Road Widening and Land Use Land Cover Change Detection at Anantnag, Kashmir

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ABSTRACT- Road networks play a crucial role in fostering economic growth and development. This current research focuses on examining and identifying changes in land use and land cover at a small scale. The study utilizes a GIS-based approach, analyzing Landsat imagery taken before (2019) and after (2022) a road widening project. The results reveal a dynamic transformation in land use and land cover in Anantnag, Kashmir, as a consequence of the road widening. This includes the introduction of new land use categories and significant alterations in the overall land use pattern in the area.

KEYWORDS- Road widening, land use land cover, change detection, Anantnag, Kashmir

I. INTRODUCTION

Undoubtedly, the widening and construction of roads bring significant benefits to society. However, various studies have revealed that these road development activities also lead to substantial land-use changes, particularly in the vicinity of the highways [1]. In these highway-effect zones, one of the major components of land-use change is the expansion of built-up areas, which often encroach upon farmland, forested regions, and water bodies. Consequently, the transformation of land for urbanization and infrastructure development has a notable impact on the surrounding environment and natural landscapes [2,3].

A. Statement of the Problem

The expansion of roads, especially within urban areas, necessitates the demolition of structures, acquisition of land, and may result in the loss of agricultural land, among other consequences. These actions inevitably lead to changes in land use and land cover. One of the ideal locations for studying such recent changes in Meghalaya state is the NH 44 area in Anantnag, Kashmir town. This location has undergone significant land use and land cover alterations due to the recent road widening project, making it a prime candidate for investigation.

B. Objective

The major objective of this research is to assess and detect the extent of land use and land cover change due to road widening.

II. METHODOLOGY

To evaluate and identify land use and land cover changes resulting from road widening, a highway-effect zone was established, extending 1 km in width and 5 km in length. The assessment was conducted using a GIS technique, where changes in land were mapped both before and after the highway expansion [4]. To achieve this, digitization of the changes was performed using either Google Earth Imagery or Landsat satellite images, saving the data in. kmz file format. Later, this data was input into ArcGIS software version 10.3 for final mapping and assessment.

For the land use and land cover mapping, visual interpretation or on-screen interpretation methods were utilized. Although time-consuming, these approaches are considered the most accurate for categorizing land use and land cover in a small area [5]. The land use and land cover categories were adopted from NESAC and MBDA land use land cover classes to ensure consistency in the mapping process.

C. Interpretation

Though it really takes time but this is the best way to get accurate land use and land cover categories for a small area. The land use land cover category has been adopted from NESAC and MBDA land use land cover classes [6].

D. Data Source

In this research, the data utilized primarily consists of Landsat satellite imagery captured before the road widening in 2019 and after the road widening in 2022. Additionally, data collection involved ground truthing using GPS instruments to validate and verify the information gathered.

E. Study Area

Anantnag, Kashmir town is located in the South Kashmir of J&K UT. It is an area dominated by the rocks granite intrusive rocks.

Figure 1: NH-44 Anantnag Site

F. Results and Discussions

The widening of the highway in Anantnag, Kashmir has brought about significant alterations in the land use and land cover. The study analyzed data from two specific years: before the road widening in 2019 and after the road widening in 2022. Before the road widening, Anantnag, Kashmir, being an underdeveloped district headquarters, had limited scope for change in its land use and land cover

patterns without human intervention. However, there was a need for upgrading especially in terms of roads [7]. The NH 44 passing through Anantnag, Kashmir town was narrow before 2019. The narrow road in mountainous regions like J&K helped control population increase due to migration, consequently influencing the area's land use and land cover changes.

Table 1 presents the land use and land cover distribution in Anantnag, Kashmir, prior to road widening in 2019. The data in the table represent the different categories of land use and land cover, their respective areas in hectares, and the percentage of each category in relation to the total area. The table-1 reveals the prevailing land use patterns at the given time. Notably, the dominant land use categories were Scrub Land (42.8%), Agricultural Land (16.9%), and Open Forest (19.5%). Settlement/Built-Up and Plantation accounted for 15.4% and 2.8% of the area, respectively. Barren Land, Waterbodies, and Road occupied smaller portions of the landscape.

Table-1 provides essential information about the distribution of various land use and land cover categories, allowing a comprehensive understanding of the existing land utilization in the region before the road widening project.

