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Spatio-Temporal Analysis of Urban Growth and Expansion of Multan City During 1998- 2020

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ABSTRACT

The purpose of this research is to examine the land use changes in the Multan city between the years 1998 and 2020 based on digital classification and accuracy. Employing remote sensing and GIS strategies, the study aims at looks into the degree and pattern of urbanization and change in land use and coverage and to compare this type of area to non-urban areas. Initially, the LSF technique for classification was found to be inadequate for the purpose of classifying urban area and hence, necessity of switching to supervised classification. From all the above stated classifiers, the Maximum Likelihood classifier yielded best results. The evaluation that was conducted displayed an estimated urbanization growth of about 4%. The degree of urbanization rose from 47% to 46% in 2008-2018; urban area grew from 4 km² to 70. 3 km². This led to high urbanization causing change of land use from agriculture and forests to building and hence affecting the thermal characteristics of the region. Significantly, the study underscores the significance of record-keeping for proper land management, pointing out that better long-term planning for cities requires fresh census data and high-resolution aerial photos

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1. Introduction

Urbanization is potentially the most radical and irredeemable change in the character of land usage(Wade, Rossi, Raftopoulos, & Coletta, 2024). Nevertheless, it is established that the process of urbanization is widespread worldwide, although it is most acute at the Indian level, as the scale of urbanization in the country has increased for the past 50 years unprecedentedly (Anestis & Stathakis, 2024). In this area, city planners require techniques for analyzing, tracking, and comprehending the dynamic suburban procedures (Yang, Yan, Chen, & Li, 2024). Changes in the land cover have become very crucial and multi-temporal geospatial techniques have become very vital in addressing them (Chaudhri & Nixon, 2024).Based on time-series Landsat data, it is possible to detect the urban footprints since the beginning of the 1970s (Szubert, Kaim, & Kozak, 2024). Man is frequently materialistic, leading in the supervision of money-related concerns in the city (Lemrová, Reiterová, Fatěnová, Lemr, & Tang, 2024). About one half of all the given population of the planet currently resides in cities. It is worth saying that for most of the human history, the greater part of the world's population was engaged in rural and simple settlements (Marks, 2024). The paper also looks into the risks of a spontaneous change of events (Mao, Cui, Hussain, & Shao, 2024). The impact of Land use controls on the spatial size of the United States of America urbanized locale in 2000 (Lisandro & Angel, 2024). The plausibility of three rule plan options in Lahore, including open private affiliations, city store choices, and changing metropolitan land-use drafting, by incorporating a study of transportation foundation supporting creation (Górna, 2024). They have overviewed the land-use controls on the spatial size of metropolitan districts and showed their perspectives about the bundle check drafting, metropolitan improvement limits, least locale limits, most preposterous construction grant limitations, and least individual per room controls (Faria, Tonmoy, & Haque, 2023).

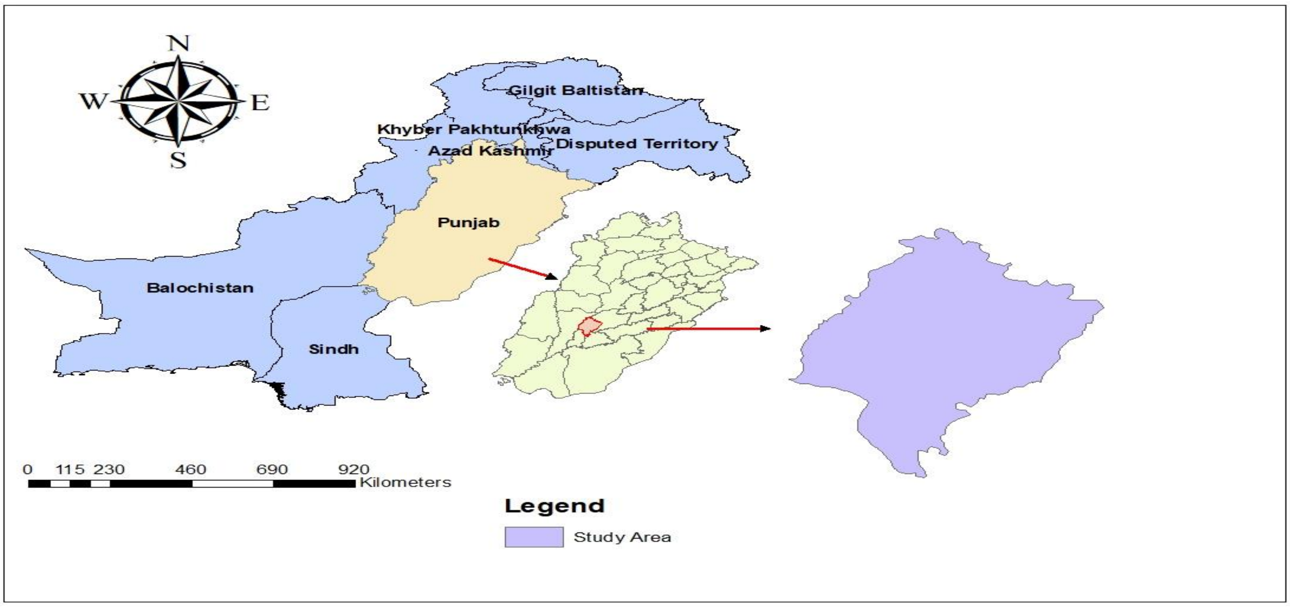
Current discussions suggest that the majority of Pakistan's population will soon be urban, continuing this trend. These rapidly growing urban populations often come from low-income and underdeveloped districts(Arif, Sadiq, Sathar, Jiang, & Hussain, 2023). In Lahore, Pakistan, the strategy considerations for subsidizing urban transportation in asset-constrained settings (Fietz & Lay, 2023). Since its inception, Pakistan has experienced ongoing urbanization. According to accurate surveys from 2012, 35% of Pakistan's population lived in metropolitan areas (Arshad, Ahmad, Abbas, Asharf, Siddiqui, & ul Islam, 2022). By 2015, Pakistan's urban population had increased to 39.2%. Given the recent economic growth, industrialization, and typical urban growth, urbanization in Pakistan is accelerating over time (HASHAAM, 2022). The study also depicts all of the causes and effects of urbanization, thus all of the facts provided by this research will be useful in developing the concerns of this arrangement in my investigation (Onanuga, Eludoyin, & Ofoezie, 2022). It in turn enables the identification of temporal and spatial suburbanization, densification and urban development in the rapidly growing twelve largest Indian metropolitan areas (Chakraborty et al., 2022). The study begins by looking at Lahore's metropolitan plan and breaking point from a transportation and land-use perspective, familiarizing the reader with a top-down, sub-city-level assessment of the city (Zhao, Sun, & Webster, 2022). Another significant advantage of employing satellite distant distinguishing data is the accessibility of recorded archives that can be used to perceive and plan metropolitan development (Ettehadi Osgouei, Sertel, & Kabadayı, 2022). The multi-scale analysis is to identify the spatiotemporal urban pattern (Cheng, Wang, Yang, Xu, & Liu, 2021). However, over the last few hundred years and especially the last few decades this has not been the case (Slater et al., 2021). There has been a massive drift from the rural areas to the urban areas. uno’s world urbanization prospects contain forecasts concerning the population of urban and non-urban areas (Turner & Kaplan, 2021). Their data estimate that 4 of the 100 adults in the US had been diagnosed with asthma at the time of 2017 (Johnson et al., 2021). The world population is estimated at 1 billion and out of this population 46% was considered to be living in urban centers (Moreno-Monroy, Schiavina, & Veneri, 2021).

