Journal of Positive School Psychology http://journalppw.com
2023, Vol. 7, No. 6, 1243-1253

Determination Of Demographic Change And Urban Settlement Pattern In Multan City, Pakistan

Muhammad Hashim[1], Atta-ur-Rahman[2], Muhammad Qasim[1] Muhammad Umar Farooq[1] Basit Nadeem[3] Shazia Muneer[4]

1. *Ph. D Scholar, Department of Geography & Geomatics, University of Peshawar*
2. *Chairman, Department of Geography & Geomatics, University of Peshawar*
3. *Incharge, Department of Geography, Bahauddin Zakariya University Multan*
4. *Department of Epidemiology and Public Health, University of Veterinary and Animal Sciences Lahore.*

Corresponding Author: hashimgeog@uop.edu.pk

Abstract:

The temporal enhancement in population and spatial changes are part and parcel of each other. The population composition and structure of Multan reflect the city's diversity and complexity, as well as the broader social and cultural dynamics. In terms of settlement pattern the city is characterized by a mix of urban and sub urban areas. Required data was collected from the Pakistan Bureau of Statistics. This study investigates the shifts in population density and spatial distribution of settlements in Multan City by utilizing spatial population data from the census years between 1951 and 2017. High rate of demographic change directly impacts on urban settlements. Population increase required more infrastructure, more amenities, and more residential areas. The settlement pattern of Multan changed from time to time. Four Landsat images; 1993, 2003, 2013, and, 2023 were downloaded from the (USGS) official website. After the classification of these images urban areas were extracted in a GIS environment. Multan City is characterized by a dense and compact urban fabric with narrow streets and high-density residential and commercial buildings. Multan City has developed as a radial type of settlement. In Multan, leapfrog development can be seen in areas such as Gulgasht Colony, which is located on the southern edge of the city. The urban area in 1993 was 183.6 km^2 which increased to 630.7 km^2 in 2023.

Keywords: Population composition, Population density, Spatial Changes, Spatial distribution.

1 Introduction

Population settlement in Asia is diverse and complex, varying greatly across the continent. High population density, limited urban services, insecurity, and informal housing are common features of poverty-related informal settlements in the Asian continent (Wilson et al., 2005). The continent is marked by the presence of informal settlements, characterized by high population density. The living conditions and general well-being of the residents of these informal settlements are severely hampered by the interaction of these elements (Leimbach et al., 2017). To address this, we examine whether models based on demographic factors can be utilized to explain past income growth and predict future economic expansion by incorporating population projections (Yol et al., 2006). Despite the fact that demographic variables are influenced by economic development, they are predominantly predetermined, offering demographic projections

that are considerably more reliable than any forecasts based solely on economic variables (Bunch et al., 2015).

As mortality and fertility rates decline, populations are inevitably, affecting both developed and developing countries (Clark & Cummins, 2009). The consequences of this demographic shift on future income growth are crucial for economic policymaking, yet they remain largely unexplored (Porter & Donthu, 2006). To shed light on this issue, we investigate the potential of demographically-based models to analyze past income growth and make predictions about future economic expansion, incorporating population projections (Ramineni & Williamson, 2018). Although demographic variables can be influenced by economic development, they possess a significant degree of pre-determination. This demographic inertia is leveraged in demographic projections, resulting in forecasts that are notably more dependable than those relying solely on economic indicators (Van-der-Aa et al., 2011).

Consequently, utilizing demographic projections as independent variables to predict economic growth shows promise as a viable approach (Stover et al., 2010). There are two main approaches for analyzing the interaction between demographic trends and long-term growth prospects. The first approach involves constructing theoretical models to gain a comprehensive understanding of the mechanisms driving the growth process, either qualitatively or quantitatively (Vespa et al., 2018). On the other hand, the second approach takes a neutral stance regarding the specific mechanisms at play; it examines empirical relationships between demographic variables and income per capita growth using recent data and extrapolates growth rates based on demographic projections (Jiang & Hardee, 2014).

