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Analysis of Land Use and Land Cover Changes in Buraimi City of Oman Using Remote Sensing and GIS

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Abstract:

The study of Land Use (LU)/ Land Cover (LC) dynamics in the face of climate change is critical for better long-term ecological management. This study aimed to detect the changes occurred in the LU/LC from 2002 to 2022 in Buraimi city of Oman. The satellite images for the years 2002 and 2022 were taken from Google Earth Pro. In this study, four types of LU/LC (i.e. vegetation cover, built-up areas sparse built-up and open lands) are estimated. This study shows that built-up area, vegetation area and sparse built-up area has been increased by 7.64 km^2, 0.787 km^2 and 15.23 km^2 respectively, while the open land area has decreased by 23.65 km^2. This study will help understand the urban development in the city and manage the land use for sustainable development.

Key Words: Land Use (LU)/ Land Cover (LC), Remote Sensing and GIS, Google Earth Pro, Sustainable Development etc.

Introduction:

The terms land use and land cover are frequently used together. However, they have quite distinct meanings. Any surface cover on the ground such as vegetation, urban infrastructure, water, bare soil, or other ground surface covers can all be referred to as land cover. When it comes to global monitoring studies, resource management, and planning activities it is important to identify, delineate and map land cover. Land cover identification creates a foundation out of which monitoring operations may be conducted, as well as providing ground cover data for baseline thematic maps. The purpose that the land serves is being known as land use. Subsequent monitoring and baseline mapping are both involved in applications that are used by land use because it is required to know what type of land is used and in what quantity to identify the changes on land use from year to year. This is done by the timely information gathered. This information will aid in the creation of plans to balance conservation, competing uses, and development pressures. The loss or disruption of fertile land, urban expansion, and forest depletion are all issues that are driving land use research. According to (Lopez et al. 2001), the huge increase in population is the most important element in the global shift of land use. Previous research has found a direct link between LU/LC and anthropogenic impacts, salinization, groundwater availability and quality, and hydro-meteorological parameters (Dias et al. 2015). The use of remote sensing and hydrological datasets in a GIS framework has been proven to be a good way to examine the effects of LU/LC change on groundwater quantity and quality on a broad scale at a cheap cost and with improved precision (Zampella et al. 2007). Because of their excellent geo-referencing processes, digital format suited for computer processing, and recurrent data collecting, satellite remote sensing and GIS are the most used approaches for quantification, mapping, and detection of LU/LCC trends (Lu et al. 2004). Nuez et al. 2008; Rahman et al. 2011). Chen et al. 2005; Nuez et al. 2008; Rahman et al. 2011). To estimate land cover changes in central and southern lake areas using Landsat data, Shalaby and Tateishi (2007) found different forms of LU/LC in Egypt's coastal zone. Gao and Liu (2010) managed to discover a soil erosion trend in central China that occurred over a 10-year period owing to soil contamination and flash floods. It labels information from numerous dates separately; therefore, proper comparison of multi-date dataset does not quite necessitate any adjustments (Singh 1989; Rivera 2005; Zhou et al. 2008; Warner and Campagna 2009). Mohammed Feras Baig (2022) made a study to assess changes to LU/LC and predict any further changes that can happen to Selangor, Malaysia. The study was done by using satellite images that were used to develop maps by SVM (support vector machine) from the year 1991 to the year 2021. Validation metrics were used to show that the spectral analysis mapper did not perform as good as the support vector machine did. There were six LU/LC classification used to base the images used in this study on, namely are water, development, barren, forest, agriculture, and wetlands. The satellite imagery has shown an area increase in developed, barren and water lands. However, there was a decrease in areas of agricultural, forest and wet lands.

Study Area and Methodology:

In this study, the Google earth image has been used to classify the various types of LU/LC and change occurred in the LU/LC has been estimated between year 2002 to 2020 in Buraimi city of Oman. The satellite images for the year 2002 and 2022 from Google were captured to digitize the various land use class. The Quantum Geographical Information System (QGIS) software was used to generate the land use data. Thereafter, all land use were estimated and compared. The methodology is given in Figure 1.