Between 1850 and 1950, significant changes occurred in urban development and expansion due to population shifts (van Mil & Rutte, 2021). Urban growth and expansion increased rapidly, particularly in Europe, and this wave eventually spread to Asian countries. Urban development reached its peak in developed nations around 1950 (Bhattarai & Conway, 2021). The urban network is becoming increasingly dense and widespread across the region (Moreno-Monroy, Schiavina, & Veneri, 2021). In general, a mass shift in land use is a direct result of the growing interest in the non-developing district as a hero among the most fundamental and primary thrusts of metropolitan and corporate development, with the industrialization of industrialization being the most important stimulus (McGee & Mori, 2021). The population is important since it is used to examine metropolitan events and the nature of adjacent environments (Imbrenda et al., 2021). The writer chose Lahore, Pakistan's second largest metropolis (Nadeem, Aziz, Al-Rashid, Tesoriere, Asim, & Campisi, 2021) Lower treatment, longer future with monetary geographic mobility.Regardless, despite constant monetary and money-related constraints, Pakistan's Provincial and Federal governments appear to be essentially committed to organizing mass travel associations (Shafi, Jan, & Manzoor, 2021). Pakistan, based on a period approach satellite image dating back to 1972. The current study aims to analyze and comprehend the metropolitan land use shift in Lahore from 1972 (Abdullah, 2023). Over the last thirty years, Lahore's metropolitan region has seen tremendous growth. findings revealed that the Lahore metropolitan region has grown by 68 percent from 1972 to 2009(Abbas & Wakil). Remote sensing information is the primary source for seeing urban development and arranging produced locales, basically confirming satellite remote distinct design for various reasons (Bennett, Koeva, & Asiama, 2021).It provides a broad and compact perspective on massive urban areas that are officially unfathomable to cross vital field inspections (Ratcliffe, Stubbs, & Keeping, 2021).

2. Materials and Method

Multan is the major metropolitan city of the southern Punjab. The geological area of Multan city is 29.56^0 latitude north and 71.22^0 longitudes east. Political wise Multan situates in the region that is profoundly populated territory of Pakistan. The population of Multan city is 2,059,534 in 2021. Growth rate of Multan city is 2.21% in 2021 Territory of Multan city is 110 square miles. Multan is the division and regional head quarter of Punjab. There are four tehsils of Multan city. Multan city, Multan sadder, Sujaabad and Jalalpur pirwala. Metropolitan Areas; Multan Cantonment, Multan Corporation, Mukhdom Rasheed and Qadirpur Rawan. These all spread the land district illogical on account of some explanation. Multan city is profoundly urbanized territory of the Multan district. Multan city comprise of 68 association chambers and brimful with metropolitan populace. The city of Multan is located at an altitude of 423 feet above the sea level. The prefix or dialing code for Multan city in telephone association is 061. Time zone is +5GMT. Multan is a city in the Multan District of the Punjab Province in the Pakistan. It is located in the south central zone of the province and the area as a whole is steeped in history. It is reported that the latest population size of this city in the 1998 population census population stood at about 3. The population of Faisalabad is estimated to be around 8 million people it is therefore considered the seventh largest city in Pakistan. It is sited on the right bank of the Chenab River, nearly in the mid of Pakistan and 966 K.m away from Karachi. Multan is also referred to as the 'City of Pirs and Shrines' that is today a city of markets, mosques, holy shrines, and beautifully built monuments of the dead. Multan International is an important airport that provides connection to most of the Pakistan's domestic destinations and the few locations in the Persian Gulf.