Examining Sweden is highly relevant, not only due to its typical demographic transition but also because of the availability of excellent demographic data dating back to the mid18th century (Carson et al., 2016). Furthermore, per capita GDP estimates are also accessible from the 18th century onwards. It utilized these long-term data to calibrate a growth model based on demographic factors. The objective was to replicate the process of economic take off and the subsequent increase in growth rates, transitioning from stagnation before the 18th century to a growth rate of 2% in the 20th century (Lesthaeghe, 2010).

This research primarily focused on leveraging spatial features and spatial metrics to identify unplanned settlements, utilizing remote sensing data (Herold et al., 2005). Spatial metrics, an expanding field in urban applications, emphasizes that the combination of spatial metrics with remote sensing can offer more consistent and detailed information on urban structure and changes than either of these approaches individually (Saura & Castro, 2007). Originally derived from landscape ecology, 'landscape or spatial metrics' have seen significant growth in applications with remotely sensed data (Wang et al., 2010). However, they have not been widely utilized in the image classification phase, mainly because it was believed that spatial metrics could only be applied to classified images (Taubenböck et al., 2009). Nevertheless, the only requirement for its use is the presence of homogeneous regions (patches) (Schwarz, 2010). Although extensively used in urban applications, there is still no standardized set of spatial metrics that is universally agreed upon for urban analysis (Herold et al., 2003). The fundamental information that can be extracted from an image is the segmentation of homogeneous regions, which serves as the initial step in image analysis and pattern recognition (Chin, 2006). Notably, a distinction exists between complete segmentation, which extracts real-world objects, and partial segmentation, which is used as input

for further image (Durand-Lasserve & Royston, 2002).

2 Methodology

2.1 Study Area

The present study is focused on Multan city, which has been selected as the study area. Urbanization is rapidly expanding in Multan, making it the third-largest city in terms of area and the seventh-largest city in terms of population in Pakistan. The geographical coordinates of Multan city, as per the Pakistan Bureau of Statistics, lie between 71.265° to 71.835° East Longitude and 29.792° to 30.457° North Latitude. Positioned on the left bank of River Chenab, Multan benefits from the fertile silt deposited by the river, making it renowned for its lush mango orchards. Additionally, Multan serves as a major industrial and commercial hub, strategically located in Punjab's south-central region with well-developed air, rail, road, and motorway connections to other significant cities such as Islamabad, Faisalabad, Rawalpindi, Karachi, Lahore, and Faisalabad.