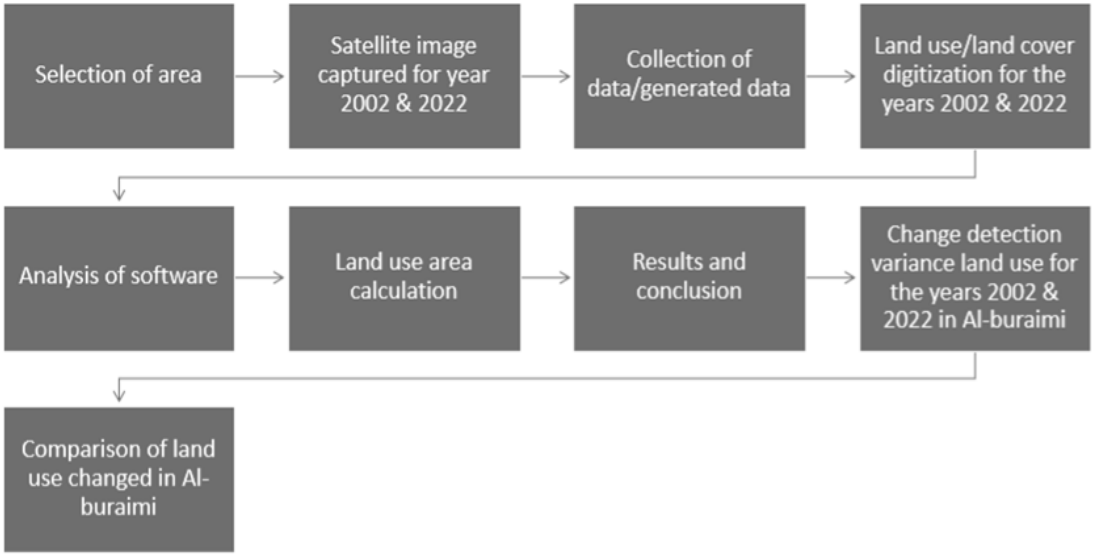

Figure 1 Methodology adopted for the study

Study Results and Discussion:

Buraimi city of Oman is a witness of rapid urban expansion in the past 20 years. The various land use classes are identified. The thematic map for the land use / land cover is generated for the year 2002 as shown in Figure 2. The built-up area is shown by red color, red inclined shaded area shows the sparse built-up area. The open land is shown by vertical black shaded area while green color shows the vegetation area. The built-up area is estimated as 8.916 km^2 while the spare built-up area is found as 8.86 km^2. The vegetation cover showed an area of 1.567 km^2. Moreover, the open land area was about 55.275 km^2. The total area of Buraimi city is 74.618 km^2. Figure 3 shows the different types of land use in Buraimi city in 2002 digitized on satellite image of the Google Earth in order to digitize the land use / land cover map of Buraimi city for the year 2002. The pie chart shows the various land use statics for the year 2002. Figure 4. Land use/ land cover statics for the year 2002 (B= Built-up area, OL= Open land, SB= Sparse Built-up area, V= vegetation area).

