainable urban growth, effective agricultural practices, and ecological preservation. The significant urbanization and population increase of recent decades have led to substantial land transformations within the district, especially around the meeting point of the Ganga and Yamuna rivers. This research endeavour focuses on analysing past LULC changes in Prayagraj by employing geospatial data and remote sensing methods. The goal is to identify key trends, the factors driving these changes, and their broader implications. The results of this analysis are intended to support improved decision-making regarding resource management and future development initiatives in the region[4]**.** According to Economic & Statistics Division State Planning Institute Planning Department, Uttar Pradesh statistical dairy 2023, reported LULC cover in the state that are following- Net area sown 68%, Forest 8%, Barren & unculturable land 2%, Land put to non-agricultural use 13%, Culturable waste land 2%, Permanent pastures and other grazing 0%, Land under miscellaneous trees, crops, and groves 1%, Current fallow 4%, Other fallow 2%[5].

Table Number 1- *Land Use/ Land Cover Changes and Accuracy Assessment of Prayagraj District*

| classification	Urban (in %)	Agricultural uses (in%)	Forest (in %)	Agricultural useless (in%)	Current fallows and other fallows (in%)	Barren and unfit for cultivation land (in%)	Land for use other than agriculture (in%)	Pasture (in%)	Area of gardens, trees and bushes (in%)	Total area (in hec.)
2011-2012	4	54.75	3.85	2.18	17.85	2.67	12.60	0.29	1.79	557074
2016-2017	4.69	62.05	3.85	1.82	8.90	2.55	14.81	0.29	1	557074
2021-2022	4.95	55.16	3.69	0.80	13.65	1.52	19.03	0.28	0.88	584700

Sources- District Statistical Data: - 2011-2012, 2016-2017, 2021-2022

Classification of following variables-

Agricultural uses (Net sown area)- According to table number 1, LULC research the net sown area (**NSA**) is the most important land which provide bases on primary economic for agricultural. In Prayagraj district data shows most of the land used agricultural activities, in 2011-2012, 54.75% land use for total land area, also 2016-2017, a 62.05% of land used under Argo sectors and year 2021-2022, 55.16% of total land engage in agriculture. The spatial variation and the distribution of net sown area in the region ranges between growth to low (-8% to +7%).

Forest Cover- According to above table Tree Canopy Cover, Minimum Area (<0.5 hectares) and minimum tree height (between 2 to 5 meters) as known as forest cover. *India's Definition for UNFCCC and FAO Reporting*-Considers structural criteria: 10-30% tree crown cover (India uses 10%), 0.05-1-

hectare minimum area (India uses 1 hectare), and 2-5 meters minimum tree height (India uses 2 meters). Forests are further categorized in the LULC as[6]: Evergreen/Semi-evergreen Forests, Deciduous Forests, Forest Plantation, Scrub Forests, Littoral/ Swamp/Mangrove Forest.
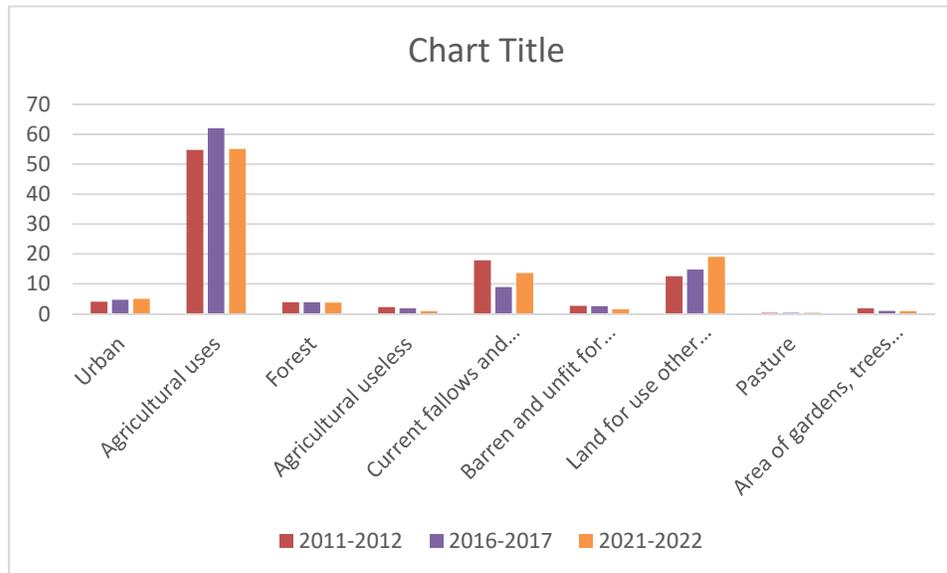