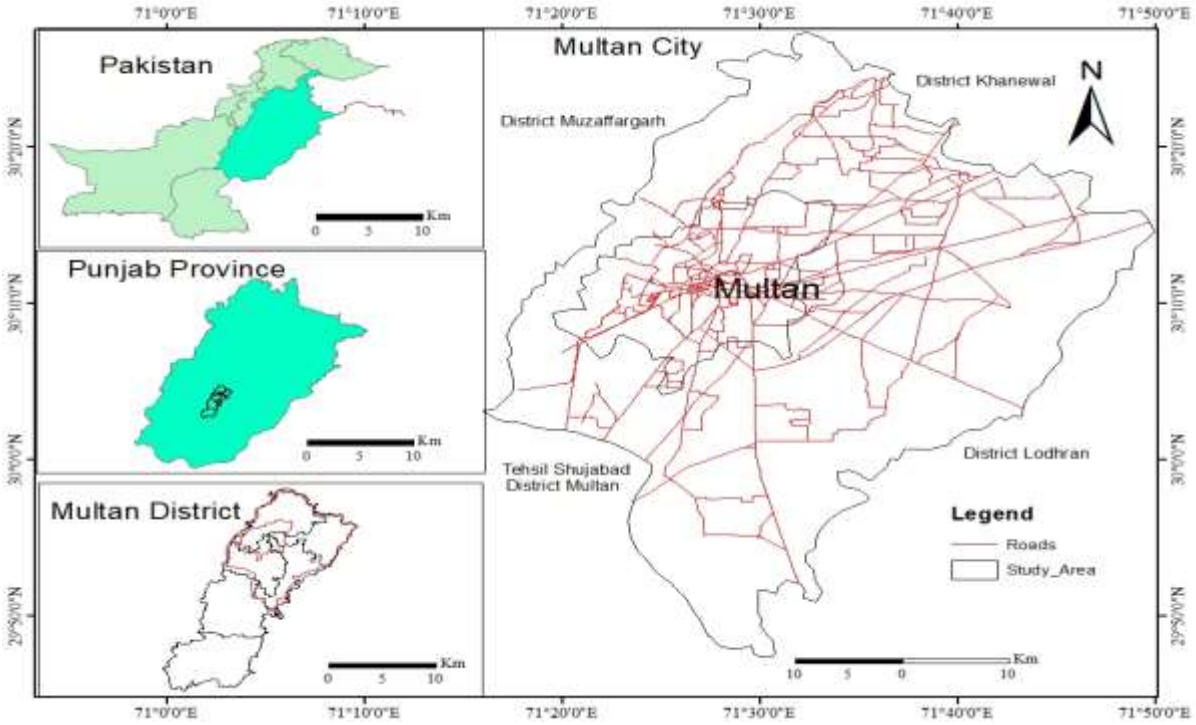

Figure 1 Location of the Study Area

2 Data Collection

The road and rail network is digitized from already published maps and high resolution images. Spatial data related to urban land use, urban set-up and amenities is obtained from Multan Development Authority. Population data containing the required data of census is collected from the Pakistan Bureau of Statistics (PBS). Similarly, data on real estate values is obtained from the Revenue Department. In addition, Landsat satellite images of 30 meter spatial resolution is downloaded from USGS official website. Settlement patterns are extracted from Landsat imagery using geospatial packages (ERDAS Imagine and ArcGIS).

3 Results and Discussions

3.1 Demographic Settlement of Multan

The demographic composition of Multan is constantly evolving, as the city continues to grow and attract new residents from across Pakistan and beyond. As a result, the city's social and cultural fabric is diverse and dynamic, reflecting the complex and multifaceted nature of urban life in contemporary Pakistan. The population of Multan is made up of people from a variety of ethnic and linguistic backgrounds. The majority of the population is Saraiki and other languages spoken in Multan include, Punjabi Urdu, and English.

In terms of settlement patterns, the city is characterized by a mix of urban and rural areas. The central parts of the city, including the area around Multan Fort, are densely populated and highly urbanized, with a mix of residential, commercial, and industrial land uses. The outer parts of the city, however, are more rural in character, with agricultural land and small villages scattered throughout the surrounding countryside.

3.2 Population Composition and Structure

Overall, the population composition and structure of Multan reflects the city's diversity and complexity, as well as the broader social and cultural dynamics of contemporary Pakistan. As the city continues to grow and evolve, it is likely that the demographic profile of Multan will continue to change, reflecting the ongoing transformations and challenges of urban life in the 21st century. The population of Multan is also characterized by a gender imbalance, with men outnumbering women in the city. This is partly due to cultural and social factors, as well as economic and employment opportunities that are often more accessible to men than to women.

3.3 Population Growth Rate and inter-sectional Increase of Multan city (1951-2017)

Multan city is selected for two reasons. First Multan is one of the fastest increasing cities in Pakistan. Second, Multan is located in the Southern parts of Punjab province, which is between the maximum vulnerable portions of Pakistan. The district Multan, which comprises Multan city is one of the largest administrative units in Punjab, it currently covers an area of 3720 square kilometers and has a population of nearly 3.1 million, 42% of which live in Multan city. Multan city had a population of 190,000 in first census 1951. Multan city had a population 1,197,384 in 1998 census. As a result of the last census Multan city population jumped to 1.87 million. In 1951, Multan had a population of approximately 190,000 residents, with a population density of 1429 individuals per square kilometer. Over the subsequent decade, from 1951 to 1961, the city experienced significant growth, with the population reaching around 358,000, indicating a growth rate of 5.22%. During this period, the density also increased to 2693 individuals per square kilometer, reflecting the expanding urbanization and population concentration in the city.

