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## **Spatiotemporal Demographic Trends and Land Use Dynamics of Metropolitan Lahore**

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### **Abstract**

The research aims to investigate the pace of rapid urbanization in the mega cities of developing countries. These are facing unprecedented population growth and unplanned rapid urbanization. Pakistan is considered as most urbanized country in Asia. Keeping in view the unplanned urbanization and rapid population growth, study was conducted in metropolitan Lahore which is the second mega city of Pakistan with 82% of urban population to examine the spatiotemporal demographics and land use changes. The secondary data about temporal demographic trends was collected from different government departments and their reports like, Lahore Development Authority (LDA), Cantonment Board Lahore (CBL) Bureau of Statistics Punjab (BOS), Punjab Development Statistics (PDS) and District Census Reports (DCR) Lahore. Spatial primary data was created by geospatial techniques to assess the land use dynamics. 2000 to 2015 Landsat images of 8MSS and 5TM were classified through supervised classification for land use land cover change detection. In-depth interviews were conducted from LDA officials to verify and interpret the temporal population trends and town wise land use land cover changes. Research findings revealed that population of Lahore is continuously rising since 1951 to date due to rural urban migration. The gradual population increase is enhancing civic population density and immense urban sprawl. The research in line with the above-mentioned factors gives the spatial presentation of urban land use land cover changes from 2000 to 2015. The stakeholders should check the alarming speed of urbanization and balance the population agglomeration and land use balance to sustain the city. These perspectives will be helpful to find new way for future project planning and prioritization of the mega cities.

**Keywords:** Spatiotemporal, Demographic trends, Urbanization, Land use dynamics, Metropolitan Lahore.

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## Introduction

Human play key role in geomorphic change and reshaping the earth's surface (Sherlock,1922; Underwood,2001). In 21<sup>th</sup> century, we are living in an overpopulated world as well as over urbanized world. The world demographic trends are determined by the two major factors which are, an exceeding rate of population growth and continuous process of emigration from rural areas (Morrie's et.al,1994). Perhaps, urbanization is an additional proportion of the total civic dwellers residing in an urban area (Jone,1991). Urbanization is a process, in which figure out population increase in the cities and surrounding of the cities (Putra and Baier,2013), to enjoy the modern civic social facilities. Urbanization occurs with different pace and levels over a period of time (Uz Zaman,2011). According to the United Nation estimates more than 50% of the world people are urban residents (United Nations,2001) and may reach up to 67% in 2025. (Ramsey, 2003). The process of urban sprawl is covering the large land area of all continents except Antarctica (M and Jr,2010). Urban population growth and expansion increase in Latin America, Asia and Africa, is because of rural to urban migration to gain economic opportunities (Miller,2010). UN reported that the urban population of Asia will increase 37.5% in 2000 and more than 54.1% in 2030 (United Nations,2001).The rate of urbanization is more rapid and generally unplanned in developing countries (Morries et.al, 1994), and cities are facing the challenges of unprecedented population growth.

Pakistan is also a developing country where the process of migration is very fast and it is considered as most urbanized country in Asia (GOP,2011). The rural and urban migration in Pakistan is fast process, having pivotal role in urban growth. The overall populated urban area of Pakistan is 36% (GOP,2011). In Pakistan, the population of Punjab Province is approximately 86 million out of which about 31.94% living in urban areas exerting heavy pressure on urban land resources and infrastructure of Pakistan (Uz Zaman,2011). Lahore ranked second as a mega city of Pakistan (NESPAK,1991). According to Siddiqi, (2004), 6.32 million population of Lahore Distric had 1.03 million migrants, it was 16% of the whole population. 1.13 million population of Lahore in 1951 increased to 7.72 million in 2009 (Uz Zaman,2011) and approximately 9 million in 2011 (Lahore CDG,2011). Currently more than 10 million inhabitants reside in Lahore making it mega city of Pakistan (Mehmood.et.al,2013). Its population growth rate is 3.7% and 84% people lives in urban area (GOP,2011). Density of population per (km<sup>2</sup>) in the cities of Pakistan are the determinant factor of the quality of life (Leautir,2006), indicating that living standards in Lahore are compromised because of rapid increase in density (Uz-Zaman, 2011). Urbanization is causing various natural resources related issues. Typically, urbanization is a great threat for limited natural resources of region and creating many social, economic and environmental challenges. It is a powerful force that transforming and damaging the environment (Aguilar,2008). Urbanization reduce the balance of energy and become the cause of greenhouse gas emissions (Rong,2008). Urbanization alter the topography and natural vegetation (M and jar,2010). The arable land of cities converted into planned and unplanned informal settlements (Slingsby,1991) and shifted the agricultural land for other economic activities (Arif,1999).