Above table presented slow progress of forest cover in consecutive years of 2011-2012, 2016-2017 in 3.58% and 2021-2022 in 3.69%. The topography of the area and the distribution of forest land are closely related. Whereas plains and plateaus are devoid of woods, river valleys are home to dense forests. In this area, forests have long since been cleared for agriculture.

Agricultural useless (Cultivable wasteland)- Those land which are not be utilized to their full potential that is not currently being cultivated. There are few data to represent how cultivable wasteland are reduce over time period, 2011-2012 there are 2.18% of area under cultivable waste land over time this will in 2016-2017 are 1.82% and year 2021-2022 in 0.80% it means that land uncultivated for more than 5 agriculture years. This property was left deserted due to several reasons, such as insufficient access to clean water, saline or alkaline soil conditions, erosion, water accumulation, an unfavourable geographic layout, According to table 1 in Prayagraj current fallow land (Left cultivation for one or less than one agricultural years) and other fallow land (Left uncultivated for past 1 to 5 agricultural years) in 2011-2012 (17.85%), 2016-2017 (8.90%) and 2021-2022 (13.65%) are spatial change between time period. human disregard, or soil deficiencies resulting from ineffective farming practices.

Prof. Akhilesh Kumar Pandey, and Ashish Kumar Mishra

Page | 317

Current fallows and other fallows- It means lands not under cultivation of the time of reporting (data collection year), but which have been sown in the past.

Barren and unfit for cultivation land- The land under the settlements, roads, mines, waterways, extraction sites, as well as mountains, deserts, and marshlands, and quarries along with barren lands are all fall into included in this category. Table 1 show spatial distribution of this land use type in 2011-2012 (2.67%), 2016-2017 (2.55%) and 2021-2022 (1.52%) this shows, how land is converting for human use after the time period.
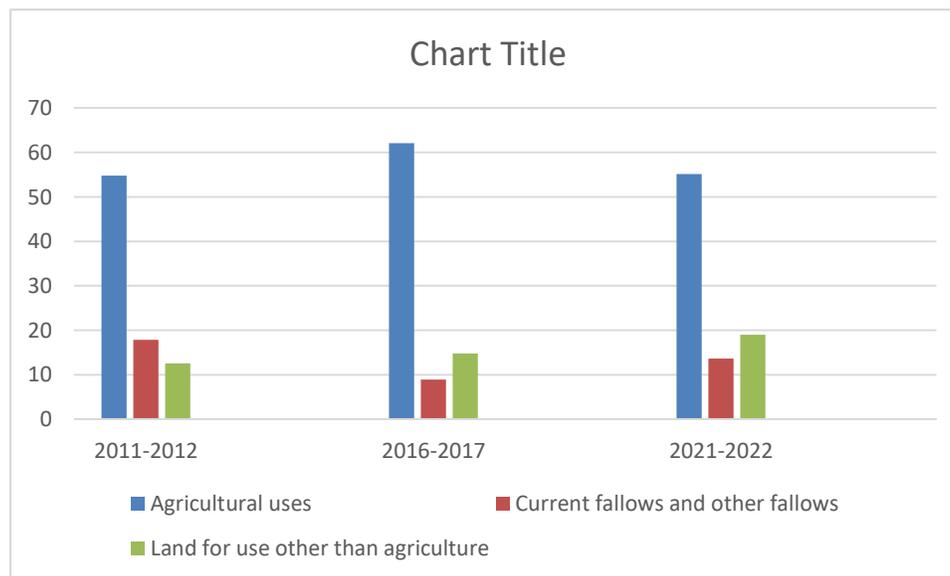
Land for use other than agriculture- It is one of the major land use cover types which is share great percentage, area under Non-agricultural Uses likely category includes all lands occupied by buildings, roads and railways or under waterways, e.g., river, and canals and other lands used for non –agriculture purpose. In table 1 year 2011-2012 (12.60%) contribute in land uses, 2016-2017 (14.81%) and year 2021-2022 (19.03%) these data represent rural human infrastructures and development.