Table 1:Percentage of land use and land cover of Anantnag, Kashmir prior to road widening

S. No	LULC_CLASS	Area (in ha)	Area (in %)
Land Use Land Cover of Anantnag, Kashmir 2019			
1	Agricultural Land	57.6	16.9
2	Barren Land	2.4	0.7
3	Dense Forest	0.0	0.0
4	Open forest	66.4	19.5
5	Scrub land	145.7	42.8
6	Settelment/ Built up	52.6	15.4
7	Waterbodies	2.4	0.7
8	Plantation	9.8	2.8
9	Road	2.9	0.9
	Total	**339.9**	**99.6**

The data presented above illustrates the land use and land cover of Anantnag, Kashmir town before the construction of the bypass in 2019. The study area covered a buffer of 1 km, totaling 340 ha of land. The predominant land cover was Scrub land, occupying 145.7 ha, followed by Open forest (66.4 ha), agricultural land (57.6 ha), settlements (52.6 ha), and plantation covering about 9.8 ha. The least occupied land use and land cover categories were road (2.9 ha), water bodies, and barren land, each covering only 2.4 ha.

Scrub land dominated most of the study area, particularly around the road, and extended east and west of the highway with agricultural use. Open forest also spread across the area, appearing scattered throughout the study region. Human settlements were well-distributed along the highway, with a significant concentration at the main center in the northern part of the area. Pineapple plantations were observed in the southern part of the town, away from the populated areas. Ponds, lakes, and fish ponds were detected in the southern part, covering a smaller area. Barren land, resulting from waste and debris disposal from highway construction, was visible in the

southern part along the highway. The development of the town in terms of population, markets, and administration likely played a crucial role in the significant changes in land use and land cover in the area [8,9].

The subsequent map and figure illustrate the land use and land cover of Anantnag, Kashmir after the highway widening in 2019. The study area covered a buffer of 1 km and a total area of 340 ha. The most dominant land cover was open forest, occupying 142.5 ha, followed by Scrub land (77.7 ha), settlements (64.0 ha), and agriculture (38.7 ha). The least occupied land use and land cover categories were plantation (5.8 ha), dense forest (2.4 ha), water bodies (2.3 ha), road (6.2 ha), and no barren land.

Overall, the widening of the highway brought notable changes to the land use and land cover patterns in the area. Table 2, presents the land use and land cover distribution in Anantnag, Kashmir before road widening in 2019. The data in the table show the different categories of land use and land cover, their respective areas in hectares, and the percentage of each category in relation to the total area. The table indicates that the dominant land use categories in 2019 were Open Forest (41.9%), Scrub Land (22.8%),

and Settlement/Built-Up (18.8%). After the road widening in 2022, there might have been changes in the land use and land cover distribution, which could be inferred by comparing this data with the updated post-road-widening information.

Table 2: Land use and land cover of Anantnag, Kashmir before road widening

Land Use /Land Cover of Anantnag, Kashmir 2019			
Sl No	LULC_CLASS	Area (in ha)	Area (in %)
1	Agricultural Land	38.6	11.3
2	Barren Land	0.0	0.0
3	Dense Forest	2.4	0.7
4	Open forest	142.5	41.9
5	Scrub land	77.7	22.8
6	Settelment/ Built up	64.0	18.8
7	Waterbodies	2.3	0.7
8	Plantation	5.8	1.7
9	Road	6.2	1.8
	Total	**339.9**	**99.7**

After the highway widening in 2019, gradual changes were observed in the land use and land cover of Anantnag, Kashmir. The majority of the land was covered with open forests and scrub land. This can be attributed to the fact that Anantnag, being the district headquarters, has a population that is largely engaged in the secondary and tertiary sectors of the economy. As evident from the percentage of agricultural land, which is only 38.7 ha, agricultural activities are scattered away from residential areas and the road. This leaves a significant portion of the land to be occupied by forests and scrub.

The town is well-distributed with human settlements covering about 64.0 ha of land, visible along the highway and away from it, with a high concentration in the main center located in the northern part of the study area. Settlements gradually increased in size due to migration from surrounding areas and other states after the highway widening. New buildings and structures were constructed not only along the highway but also away from it.

In the southern part of the main town, away from populated centers, pineapple plantations were observed. Ponds, lakes, and fish ponds were detected in the southern part of the study area, covering a relatively small area. Barren land disappeared by the year 2022, as it was occupied by roads and human settlements.