Urbanization has transformed the rural dwelling to urban settlements which is generated an urban agglomeration area (Putra and Baier,2013), as well as urban population accumulates in the marginal settlements, these settlements are increasing at alarming rate, in some countries about 20% to 50% of population living in the form of marginal settlements (Lea and Courtney, 1986). Such abnormal rising of population also changed the local and regional climate (Moglen, 2009). Urban areas getting densely populated and expanding rapidly, that is created unwanted stress on natural recourses such as water resources, the demand of fresh water is increasing rapidly (Tembe,2008). It is an established fact, the inclination of population towards Lahore district has been increasingly rapidly. The urban growth is an important indicator of the situation and accelerating expansion, growth and economic development of the city. Migration of population from the vicinities and rural areas towards Lahore to enjoy urban facilities has big contribution in overpopulation. In 1951, urban growth rate of Pakistan was18% that raised to 28% in

1981 and 32.52% in 1998. Now approximately 35% of Pakistan population lives in cities. Current urban growth rate per year in Pakistan is 4% and it may grow up to 90% by 2025 (Elahi,2010). Pakistan has 36% over populated urban areas while only Lahore has 84% urban residents (Gop,2011). There are fluctuations in urban growth rate of Lahore, as it was lower in the census of 1981 to1998 as compare to the census of 1972 to 1981(WASA, 2013). In 1951 the population density of Lahore was 43 persons per square km that has increased 128 % during the period of 1951 to 1972 and 149% during the period of 1981 to 2010. In 2014 the population density of Lahore was 5302.707 square km (PDS,2014). The situation is contributing the immersive land use changes and urban sprawl. The city is shrinking in context of environmental, natural and land resources and developing in context of economic activities and population invasion.

Thus, the study has investigated how the spatial and temporal demographic diversifications occurs in metropolitan Lahore. The actual rate of Metropolitan towns contribution in population of Lahore. The study has also investigated land use land cover change detection glimpse of Lahore between 2000 and 2015.

### **Study Area**

The study area is a Metropolitan city of Lahore, the second most populous city of Pakistan (Qureshi,2014). It is generally called as a “Heart of Pakistan”. It is a cultural hub of Pakistan, geographically located between the 31.15`-31 45` N and 75 01-74 39` E. The total area of Lahore is 1,772 sq. km and 213 meters (m) elevation from mean sea level. It covers 404 sq.km land area is which is still growing. Lahore is the rapidly growing city of Pakistan and more urbanized city of Punjab province. It is the historical center of South Asia. Lahore is ranked No. 42 most populous city of the world. Currently the city has approximately 10 million population with 7000 persons/km<sup>2</sup> density and may expected to intake 22 million people by 2025 (Siddiqi,2004). Lahore is a metropolitan city that provide all types of opportunities to attract the attention of population. There is a vast difference in the rural and urban population. Approximately it inhibits 82% urban dwellers while remaining 12% are rural. Lahore is divided in to eight administrative units called towns.