Pasture- this category generally found in village area for grazing Lands where there are permanent pastures and meadows. The data shows that there is a minimum representation in permanent pasture and other grazing land from 2011-2012 (0.29%), next 2016-2017 (0.29%) and year 2021-2022 (0.28%) in following order.

Area of gardens, trees and bushes- This area does not represent forest area and not be **NSA** so it's show single and bunch of trees around agricultural area. Lands under Casuarina trees, thatching grasses,

Prof. Akhilesh Kumar Pandey, and Ashish Kumar Mishra

Page | 318

bamboo bushes, and other groves for fuel. The data shows that there is a decrease in Land under Miscellaneous Tree Crops land from 2011-2012 (1.79%), next 2016-2017 (1%) and year 2021-2022 (0.88%) are shown garden area convert in cultivable land or human infrastructure.

Urban area (Sadar)- This type includes all above variables in city or town administrative boundary. So, all land forms show in inclusive manner like 2011-2012 (4%), next 2016-2017 (4.6%) and year 2021-2022 (4.9%) over the time table 1.0 explain urban are capture our surrounding land cover.

Table Number 2 - Changing Pattern of LULC in 2007 to 2022

Sources- District Statistical Data: - 2007-08, 2011-12, 2016-17 2021-22

	2007-08 to 2011-12	2011-12 to 2016-17	2016-17 to 2021-22
Agricultural uses	-6416	+40666	-23137
Forest	0	+17	+156
Agricultural useless	+3118	-49838	-30231
Current fallows and other fallows	+3118	-46720	+30231
Barren and unfit for cultivation land	-894	-670	-5299
Land for use other than agriculture	+3815	+12313	+28792
Pasture	0	+1	0
Area of gardens, trees and bushes	+402	-4403	-394
Urban	0	+3882	-2784

The provided table number 2- are illustrates the changing patterns of Land Use/Land Cover (LULC) over time, offering insights for future regional planning. These changes reflect the combined positive and negative impacts of government schemes and initiatives by private organizations and NGOs. The period from 2011-12 to 2016-17 stands out as a crucial transition phase, marked by rapid positive changes across various LULC categories. This includes shifts in agricultural land use (both productive and currently fallow), forest cover, barren land, land designated for non-agricultural uses, pastures, gardens, and urban areas. Notably, increased afforestation in urban areas, through public parks, green belts, and riverfront developments, has contributed to these positive changes. Improvements in irrigation management, such as the development of spider-network canal systems, have enhanced coverage in remote agricultural areas during appropriate seasons. Furthermore, government efforts to improve "last-mile connectivity" have facilitated faster and smoother mobility within the region.

Recent trend of land use land cover (LULC)-

According to Latest District Statistical département reported 584700 hec. In year 2021-2022 Land cover and survey among 9 LULC variable and describe their spatial distribution of land use land cover.

The land use and land cover data for BARA tehsil, Prayagraj in 2021-2022 reveals that agriculture constitutes the largest portion of the total reporting area at 4.656%. This is followed by Current Fallow and Other Fallow land, accounting for 1.823%, indicating a significant portion of land is temporarily uncultivated. Land designated for uses other than agriculture occupies 1.289%, suggesting areas allocated for infrastructure, settlements, and other non-farm activities. Forest area covers a modest 0.898%, while Cultivable Wasteland and Barren and Uncultivable Land are relatively low at 0.301% and 0.277% respectively. The areas under Pasture and gardens, trees, and bushes are minimal, at 0.009% and 0.074% respectively, highlighting their limited presence within the tehsil's land cover. The total reporting area considered in this data represents 9.324% of the tehsil's geographical extent.