Figure 1: Study Area



2.1. Data collection

Landsat satellite symbolism is the essential wellspring of information given its fleeting goal and free accessibility. Altogether, 5(five Landsat satellite pictures were gathered for this exploration. Essential information is procured all the way through multi-sources and satellite images from 2000 to 2020 gave the information source to the spatiotemporal investigation of the review. For the years 2000 to 2020, Landsat 7/ETM+ and Landsat 8/OLI TIRs images are used to assess metropolitan development and subsequent changes in land use. These Landsat images were obtained and downloaded from the US Topographical Survey database base and the Global Land Cover Facility (GLCF) website (glcf.umiacs.umd.edu), respectively. as indicated by the reasonableness and accessibility because of overcast cover (the satisfactory overcast cover ought not to be more than 10%). GLCF aids in understanding the natural framework fittingly giving geology information and its items.

2.2. Secondary data

Population statistics are applied to analyze the connection between the expansion of the research area and density of the population. This is because of anthropogenic activities and Multan's urban earth, densely populated localities and industrial sites in the study area probably have. From the population of Pakistan census organization 1998 to 2017 and the Punjab Development statistics from 1998 to 2017, the Pearson's correlation test of urban expansion in relation to the population size was conducted. The data analyzed is from the same period as the study thus it is considered current data. This paper uses statistical data gathered from prior Pakistani censuses ranging from 1998 up to 2017. The research includes the course of satellite pictures to gain exact, fundamental, and definite data on the Land-use variety that the world's surface climate is going through. The examination technique can be sorted into three principal segments;

1) Data assortment and pre-handling,
2) Data handling and
3) Data examination.

3. Results

Table 1: Band combinations in RGB comparisons

Image	Natural Color	False Color (RGB)
		R: 4
Landsat 7	R: 1	G: 3
	G: 2	B: 2
	B: 3	R: 5
Landsat 8		G: 4
		B: 3

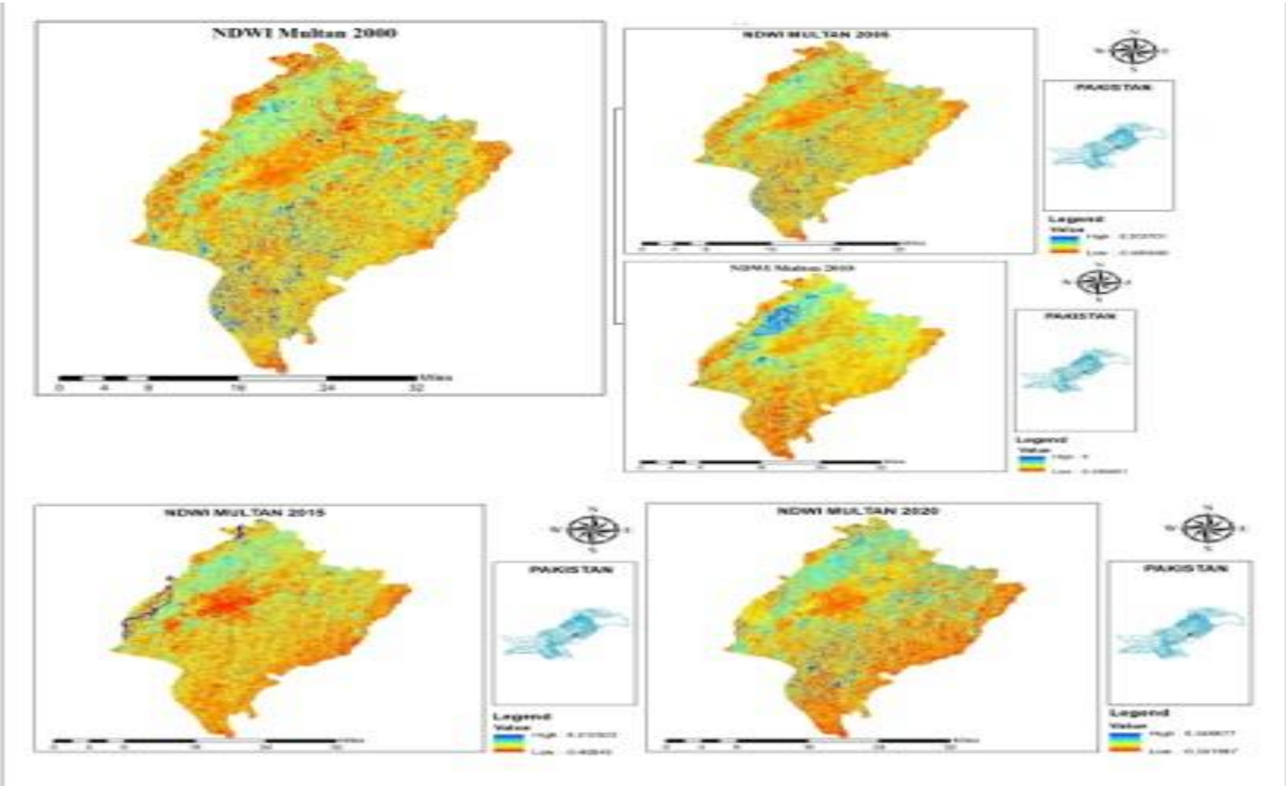
Source: http://landsat.usgs.gov/L8_band_combos.php

Table 2: Shows census year, inter-sectional increase and density of Pakistan from 1951 -2017