### **Methodology**

Both primary and secondary data is used in the research. Secondary data was used to find out temporal diversification of the population. For this purpose, the civic population data was collected from the Lahore Development Authority (LDA), Cantonment Board Lahore (CBL), and Bureau of Statistics Punjab (BOS), Punjab Development Statistics (PDS) and District Census Reports (DCR) of Lahore. The temporal diversification of population data was made of previous decades from 1951to 2014 to find out the population growth differences from 1951 to present. The spatial primary data was created to detect the urban sprawl by the detecting the land use land cover changes of Metropolitan Lahore from 2000 to 2015. Both years images data was Landsat 8MSS and 5TM which was classified through supervised classification. The classification helped to detect the urban land use dynamics of Lahore. The secondary data and spatial primary data were verified and further interpreted by in-depth interviews with LDA officials. The masterplan of Metropolitan Lahore is also used as a secondary source of data from LDA Lahore to assess the future land use trends.

### **Temporal Growth Rate of Urban Population of Lahore**

Population growth is the basic demographic process which is associated with all the demographical aspects. It determines the density and distribution of population. It also refers to the emergence of population on an area according to the time and space. The current information reveals the dynamic population growth rate of Lahore. According to 1951 census the total population of Lahore was 113500, and after ten years turned to 1626000, showing the growth rate of 3.7%. 1961, 1972 and 1981 intercensal increase was 59.2

and 37.0 respectively. 1998 census reported the 6319000 population with the 3.7 growth rate and 78.3% intercensal increase. The results of intercensal growth were fluctuated in the years of 1961, 1972 and 1981. The main increase was in 1972. In recent estimation of 2013, the population of Lahore is 9,159000 and is expected to be 22 million till 2025 as shown in table 1.

**Table 1: Growth Rate of Lahore in different Years**

<b>YEAR</b>	<b>Total Population of Lahore (in 000's)</b>	<b>Percentage of Growth Rate</b>	<b>Intercensal Increase( %)</b>
1951	1,135	-----	-----
1961	1,626	3.7%	43.3%
1972	2,588	4.1%	52.2%
1981	3,545	3.8%	37.0%
1998	6,319	3.5%	78.3%
2013	9,159	-----	-----
2025	22 Million Estimated	-----	-----

**Source: DCR,2000 & PDS,2013**

The main factor which boosted the population growth in the Lahore was urbanization. The results indicate the urban growth rate of different decades in Lahore. First major growth rate which experienced the Lahore was in 1972 that was 4.1%. It was the major push in the history of Lahore. The main reason was the speedy industrialization in that era. That industrialization speeds up the migration process from the vicinity and outside the Lahore. In this era, the intercensal population growth rate was also very prominent from 1961 to 1972. The second intercensal growth rate was from 1981 to 1998 because of the major push in the real estate industry. Government and private sector started the investment in the real estate. There was a start of main housing societies in the Lahore. Due to increase inflation rates the property prices were boosted up.

There was a start of great investments in the housing societies and cooperative housing societies in the Lahore. This trend also accelerated the rate of migration especially from the outside of the Lahore. Mostly rural population outside the Lahore and vicinity turned to migrate and reside in the Lahore. That was the largest intercensal rise of population growth in the history of Lahore. The process is still in the progress and going to increase with near about with constant rate with somewhat fluctuation because of the start of conurbation process of Lahore that is intruding in the adjacent districts. In short, migration from the different areas towards the city in the search of job urban opportunities has pushed the high tide of population in Lahore. The city has been experiencing the massive population explosion, exerting high pressure on urban land and infrastructure. In 2010, the total population of Lahore was approximately 10 million. (Mehmood et al,2013) and it is estimated to be increased up to 22 million till 2025. It is the historical center of south Asia. Now it is amongst the densely populated urban areas and ranked as 25th mega city of the world. Population was increased up to 8.9 million in 2003. Population is more than 10 million with 7000 persons per sq. km density according to recent estimates. With this pace the population of Lahore will cross over 22 million up to 2025.