Between 1961 and 1972, Multan's population continued to grow, reaching approximately 539,000 residents, with a growth rate of 3.66%. The city's density further rose to 4052 individuals per square kilometer. The trend of population growth continued steadily, and by 1981, the population had surged to about 732,000, with a growth rate of 3.36%. The density also increased significantly to 5504 individuals per square kilometer. As urbanization accelerated, Multan experienced substantial population growth, and by 1998, the city's population had reached approximately 1,197,384, with a growth rate of 2.93%. The density escalated to 9002 individuals per square kilometer, signifying the city's expanding infrastructure and increasing population density.

By 2017, Multan's population had grown even further, reaching approximately 1,871,843, with a growth rate of 1.67%. The density had dramatically increased to 14074 individuals per square kilometer, indicating the city's transformation into a densely populated urban center. The table demonstrates the remarkable demographic changes that Multan city underwent over the decades, showcasing its steady population growth and the resultant increase in population density as it evolved into a bustling urban hub in Pakistan (Table, 1).

Table 1 Growth Rate and inter-censual increase of Multan city (1951-2017)

Census Year	Population	Growth rate %	Density (Per sq. Km)
1951	190000	-	1429
1961	358000	5.22	2693
1972	539000	3.66	4052
1981	732000	3.36	5504
1998	1197384	2.93	9002
2017	1871843	1.67	14074

Source: (GoP, 2022)

3.4 Urban Settlement pattern of Multan City

In recent years, Multan has experienced rapid urban growth, resulting in the development of new residential areas and commercial centers on the outskirts of the historic city. These areas are characterized by modern planning and infrastructure, with wide roads, large residential plots, and modern commercial developments. Overall, the urban settlement pattern in Multan is a mix of traditional and modern urban development, with the historic city core retaining its traditional character and the outskirts of the city embracing modern planning and development.

In addition to these three settlement patterns, Multan also has a number of informal settlements, which have developed over time on the city's periphery. These settlements are typically characterized by their lack of formal infrastructure and services, including electricity, water, and sanitation. Multan is a historic city located in the Punjab province of Pakistan. The urban settlement pattern in Multan is characterized by a mix of traditional and modern urban development.

The historic city of Multan is characterized by a dense and compact urban fabric with narrow streets and high-density residential and commercial buildings. The city has a traditional bazaar system, with each bazaar specializing in different types of goods. The bazaars are interconnected through a network of narrow alleys and streets, creating a vibrant and active street life. Types of settlements in Multan change with time to time from past three decades (Figure, 2).

The given map is the base map for this research in 1993. Rapid urban growth in Multan has led to the emergence of new residential areas and commercial centers on the periphery of the city, alongside its historic core. In the initial study period map, the built-up area within the tehsil city boundary is shown to be partially occupied. The density of settlements is concentrated in the central area of the city, characterized by a compact arrangement (Figure, 2).