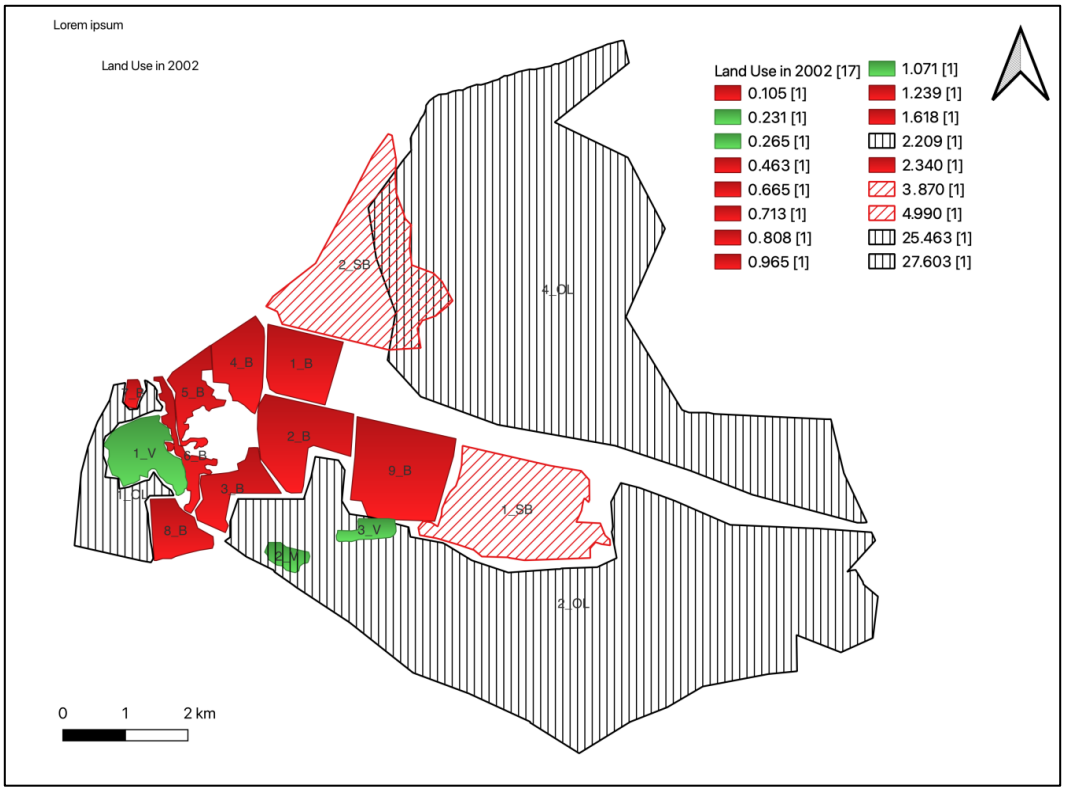

Figure 2. Land use / land cover map of Buraimi city of year 2002

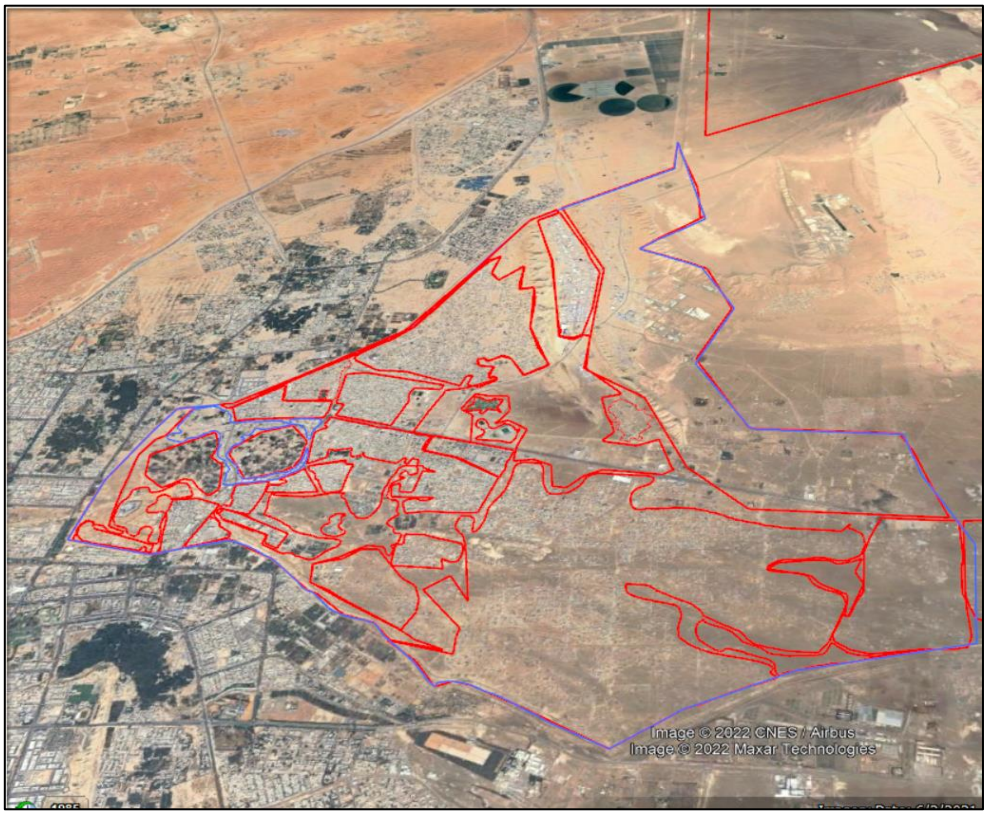

Figure 3. Satellite image captured from Google Earth to digitize the land use / land cover map of Buraimi city for the year 2002