Overall, the land use and land cover changes reflected the impact of the highway widening on the distribution and utilization of land in Anantnag, Kashmir.

G. Change Detection: Comparative Study

The comparative study has been made by determining the percentage of change and assessing it as follows:

Table 3 illustrates the comparative changes in land use and land cover percentages in Anantnag, Kashmir, between 2019 and 2022. The data in the table present the original percentages of each land use and land cover category in 2019, their corresponding percentages in 2022, and the calculated changes.

The data highlight several significant shifts in the landscape over this period. Notably, there was a decrease in Agricultural Land (-5.6%), Barren Land (-0.7%), Scrub Land (-20%), and Plantation (-1.1%), indicating changes in these categories. Conversely, there were substantial increases in Open Forest (+22.4%) and Settlement/Built-Up (+3.4%), indicating expansion in these areas. Additionally, Dense Forest showed a modest increase (+0.72%) while Waterbodies and Road percentages remained relatively stable.

This table provides a clear overview of the alterations in land use and land cover distribution over the three-year period, reflecting the impact of factors such as road widening, urbanization, and changes in vegetation.

Table 3: Comparative percentage of land use and land cover of Anantnag, Kashmir

Land Use Land Cover change at Anantnag, Kashmir between 2019 and 2022 (Area in %)				
Sl No	LULC_CLASS	2019	2022	Change
1	Agricultural Land	16.9	11.3	-5.6
2	Barren Land	0.7	0.0	-0.7
3	Dense Forest	0.0	0.72	+0.72
4	Open forest	19.5	41.9	+22.4
5	Scrub land	42.8	22.8	-20
6	Settlement/ Built up	15.4	18.8	+3.4
7	Waterbodies	0.7	0.7	same
8	Plantation	2.8	1.7	-1.1
9	Road	0.9	1.8	+0.9
	Total	**99.7**	**99.7**	

The widening of the highway in Anantnag, Kashmir town has significantly altered the land use and land cover in the vicinity. A substantial change has been observed in the agricultural sector when comparing the years 2019 and 2022, with a notable loss of 5.6% of agricultural land. This agricultural area has been replaced by settlements and roads. The percentage of settlements increased by 3.4%, mainly due to migration from neighboring villages and other districts as people seek livelihood opportunities in the town [10].

Barren land has disappeared as it has been reclaimed by vegetation and occupied by human settlements and roads. Open forest now occupies the highest percentage, accounting for 22.4% of the area. Meanwhile, scrub land has reduced to 20% as a consequence of road acquisition and being taken over by human settlements [11]. The widening of the highway has brought about significant changes in the landscape and land usage patterns in and around Anantnag, Kashmir town.

III. CONCLUSION

The widening of the highway has caused significant and widespread changes in land-use and land-cover. The landscape has been altered to accommodate and facilitate development. In the study area of Anantnag, Kashmir, development is an ongoing process, and it will continue to reshape the land-use and land-cover in the future. This development, coupled with education, is expected to bring about sustainable changes in the land use and land cover patterns.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

REFERENCES

[1] Arjun Poudel (2014). 'Mitigation of road construction induced land degradation effects on livelihoods: A case of rural access programme Nepal'.

[2] Atlas, 2016, Meghalaya Basin Development authority.

[3] Bhakta .G.P, (1995) Geography of Meghalaya, Shillong; Bimal Bawri, India.

[4] Erickson, D.L. 1995. Rural land use and land cover change. Land Use Policy. 12 (3).

[5] Joseph A. Di Pietro, in Landscape Evolution in the United States, (2013).

[6] Karis L.Day (2001). "Assessing the Impact of highway development on Land Use/Land cover change In Appalachian Ohio"

[7] Kijowska. J, Kijowski, A. (2013), Landscape Changes Caused by the Construction of the Poznan Western Ring road - Selected Problems. Institute of Physical Geography and Environmental Planning, Department of Integrated Geography. pp 153 - 154.

[8] Manju Mohan1, et,al (2011). "Dynamics of Urbanization and Its Impact on Land-Use/Land-Cover: A Case Study of Megacity Delhi ".Journal of Environmental Protection, 2011

[9] Morimoto Akinori (2015). "Transportation and Land use"

[10] Skinner, R.E. 2002. "Highway Research for the 21st Century." Issues in Science and Technology 19:31-35.

[11] Whitelegg. J. (1994). 'Transport and land take' A report for CPRE, Eco Logica Ltd. White Cross Lancaster.