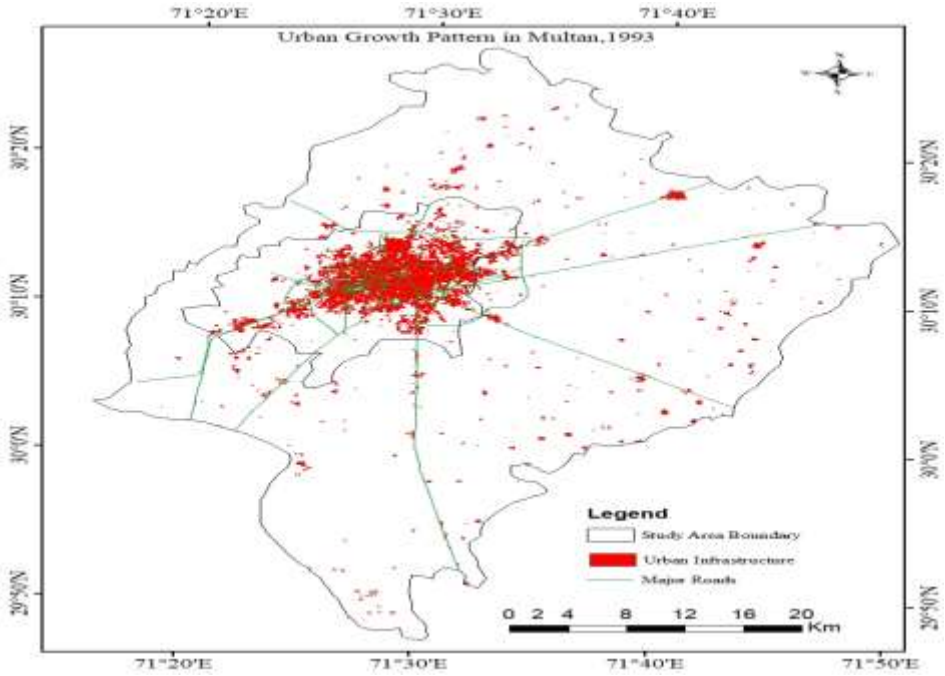

Figure 2 Urban Settlements in 1993

The Figure 3 show the settlement pattern of Multan is changed from time to time. In addition to the radial type of settlement around Multan Fort, there are also examples of leapfrog type of settlement in the city. Leapfrog development is a type of urban growth in which new development occurs in scattered locations on the periphery of the city, rather than filling in the gaps between existing neighborhoods. In Multan, leapfrog development can be seen in areas such as Gulgasht Colony, which is located on the southern edge of the city. Gulgasht Colony is a relatively new residential area that was developed in the late 20th century, and is characterized by its large, detached houses and spacious gardens.

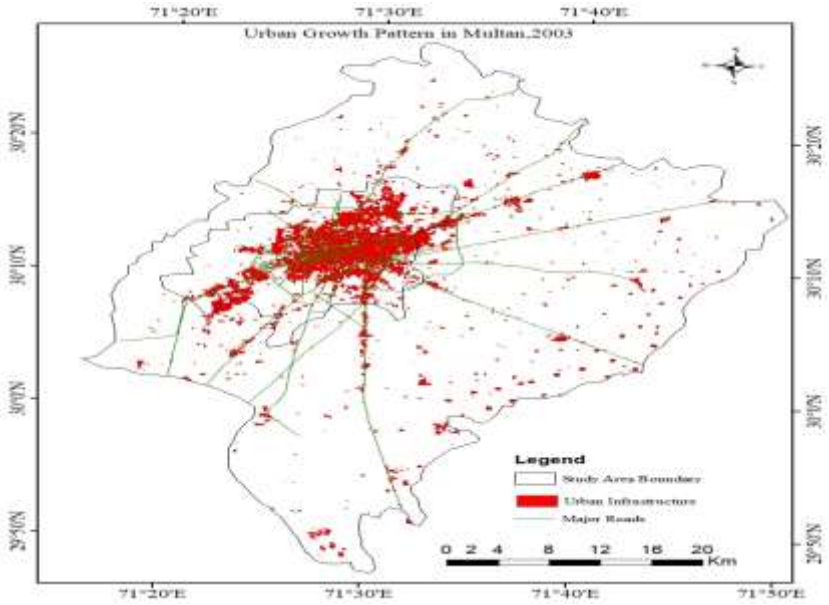

Figure 3 Urban Settlements in 2003

The outermost circle of the city contains newer developments, such as suburban neighborhoods and commercial districts. A radial type of settlement is a type of urban settlement in which the streets and buildings radiate outwards from a central point. This pattern is often associated with historical cities and towns that were built around a central fortress, religious site, or other landmark. A radial type of settlement can create a distinctive and recognizable urban form that reflects the historical and cultural context of a place. On the other hand, it can also lead to fragmentation and isolation, as well as increased travel times and environmental impacts. Overall, the mix of radial and leapfrog development in Multan reflects the complex and dynamic nature of urban growth and development in this historic and culturally rich city.