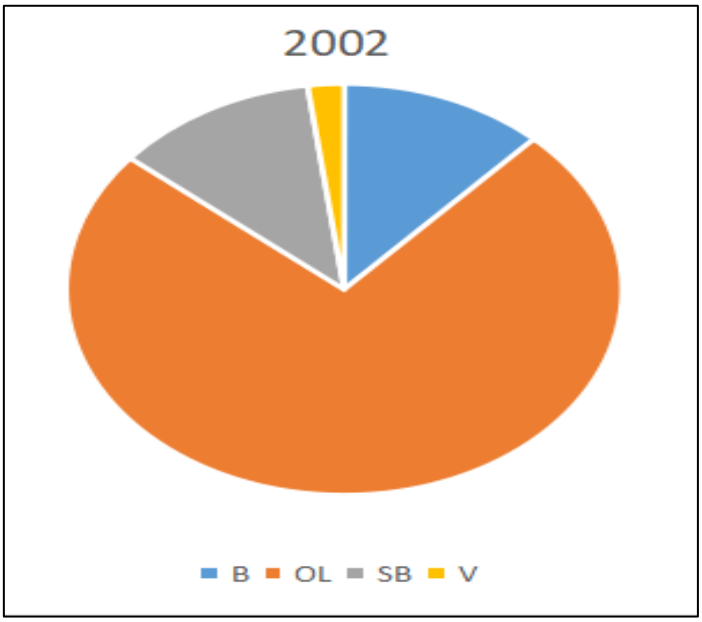

Figure 4. Land use/ land cover statistics for the year 2002

(B= Built-up area, OL= Open land, SB= Sparse Built-up area, V= vegetation area)

The land use is also classified for the year 2022 as shown in Figure 5. The built-up area is shown by red color, red inclined shaded area shows the sparse built-up area. The open land is shown by vertical black shaded area while green color shows the vegetation area. The built-up area was estimated as 16.556 km^2. The spare built-up area estimated as 24.092 km^2. The vegetation cover showed an area of 2.354 km^2. Moreover, the open land area was calculated as 31.616 km^2. Figure 6 shows the different types of land use in Buraimi in 2022 digitized on satellite image of Google Earth. The pie chart shows the various land use statics for the year 2022 in Figure 7.