### Time Line of Urban Population Growth of Lahore

The space of Lahore is filling with the urban dwellers over the years. The results are depicting gradual increase of urban population since inception. Urban population growth in 1951 was 0.839 thousand that raised to 5,209 thousand till the senses of 1998. In 2013 it was estimated to be 7.522 thousand (Table.2)

**Table 2:** Temporal growth of urban population

YEAR	Urban population of Lahore (in 000's)
1951	0.839
1961	1.296
1972	2.169
1981	2.953
1998	5.209
2013	7.522 estimated

**Source: DCR,2000 & PDS,2013**

The process of increase of peri-urban population of the metropolitan Lahore becomes more vivid when it is compared with the overall population of the Lahore including the vicinities. Since partition, refugees rushed towards Pakistan. Majority was from eastern Punjab and most of them preferred to live in Lahore. Then various factors like industrialization of late sixties caused the rush of urban population. It is still to be continued till date and escalating the conurbation process of Lahore due to the highly urbanized population of Lahore.

### Town Wise Comparative Temporal Increase of Population of Lahore

Administrative division of Lahore comprised of nine major towns. The time line of population growth of these towns according to the senses of 1998 and the estimated findings of 2014 are shown in the table 3.

**Table 3:** Town Wise Temporal Increase in population

Towns of Lahore	Population (Thousand Persons)	
	1998	2014(Estimated)
Aziz Bhatti Town	414	610
Data Gunj Bukhsh Town	712	1048
Gulberg Town	571	841
Iqbal Town	567	835
Nishter Town	734	1081
Ravi Town	1163	1713
Samanabad Town	722	1064
Shalimar Town	389	573
Waga Town	481	709
Cantonment	566	874

**Source. PDS, 2014**

The main reason behind town wise temporal increase in population was migration of the masses from vicinities and other areas of Pakistan. The people come in the search of jobs education and business and prefer to settle in the urban Lahore in spite of going back to their countryside remote areas. Therefore, giant masses of Lahore district reside in the urban areas. The more population increase is in Ravi Town as shown in the table 3. It is connected with adjacent District Sheikhpura. Secondly this is an industrial area. Land value is low, and people rush here to resides. Most of the slum areas are in this town. Lahore Metro Bus Service connects city from North to South. People from rural areas and District Sheikhpura rush here to reside and reluctant to go back to enjoy the facilities of Lahore. Still population increase is in progress. Data Gunj Bakhsh Town and Nishter Towns are near the Central Business District (CBD) of Lahore; therefore, the retailers, wholesalers and labor class prefer to live here. Old population of interior Lahore resides here. The described categories from other areas also prefer to live here, therefore the population is going to increase till the moment. Samanabad Town has also significant increase in urban population. It was good town outside the CBD. Higher class and middle class had tendency to live here and process is still to be continued. The other towns are also showing the increase in population due to the development of new housing societies.

#### **Time Line of Urban Population Density of Lahore**

Population density of Lahore was 2001 persons/km<sup>2</sup> in the year 1981 which gradually increased to 3566 persons/km<sup>2</sup> in 1998 and continuously increasing. In 2014, the density of population was estimated to be 7000 persons/km<sup>2</sup> in Lahore as shown in table 4.

**Table 4:** Lahore Urban Population Density Trends in various Decades

YEAR	(Persons/Km <sup>2</sup> )
1981	2001
1998	3,566
2014	7000 Estimated

**Source: PDS, 2013**

The gradual increase in population density ranked the Lahore as 42th densely populated city in the world. The population density of Lahore has tendency to increase since the mid-seventies. In early seventies the area of Lahore was not very large compared to its current giant size. Some areas were developed outside the walled city and its old Central Business District Shah Almi. The outside extension of Lahore was up to Ichra on Ferozepur road side and Samanabad on Multan road Lahore. Population was going to increase but the area was not so much extended. The development was also mostly vertical, and people were making multi story shops and houses that was the main cause of increase in population density. From eighty to end of nineties the population density increased but with the slow rate and it boosted up till the date. In 2014 the population density was 5302.707 persons/km<sup>2</sup> found in the Lahore city. (PDS,2014). Now the Lahore is suffering from the conurbation process and its boundaries are extended up to Qasoor and Sheikhpura on one side and Gujranwala district on other side. But due to rapid process of urbanization the density of population is going to increase till date, it requires proper planning and management strategies to control the population density to release the stress on the available infrastructure and resources of the Lahore.