The given figure shows the settlement pattern in 2013 and the pattern of settlement is radial type. As you can see from the map, Gulgasht Colony is located on the southern edge of the city and is separated from the older parts of the city by a greenbelt area. This greenbelt was intended to preserve agricultural land and prevent the city from expanding too rapidly, but it has also contributed to the leapfrog development pattern seen in Multan. Leapfrog development can have both positive and negative impacts on a city. The figure intensely illustrates two distinct settlement patterns: radial and leapfrog types. A noticeable disparity can be observed between as the figure indicates that urban growth is not influenced by the road network. Conversely, the former map reveals that the presence of major roads has triggered urban expansion and altered the

settlement pattern. Notably, urban growth exhibits a gradual increase along key roads such as National Highway N-5, Multan Bahawalpur Road, Vehari Road, Kahnewal Road, Bund Bosan Road and Sher Shah Road.

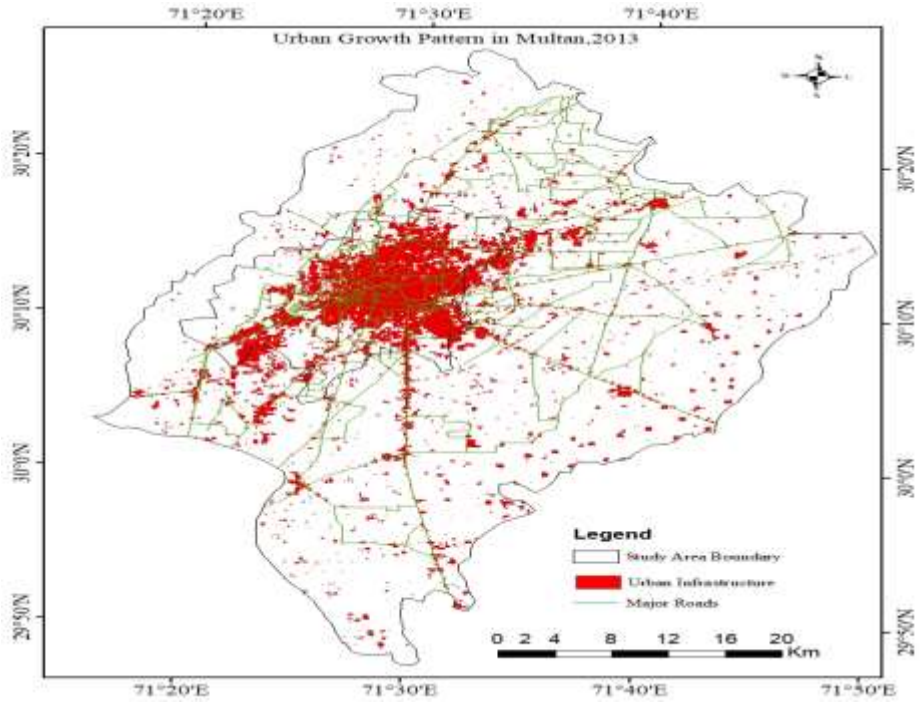

Figure 4 Urban Settlements in 2013

Gulgasht Colony is located on the southern edge of the city, DHA located northern edge and all other housing societies is separated from the older parts of the city. This greenbelt was intended to preserve agricultural land and prevent the city from expanding too rapidly, but it has also contributed to the leapfrog development pattern seen in Multan. Leapfrog development can have both positive and negative impacts on a city. On the one hand, it can provide opportunities for new housing and economic growth and can reduce congestion and other problems in the older parts of the city. On the other hand, it can also lead to fragmentation and isolation, as well as increased travel times and environmental impacts. Overall, the mix of radial and leapfrog development in Multan reflects the complex and dynamic nature of urban growth and development in this historic and culturally rich city (Figure, 5).