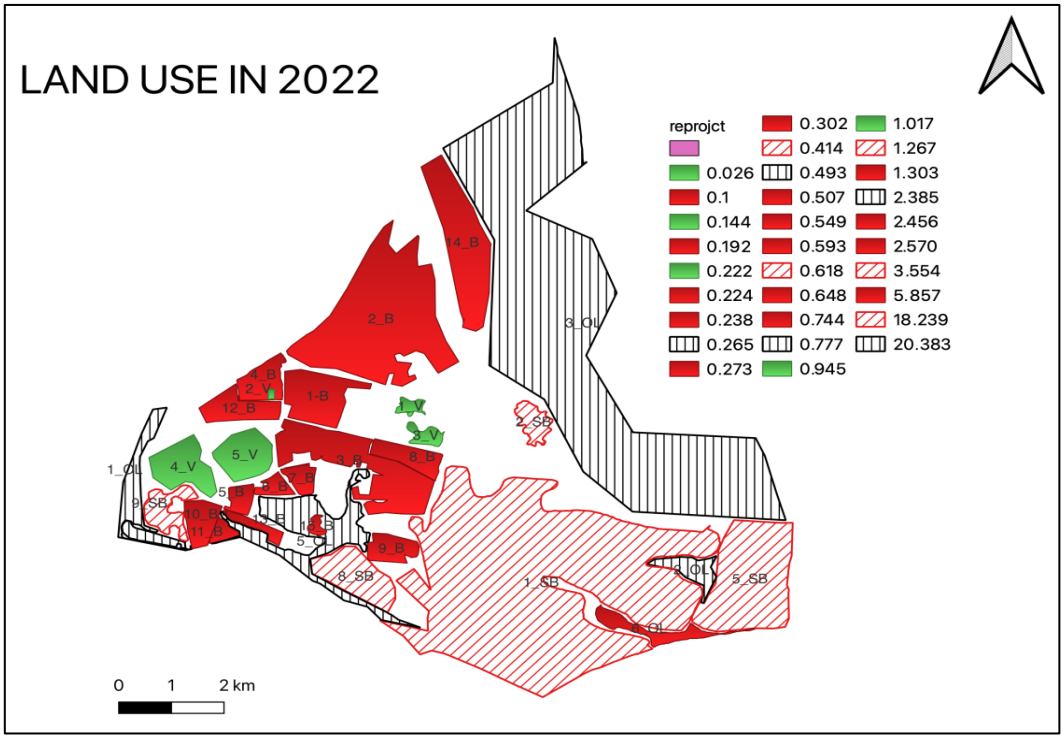

Figure 5. Land use / land cover map of Buraimi city for year 2022,

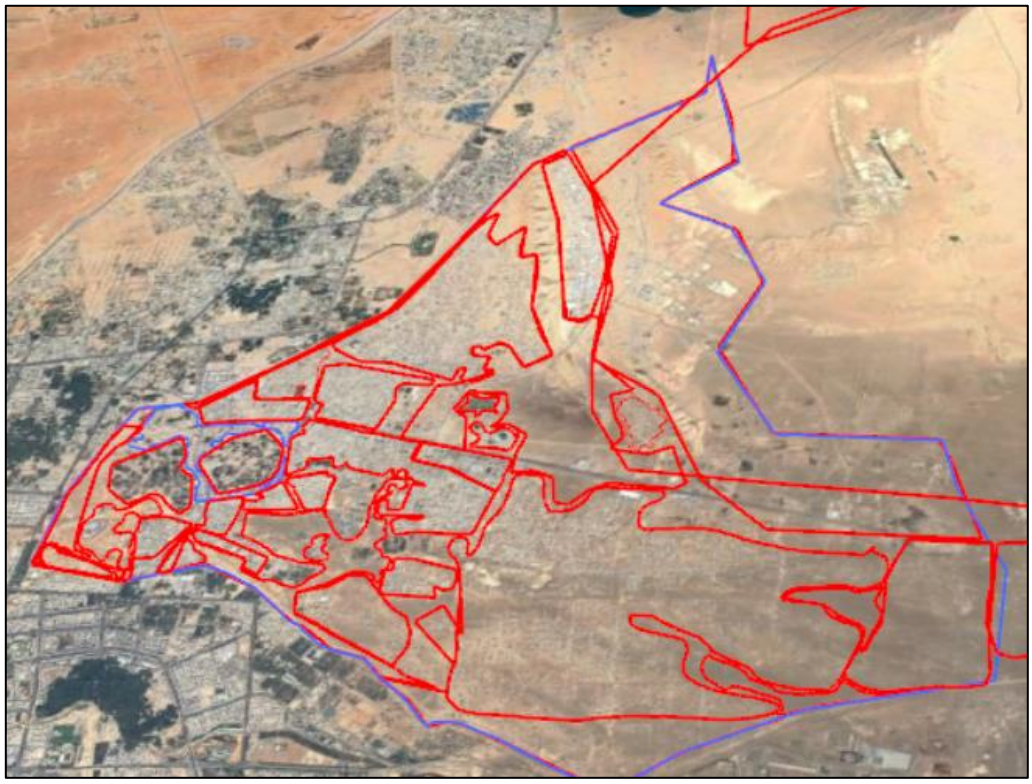

Figure 6. Satellite image captured from Google Earth to digitize the land use / land cover map of Buraimi city for the year 2022

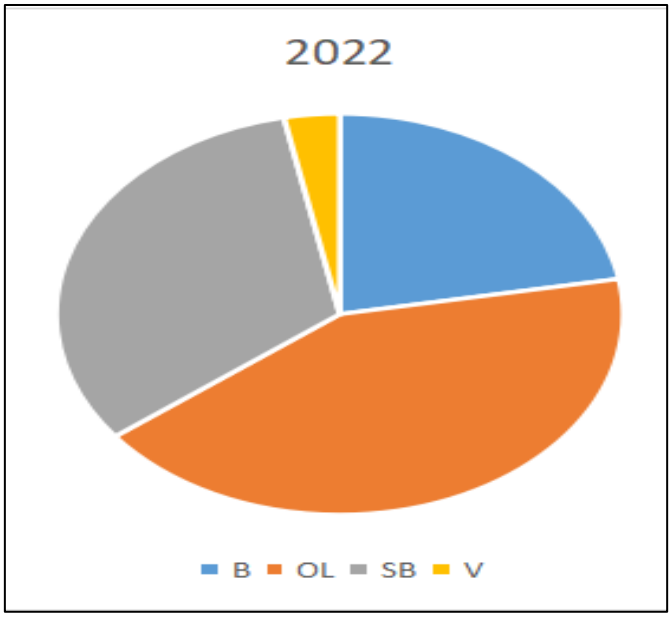

Figure 7. Land use/ land cover statistics for 2022

(B= Built-up area, OL= Open land, SB= Sparse Built-up area, V= vegetation area)