Year	Population	Census Date	Interval (year)	Inter Sectional Increase (%)	Density (sq km)
1951	33740190	28 Feb 1951	-	-	42.38
1961	42880621	31 Jan 1961	10	27.09	53.86
1972	65309543	16 Sep 1972	11.5	52.31	82.03
1981	84253644	01 Mar 1981	8.5	29.01	105.83
1998	132352279	02 Mar 1998	17	57.08	166.30
2017	207774520	25 May 2017	19	19.25	260.99

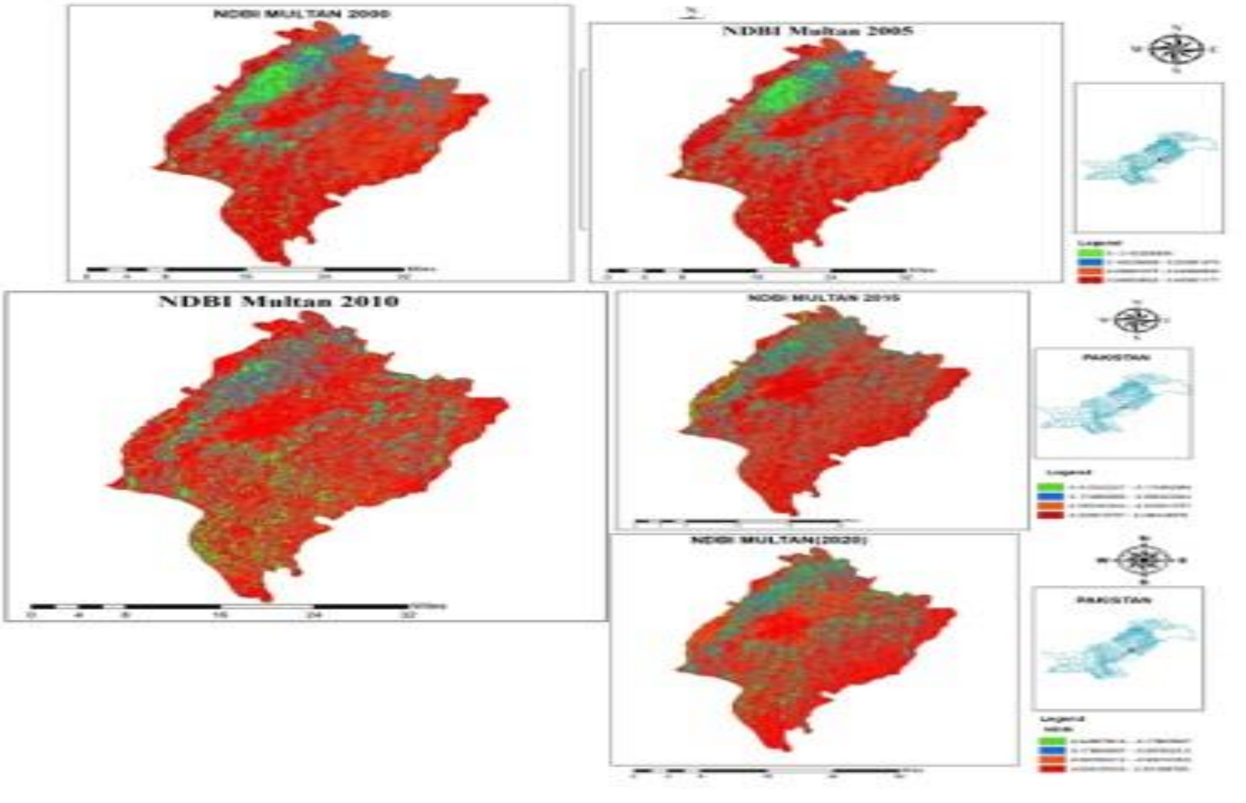
Pakistan statistical year book 2017. Islamabad: Federal Bureau of Statistic, Pakistan.