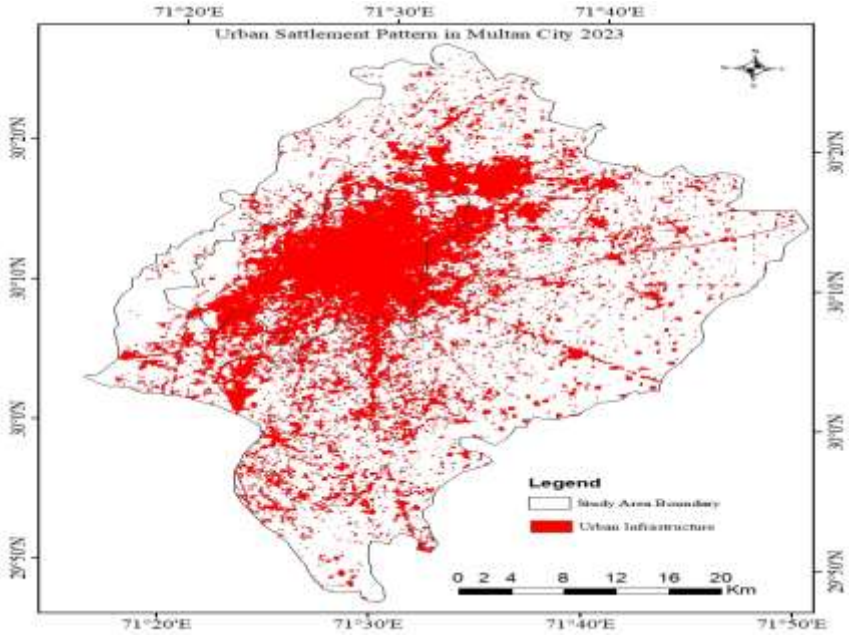

Figure 5 Settlements in 2023

4 Conclusion

The temporal enhancement in population and spatial changes are intricately connected phenomena. Multan's population composition and structure mirror the city's rich diversity and complexity, reflecting broader social and cultural dynamics. The city's settlement pattern is characterized by a blend of urban and suburban areas, highlighting its multifaceted nature. Data for this study was diligently gathered from the Pakistan Bureau of Statistics, enabling an investigation into the shifts in population density and spatial distribution of settlements in Multan City. Over time, the rapid demographic changes have directly impacted urban areas, necessitating increased infrastructure, amenities, and residential spaces.

The settlement pattern in Multan has undergone notable transformations. The study leveraged four Landsat images from the years 1993, 2003, 2013, and 2023, all sourced from the official website of the United States Geological Survey (USGS). These images were analyzed using Geographic Information System (GIS) technology, which allowed for the extraction of urban areas. Multan City exhibits a distinctive urban fabric characterized by density and compactness. Its narrow streets are lined with high-density residential and commercial buildings, underscoring the urbanization trends within the city. Furthermore, Multan City has evolved into a radial type of settlement, possibly indicating a central core from which development radiates outward. One observable phenomenon in Multan is leapfrog development, particularly evident in areas like Gulgasht Colony, situated on the southern fringes of the city. This form of development suggests discontinuous expansion and urban sprawl. Over the years, the urban area of Multan has expanded significantly. In 1993, it covered an area of 183.6 square kilometers, but by 2023, it had grown substantially to encompass 630.7 square kilometers. These changes underscore the dynamic nature of urban development and the challenges and opportunities it presents for city planners and policymakers.