The results shows that Built-up area, Sparse Built-up area, has increased by 8.36 km^2 and 15.23 km^2, respectively. It is also observed that the vegetation cover has also increased by 0.78 km^2 but the open land area has been decreased by 23.66 km^2. The results are summarized and listed in Table 1, while Figure 8 shows that both built-up area and sparse built-up area with vegetation cover has been increased while open land has been decreased.

Table 1. The land use class in the year 2002 and 2022

No.	Land Use / Land Cover Class	Area in 2002 (km^2)	Area in 2022 (km^2)	Area Increased (km^2)	Area Decreased (km^2)
1	Built-up Area	8.196	16.55	8.36	
2	Sparse Built-up Area	8.86	24.09	15.23	
3	Vegetation Cover	1.567	2.35	0.78	
4	Open Land	55.275	31.61		23.665
Total Area (km^2)		74.61			

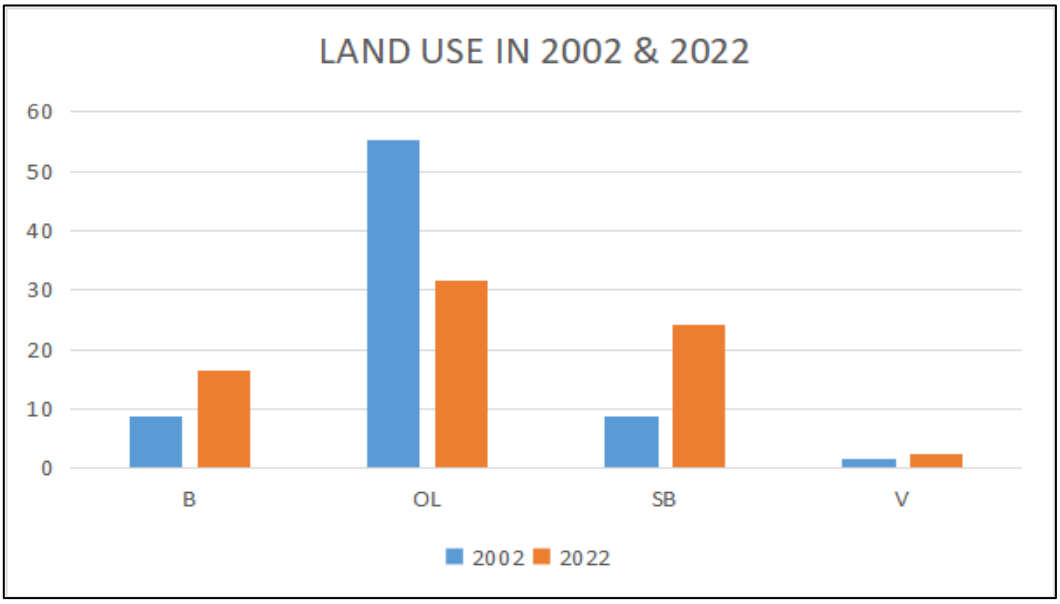

Figure 8. Comparison of Land use / land cover between the year 2002 and 2022

Conclusions and Recommendations:

The above investigations were based on change detection of land use / land cover for the year 2002 and 2022 using satellite imagery. The results clearly depict that built-up area, sparse built-up area, vegetation area has been increased by 11.20%, 20.41 %, and 1.04 %, respectively. While the open land has been decreased by 31.71% in the last 20 years. It can be concluded that the change in land use is due to urban development, population and the industrialization has been also increased. Most of the open land has been converted into the built-up and sparse built-up area. Moreover, it is observed that the vegetation cover has almost doubled when comparing them between years 2002 and 2022. The reason behind that is the parks and sports area has been increased. However, it is still considered a small number of the overall area.

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