Table Number- 3 *Land Use/ Land Cover Changes and Accuracy Assessment of Prayagraj District*

Tehsil/ Classification	BARA (in %)	HANDIA (in %)	KARCHHANA (in %)	KORAON (in %)	MEJA (in %)	PHULPUR (in %)	SORAON (in %)	SADAR (in %)

Total Reporting Area	9.324	15.818	11.993	9.273	14.854	15.639	18.144	4.951
Agricultural area	4.656	9.379	7.619	7.034	8.214	9	9.260	1.029
Forest Area	0.898	0.003	0	1.105	1.662	0	0.029	0.001
Cultivable Wasteland	0.301	0.023	0.052	0.059	0.226	0.047	0.896	0.091
Current Fallow & Other Fallow	1.823	2.338	0.817	0.191	2.038	1.868	4.576	0.969
Barren and Uncultivable Land	0.277	0.114	0.202	0.025	0.257	0.415	0.230	0.079
Land for use other than agriculture	1.289	3.694	3.126	0.704	2.391	4.152	3.679	2.766
Pasture	0.009	0.010	0.149	0.007	0.007	0.051	0.047	0
Area of gardens, trees and bushes	0.074	0.253	0.165	0.003	0.566	0.102	0.230	0.212

**SOURCE- District Statistical Data: - 2021-2022**

The land use data for HANDIA tehsil, Prayagraj in 2021-2022 shows that agriculture dominates, covering 9.379% of the total reporting area (15.818%). A notable 2.338% is classified as Current and Other Fallow land. Land for non-agricultural uses constitutes 3.694%, a significant portion. Forest cover is minimal at 0.003%. Cultivable Wasteland and Barren land are very low, at 0.023% and

0.114% respectively. Pasture and gardens/trees occupy small fractions at 0.010% and 0.253%, indicating their limited extent within the tehsil.

In KORAON tehsil, Prayagraj (2021-2022), agriculture is the major land use, occupying 7.034% of the 9.273% total reporting area. Forest area constitutes 1.105%, a notable presence compared to other tehsils. Land for non-agricultural uses accounts for 0.704%. Current and other fallow land is low at 0.191%. Cultivable wasteland and barren land are minimal, at 0.059% and 0.025% respectively. Pasture and gardens/trees have very small shares, at 0.007% and 0.003%.