References

Bunch, J., Clay-Warner, J., & Lei, M.-K. (2015). Demographic characteristics and

victimization risk: Testing the mediating effects of routine activities. Crime & Delinquency, 61(9), 1181-1205.

Carson, D. B., Carson, D. A., Porter, R., Ahlin, C. Y., & Sköld, P. (2016). Decline, adaptation or transformation: new perspectives on demographic change in resource peripheries in Australia and Sweden. Comparative Population Studies, 41(3-4).

Chin, N. N. G. (2006). Spatial analysis and the measurement of urban sprawl: University of London, University College London (United Kingdom).

Clark, G., & Cummins, N. (2009). Urbanization, mortality, and fertility in Malthusian England. American Economic Review, 99(2), 242-247.

Durand-Lasserve, A., & Royston, L. (2002). Holding their ground: Secure land tenure for the urban poor in developing countries: Earthscan.

Herold, M., Couclelis, H., & Clarke, K. C. (2005). The role of spatial metrics in the analysis and modeling of urban land use change. Computers, environment and urban systems, 29(4), 369-399.

Herold, M., Goldstein, N. C., & Clarke, K. C. (2003). The spatiotemporal form of urban growth: measurement, analysis and modeling. Remote sensing of Environment, 86(3), 286-302.

Jiang, L., & Hardee, K. (2014). Women's education, family planning, or both? Application of multistate demographic projections in India. International journal of population research, 2014.

Leimbach, M., Kriegler, E., Roming, N., & Schwanitz, J. (2017). Future growth patterns of world regions–A GDP scenario approach. Global Environmental Change, 42, 215-225.

Lesthaeghe, R. (2010). The unfolding story of the second demographic transition. Population and development review, 36(2), 211-251.

Porter, C. E., & Donthu, N. (2006). Using the technology acceptance model to explain how attitudes determine Internet usage: The role of perceived access barriers and demographics. Journal of business research, 59(9), 999-1007.

Ramineni, C., & Williamson, D. (2018). Understanding mean score differences between the e-rater® automated scoring engine and humans for demographically based groups in the GRE® general test. ETS Research Report Series, 2018(1), 1-31.

Saura, S., & Castro, S. (2007). Scaling functions for landscape pattern metrics derived from remotely sensed data: Are their subpixel estimates really accurate? ISPRS Journal of Photogrammetry and Remote sensing, 62(3), 201-216.

Schwarz, N. (2010). Urban form revisited—Selecting indicators for characterising European cities. Landscape and urban planning, 96(1), 29-47.

Stover, J., McKinnon, R., & Winfrey, B. (2010). Spectrum: a model platform for linking maternal and child survival interventions with AIDS, family planning and demographic projections. International journal of epidemiology, 39(suppl_1), i7-i10.

Taubenböck, H., Wegmann, M., Roth, A., Mehl, H., & Dech, S. (2009). Urbanization in India–Spatiotemporal analysis using remote sensing data. Computers, environment and urban systems, 33(3), 179-188.

Van-der-Aa, N., Kommer, G., Van Montfoort, J., & Versteegh, J. (2011). Demographic projections of future pharmaceutical consumption in the Netherlands. Water Science and Technology, 63(4), 825-831.

Vespa, J., Armstrong, D. M., & Medina, L. (2018). Demographic turning points for the United States: Population projections for 2020 to 2060: US Department of Commerce, Economics and Statistics Administration, US ….

Wang, Z., Jensen, J. R., & Im, J. (2010). An automatic region-based image segmentation algorithm for remote sensing applications. Environmental Modelling & Software, 25(10), 1149-1165.

Wilson, J. R., Holst, N., & Rees, M. (2005). Determinants and patterns of population growth in water hyacinth. Aquatic Botany, 81(1), 51-67.

Yol, S., Serenko, A., & Turel, O. (2006). Moderating roles of user demographics in the American customer satisfaction model within the context of mobile services. AMCIS 2006 Proceedings, 245.