Figure 2: NDWI Multan 2000-2020



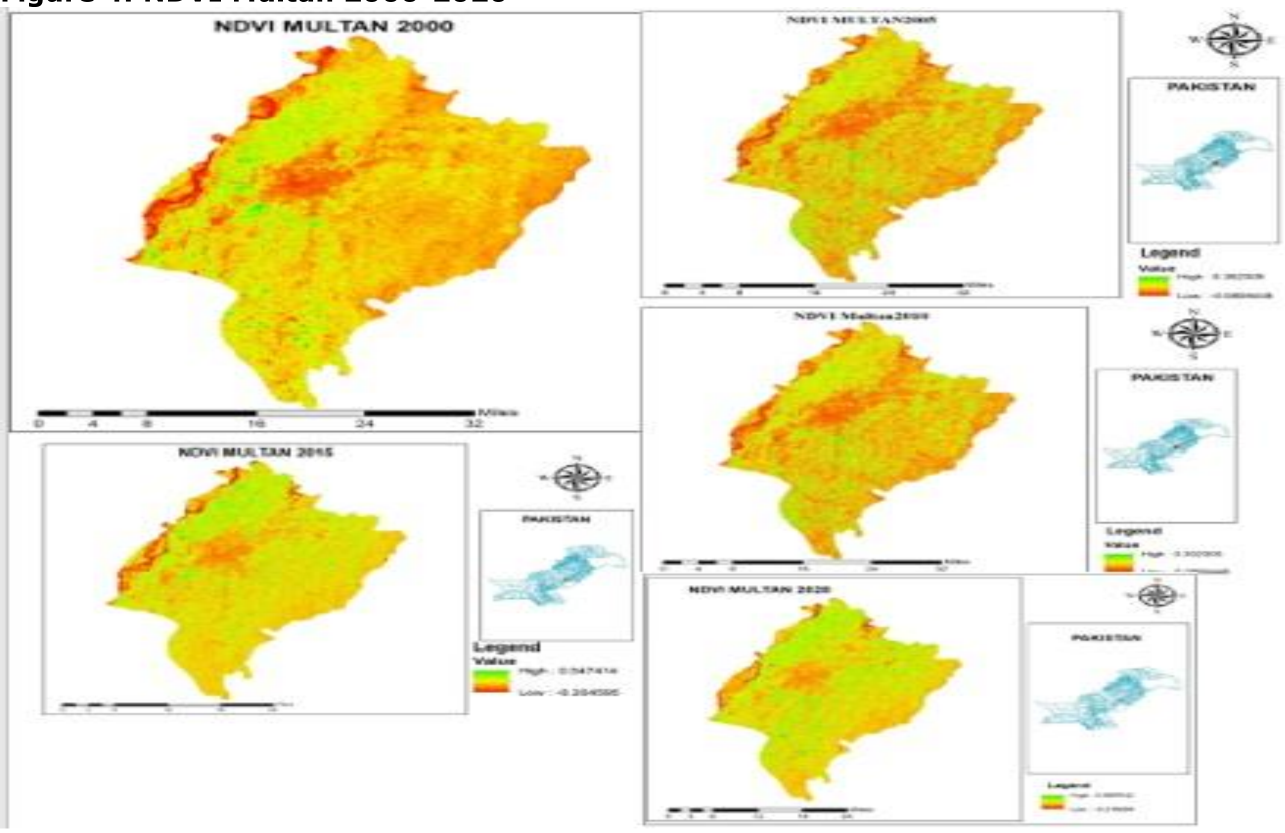
The map of Multan produced by the NDWI in 2000 employs the color ramp feeling to portray water intensity. Shades of blue represent areas with a greater amount of water implying water bodies. The red areas should be considered as negative values where means no water is available. Other land cover types are represented by yellowish colors and can encompass vegetation, or built-up land. This is informing on the particular color scheme that is used to distinguish between water bodies and the rest of the land class. In the 2005 NDWI image for Multan, the same color ramp is used: From blue to red. Light blue corresponds to areas that are fully covered by water and red to areas without water (negative values). The other objects on the land are represented by yellowish colors; they could be parts of vegetation or built-up areas. By reducing to blue color, such an indication points to the presence of other forms of substances other than water. In greater detail, dark yellow mostly covers such areas as built-up areas. The NDWI image for the year 2010 has the blue to red progression also. A single bit prod means blue areas for water-positives, which will be positive values, and red areas for no water or negatives. All other land cover types are represented by yellowish colors; dark yellow for the built-up areas, and light yellowish for vegetation. This color ramp assists in separating water bodies, vegetation and built up areas. Regarding the same color scale for the NDWI image of Multan, it is also remained same in the year 2015. Water bodies including oceans are colored blue, non-water areas are colored red while areas with land-cover other than water bodies are dyed yellowish. Also as in previous years, dark yellow means built-up areas while the lighter yellowish hues mean vegetation. Their consistent color ramp helps in the determination of the changes in water coverage and the use of land over time. The same blue to red spectrum color Composite is applied for the image of NDWI of Multan for the year 2020. Old blue color defines areas with higher water content; the shades of red define negative values – no water. Other land cover types include vegetation and built-up areas represented by yellowish colors. Thus, dark yellow is for built-up areas, and lighter yellowish shades are for vegetation. To my mind, the general idea of this color ramp can help to visualize changes in water and land usage conveniently. All the NDWI images from 2000 to 2020 of Multan use a similar blue to red color ramp to represent the intensity of water and the type of land cover. Blue represents water surface; red areas represent non water areas while yellowish colors represent vegetation and built-up areas. The consistency created here enables simple comparisons and interpretations of changes in the water coverage as well as the land use.