KARCHAANA tehsil in Prayagraj (2021-2022) shows agriculture as the dominant land use, covering 7.619% of the 11.993% reporting area. Land for non-agricultural uses is also significant at 3.126%. Current and other fallow land accounts for 0.817%. Forest area is nil. Cultivable wasteland and barren land are minimal, at 0.052% and 0.202% respectively. Pasture and gardens/trees occupy minor portions, at 0.149% and 0.165%.
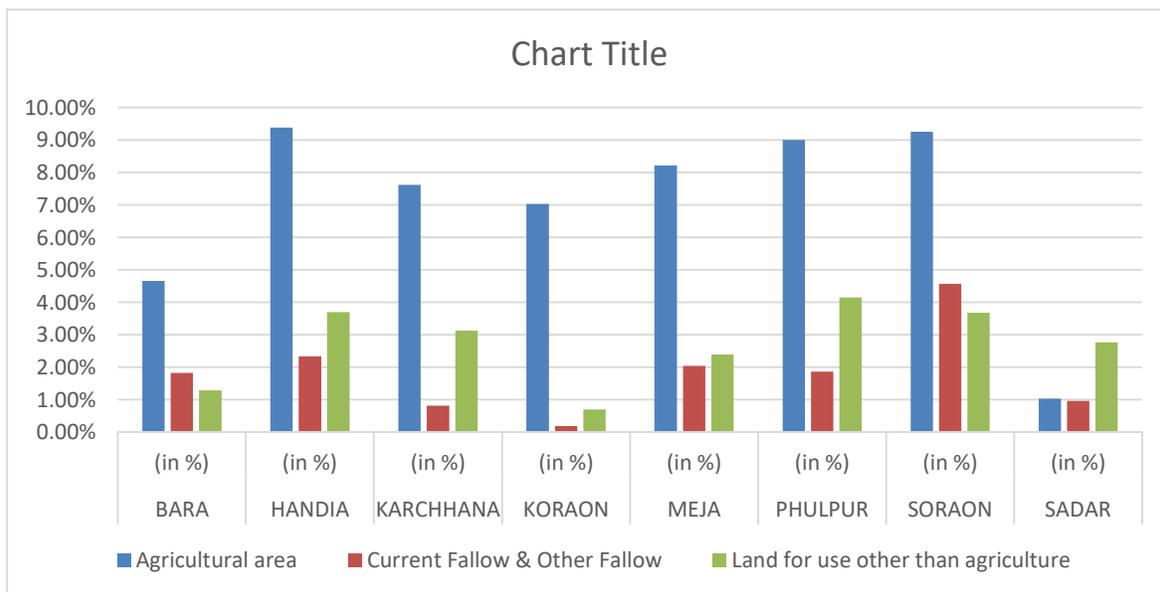
In MEJA tehsil, Prayagraj (2021-2022), agriculture dominates the land use, covering 8.214% of the 14.854% total reporting area. Forest area is relatively significant at 1.662%. Current and other fallow land occupies 2.038%, while land for non-agricultural uses accounts for 2.391%. Cultivable wasteland and barren land are low, at 0.226% and 0.257% respectively. Pasture is minimal at 0.007%, while gardens, trees, and bushes cover 0.566%.

In PHULPUR tehsil, Prayagraj (2021-2022), agriculture is the primary land use, occupying 9% of the 15.639% total reporting area. A significant portion, 4.152%, is allocated for non-agricultural uses. Current and other fallow land accounts for 1.868%. Forest area is absent. Cultivable wasteland and barren uncultivable land are low, at 0.047% and 0.415% respectively. Pasture and the area under gardens, trees, and bushes are minimal, at 0.051% and 0.102%.

In SORAON tehsil, Prayagraj (2021-2022), agriculture constitutes the largest land use at 9.260% of the 18.144% total reporting area. A substantial 4.576% is classified as current and other fallow land. Land allocated for non-agricultural uses is also significant at 3.679%. Forest cover is minimal at 0.029%. Cultivable wasteland occupies 0.896%, while barren land is 0.230%. Pasture and gardens/trees represent small proportions, at 0.047% and 0.230% respectively.

In SADAR tehsil, Prayagraj (2021-2022), the total reporting area is 4.951%. Land for uses other than agriculture constitutes the largest portion at 2.766%, indicating significant urbanization or infrastructure. Agricultural area is 1.029%, followed by Current and Other Fallow land at 0.969%. Forest cover is negligible at 0.001%. Cultivable wasteland and barren land are minimal, at 0.091% and 0.079% respectively. Pasture is non-existent, while gardens, trees, and bushes cover 0.212%.

CONCLUSION

Land use in Prayagraj reflexes a complex interplay of geographical, socio-economics, political and cultural factors. The results obtained from the study confirm that showing data the major land cover are divided into three main domains in Agricultural area, Current fallow & other (old) fallow and Land for use other than agriculture. Forest is at last 15 year less than >4%, mainly forest cover change in direct use of human for grazing his animals and micro agricultural activities. Area of gardens, trees and bushes are down fall in 2% to >1% this defines permanent green cover in rural and urban area shrinking during time. Rapid urbanization and uneven population are main causes to sustain use of Land use; expansion of urban area catch nearest agricultural land. Those following data show how mismanaged land therefore, there is an urgent need for integrated land use planning that promotes sustainable agriculture, protects natural resource and accommodates development while ensuring ecological balance and food security for future generations.

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