Figure 3: NDBI Multan 2000 to 2020



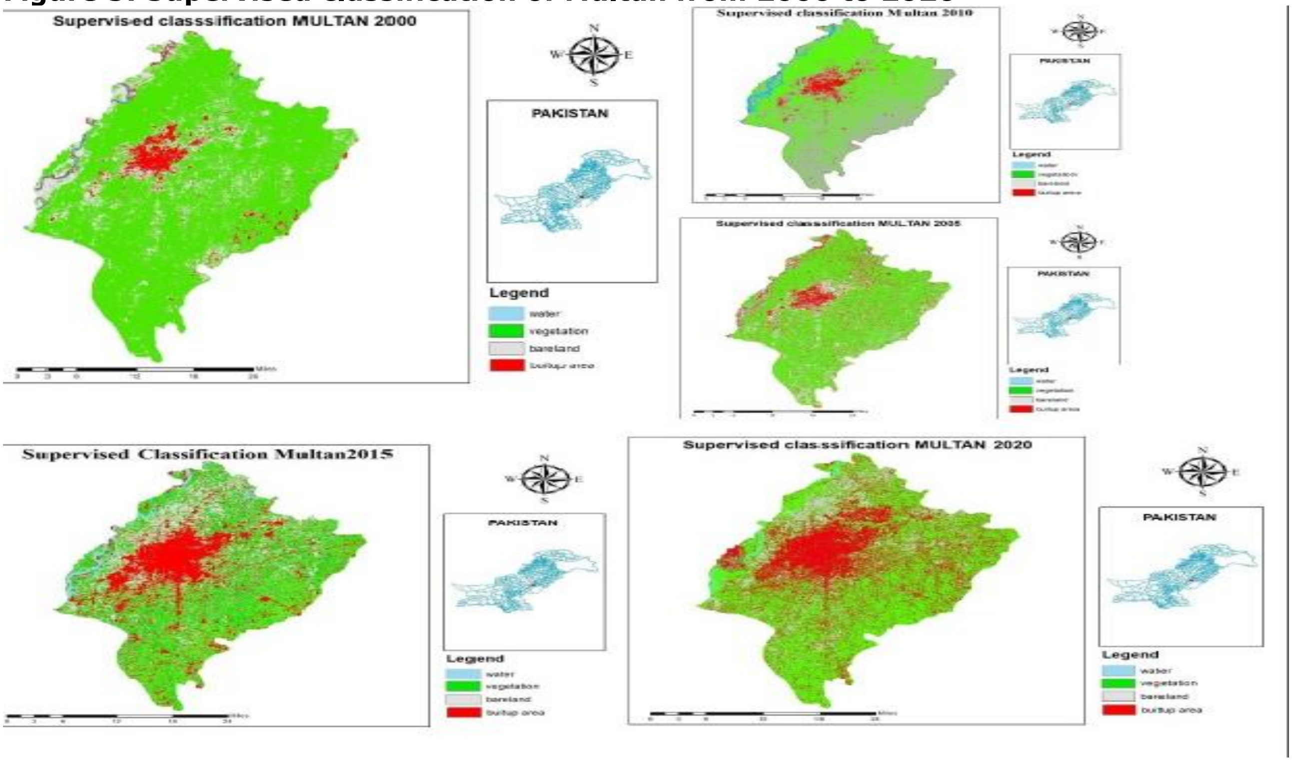
The above figure is the NDBI of Multan city computed for the year 2000 data of Landsat-7. Four colors represent the results: green signifies the areas that are heavily built up, blue represents the areas with moderate areas of construction and red represents vegetation. Analyzing the results, it is revealed that the analyzed area has been mostly characterized by the presence of vegetation. Likewise, the figure for 2005 is based on the data gathered from Landsat-7 concerning the NDBI of Multan. Here, red implies the lowest level of constructions, green depicts areas of highest constructions, while blue employs a low level of constructions. According to the results the vegetation cover the most part of the territory in 2005. Arising from the 2010 figure analysis, Landsat-7 data is used for the analysis. Red indicates that the area has fewer structures; green demonstrates that it has lots of structures; and blue means it has a few structures. This paper shows that the current state of the area in 2010 showed that vegetation cover is still dominant, but built up area has expanded as recorded in earlier records. In the case of NDBI of Multan for the year 2020, data of Landsat 8 was utilized. The figure also paints dark red for most built-up areas, yellow for less built-up land, and green for water body such as river. From the following results it is clear that vegetation cover has reduced over the years but is still high as the built up area has also gained ground over the years. The above figure depicts the predicted NDBI for Multan for the year 2025 on the base of the image dataset of Landsat-8. The darkest red refers to the areas where construction is prominent most, yellow portrays moderate construction, and the green portrays the water area. The outcome of the results indicates that this aspect of the earth's surface will further be characterized by built up areas as the vegetation cover still occupies a fairly large extent. Analyzing the NDBI data of Multan from the year 2000 to the year 2020 based on the Landsat-7 and Landsat-8 data confirmed the escalating built-up land state. Despite this, vegetation occupies a substantially large part of the area, however the built up area has increased over the years.

Figure 4: NDVI Multan 2000-2020



The graphic shown above indicates the NDVI analysis of Multan of the year 2000. Vegetation is green and as the extent of vegetation reduces, the color appearance moves to reddish and gradually to dark red. Black patch shows no vegetation cover at all. In 2000 vegetation cover was 36 percent and the loss has continually been rising till today. 41% territory of the republic. The NDVI results in this case for the year 2005 presents green color as representing the vegetation cover and as vegetation cover reduces it turns to reddish color and darkest red color as evident from the results presented below. Blank areas are depicted in dark red which signifies that there are no vegetation resources in these areas. In 2005, vegetation covered 39%. 34% of the area having improved from 2000. The figure for 2010 follows the same color scheme: green representing vegetation cover and as the color fades to reddish then to dark red, it means less vegetation cover or none at all. Thus, the area of vegetation cover declined to 29 hectares by year 2010. Thus, the level of utilization of the areas acquired was determined to be as follows: 49% of the total area. The analysis of the NDVI of 2015 also employs green color, indicating vegetation; the colors shift to reddish and dark red as vegetation diminishes. Thus, vegetation occupied 28 % in 2015 and it showed that year was barren throughout the year 2015. 33% of the total area, persistent with 2010's declining tendency. Thus, similar to the analysis of the NDVI for the year 2020, green corresponds to vegetation, while reddish to dark red points to less or no vegetation. According to the global monitor of 2020, a decrease in vegetation coverage was noted and it was 22 percent only. 2% of the total area; however, this has shown a decreasing trend over the years. This then generated the NDVI series of south Asia and specifically Multan for the year 2000 to the year 2020, which reveals a reduction in vegetation cover. Starting at 36. The vegetation coverage elevated from 41 % in 2000 to 39 in the assessment done in the year 2006. In 2005, the percentage was 34, and in 2007 it was recorded to have gone down to 29. 49% in 2010, 28. 33 percent in 2015 and to 22 percent in 2016/2017. 2% in 2020. This is due to the fact that the vegetation colors mapped throughout these years remain green, while the progressive trend shifts to reddish and dark red colors in the regions with less or no vegetation assists in visualizing the changes.

Figure 5: Supervised classification of Multan from 2000 to 2020



This study for the first time delineates the supervised classification of Multan from the year 2000 to 2020 with the help of Landsat-7 and Landsat-8 data illustrating the changes in the land cover of the city. As the records cited in the year 2000 reveals that water bodies occupied 4.The above data indicates that in the year 2000 the appropriation of water bodies only comprised 4. F Lorenz, PG Annino, R Pedrozo, and JFR Rueda 92% of the area vegetation 36% 41 pct, bare land was 27 pct. Percent of forest cover reduced to 74.77%, while built up areas constituted of 31. 59%. Thus, by the end of 2005 the water coverage slightly declined to 4. 34%, vegetation enhanced to 39%. 34%. Pursuant to the fireplace zoning plan the bare land was reduced to twenty-four. 02%, while nice areas' participation was slightly up by 32. 28% of the depot with the compacted heavily populated urban centre of the city in the middle part of the city. In 2010 land and water bodies grew greatly to comprise 12ografie percent of the total area. 03% of the area, and vegetation reduced to 29 percent of the area, respectfully. 49%. Bareland also declined to 21. 'Same day coverage increased to 95% and built up area increased to 36. 52%. The pattern of growth of built-up areas was maintained in 2015 though water sources occupied 7. 100% as people's settlements reducing to 59%, and vegetation decreasing to 28%. 33%, and bare land is even lower and reaches the figure of 14 %. 78%. In the built-up areas big increase was recorded with an area of 49. The selected sites combined constitute 45 percent of the total geographical area of the county. According to data, it was assumed that the water coverage reduces by 2020 to 6. IP-fixed telephones: By 2020, the fixed telephones decreased by 0. To cultivated land, it assigned 55 % and to vegetation 22.2%. Other categories also reduced to the following, bare land 11. 05% of the state's total geographical area, appreciable growth in built up areas was observed as they extended over 60 percent of the total geographical area of the state. woning with an extent of 2 per cent of the total area. This continuous urbanization defined the conversion of vegetated &bare lands into built-up regions, thus depicts the growth & expansion of Multan city over the two decades. The stable color codes used over the years are blue for water, green and gray for different types of vegetation, and red for the built-up areas which have also helped greatly in visualizing such transitional changes.

Figure 6: Graph showing change detection in city Multan in past 20 years from 2000 to 2020

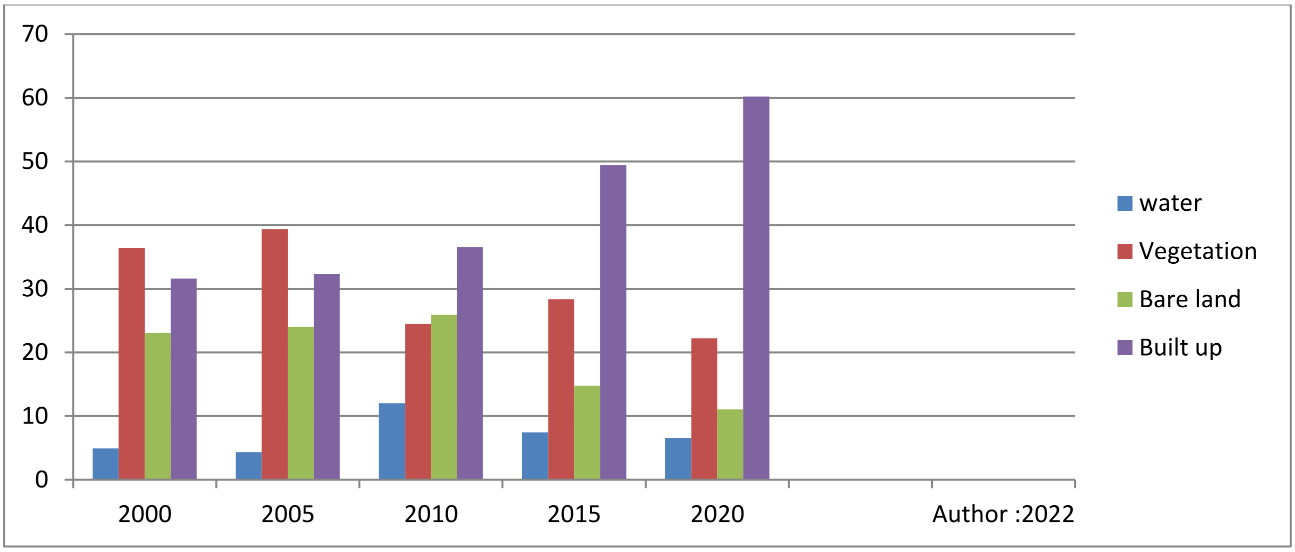


Table 4: Accuracy assessment of LULC

LULC	Ground reference data Built-up	Bare soil	Vegetation	Cultivated area	Total	User Accuracy (%) D.V/Total*100
Builtup	42	3	2	0	47	89.36
Bare soil	5	26	0	1	32	81.25
Vegetation	2	1	15	1	19	78.95
Cultivated area	1	0	3	8	12	79.67
Total	50	30	20	10	110	
Producers Accuracy (%) D.V/Total*100	84.0	86.7	75.0	80.0		82.72

Based on the provided table, the producer's accuracy for built-up areas is 84%, with a user's accuracy of 89.36%. The highest producer's accuracy in land use and land cover classification was found in bare soil at 86.7%, while vegetation had the lowest at 75%. In terms of user's accuracy, built-up areas also ranked highest at 89.36%, and cultivated areas had the lowest at 66.67%. Overall classification accuracy was calculated at 82.72%, with a Kappa coefficient of 0.74, indicating substantial agreement in the classification results.

4. Discussion

The researcher also aimed at establishing the importance of land cover planning using aspects of digital classification and accuracy assessment of classifications. The first part describes the methodology of land cover changes by using unsupervised and supervised classifications. The results obtained from the process of the unsupervised classification were rather disappointing due to the fact that the area could not be classified clearly in terms of the level of urbanization (Dolui & Sarkar, 2024). Thus, the study used the supervised classification procedure, elaborating on the sources and methods of the training data, label separability, and the modified classification system of Anderson and others. Herein, the data application and analysis in the entire related area and separately for each layer of the study area explained different classifiers along with the supervised classification; nevertheless, the Maximum Likelihood classifier proved to be the most efficient.This paper applied remote sensing to analyze the growth and expansion of Multan city during 1998 to 2020 in terms of area, location and rate of change The combination of GIS and remote sensing method proved to be an effective way to identify urban growth and expansion .(Anand & Deb, 2024)This study identified a significant change in Multan's land use from 1998 to 2020 with average growth rate of 4. This prevalence rate was slightly lower in the built-up area at 46%. Rapid urbanization of Multan rendered apace with the growing population in the city (Ullah, Hussan, Khan, Khan, Junaid, & Muaz, 2024).

According to the study, there was a significant growth of urban expansion eradicating non-urban crown lands including rurality, agriculture, and forests necessary for modulating the thermal nature of Multan's urban land. Classification of REMS images gave a systemic portrayal of the urban growth and monumental thermal transformations concerning its nature, areal coverage, rate, trends, and locations. This scenario of fast growing Urbanization in Multan can be ascribed to speedy economic and industrial growth and the increasing populace of the urban city caused by migration from rural areas (Hassan et al., 2024). The study appreciates the actual historic data for land cover and land use change at the district level. It is seen that enhanced planning methodologies and precise preliminary data are central to the effective utilization of land resource. Accordingly, the authors proposed similar land use surveys conducted at several time intervals to evaluate the effectiveness of the carrying out of land conservation polices and aid similar future studies (Yu et al., 2024). Global analysis of land cover was done using medium resolution imagery from Landsat MSS and Landsat TM (Radeloff et al., 2024). That is why the imagery from the systems such as SPOT, IKONOS or GeoEye could give the more accurate rates of the changes in land. This meant that the study employed major land cover classes and shed light into the changes in the rate of extension or reduction of the size of area under agriculture, forests and the built up areas in the last forty years. As for the variables to be determined, the Medicare databases could provide the figures at the union council level for plot position, crop type and plantation density and also quality visuals for plotting the agricultural and deforestation rates. The method applied in this research to map constructed regions is most suitable for little sized areas. In the approach, the population census data is then incorporated in the study with the help of GIS overlay tools. Standard methods for classification of LU patterns and HD & LD buildings will facilitate comparable assessments across the regions (Nguyen, Fukuda, & Nguyen, 2024).

Many more studies are still required for adequate understanding on Rural-urban and Urban migration. Further, it has been identified that the studies on the nature of push and pull factors that influence the migration movement should be integrated in the subsequent population studies. The study also highlights the challenges of relying on traditional census periods due to significant temporal gaps in acquiring and publishing population census data in Pakistan (Rasheed & Louca, 2024). The study recognizes that key population variables can be inferred from the extent of built-up land. Numerous authors advocate for global settlement mapping and population estimation through remote sensing, including night-time imagery showing emitted (anthropogenic) light. Visual imagery can also provide detailed land cover information, offering a consistent method for estimating and depicting population trends (Morford et al., 2024). The government of Pakistan spends substantial amounts on surveying agricultural, forest, and barren lands. Future studies could involve land cover change assessment using satellite data to verify manual records. The study also notes that district governments often fail to implement policies due to a lack of planning, leading to the illegal establishment of private estates and industries. High-resolution satellite data could assist in updating records and categorizing urban areas according to their land use for monitoring and future planning (Li, Chen, Wu, Su, Chen, & Xu, 2024).

5. Conclusion

The Study evaluated the urban growth in Multan from 1998 to 2020 based on the remote sensing and GIS analysis to determine the urban growth rate and direction. During this period, the developed area of Multan was expanded significantly which was mere 47. 4 km² in 2008 to 70 it had and increased from 4 km² in the year 2008 to 70 km². 3 kilometers squared in 2018, implying on an annual growth rate of 4 percent. 46%. This growth was coupled with a very high population increase from 1, 197,384 in the year 1998 to 1, 871, 843 in the year 2020. The major factors for this growth include mobility, particularly from rural areas to urban areas, as well as an enhancement in the economic and industrial sectors. Land use changes were noted equally high not only regarding urban areas but also with other areas including agricultural and forested areas which have been transformed into urban uses. Such change has conveniently affected the thermal profile of surface in Multan space. The review also mentioned the fact that while the urbanization has benefited the economical development and has enhanced the socio-technical infrastructure, it has at the same time imposed a burden in the form of pollution and alteration of ecosystems. The unplanned growth of the urban built environment, especially in the northern part of the city because of the expansion of new home and business sectors, point strongly towards ideas of sustainable urban development and management.

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