#### **Spatiotemporal Demographic Impacts on Land use Dynamics of Lahore**

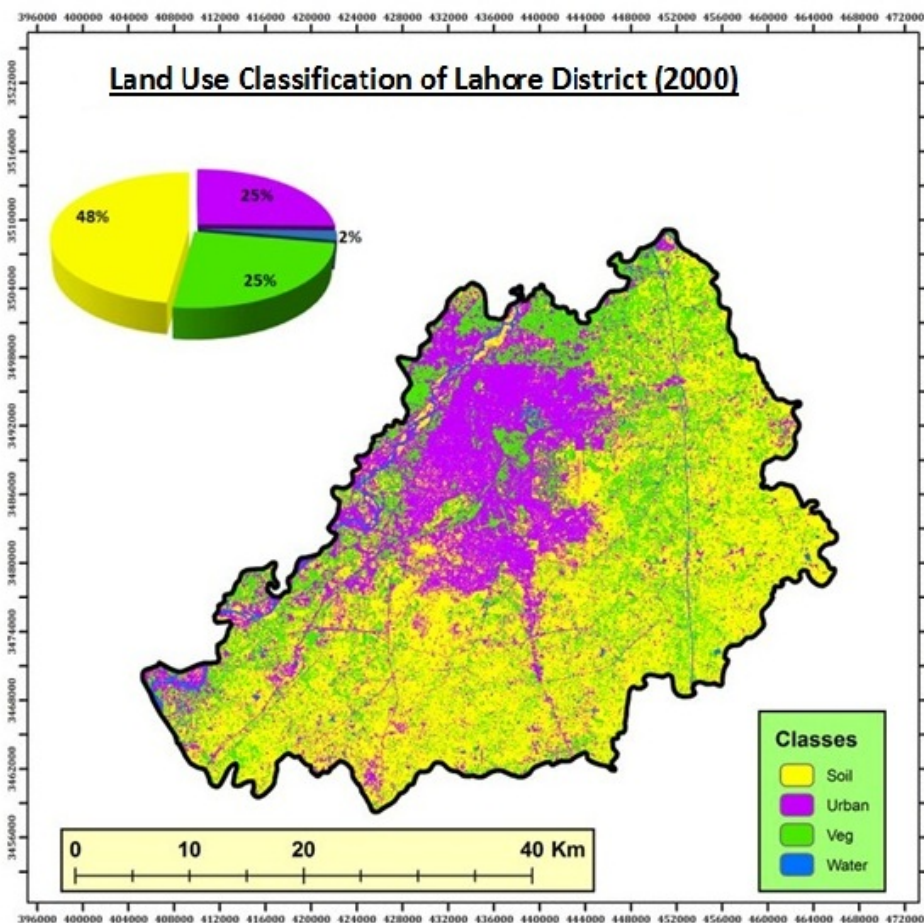
Rapid population growth is causing immense land use changes and sprawl in the Metropolitan Lahore. The process of urban sprawl of Lahore dates back to the British Colonial era. Since then it is going to spread.

There is continuous growth in the population of Lahore, that is 7.5 times more since the first census of 1951. The highest pace was between 1972 and 1981, that was. 4.3 % annual. Since then, it has been steadily declining. Recently, the estimated growth rate is 2.69% but with slow pace it is continued to proceed with limited natural and land resources. The fluctuations of growth rate are discussed in the above topics. The consequent land use changes are discussed below.

**Urban Demographic Impacts on Land Use Changes**

Urban demographics caused the process of urban expansion of Lahore. People once directed from vicinities and other areas of Pakistan towards Lahore to enjoy the civic facilities were reluctant to go back to their native areas and preferred to settle in Lahore. The process was accelerated since 1990s due to inflation and real estate business, which is going to increase with surprising rate to the date. Despite of other factors discussed above about the population density, population growth rate expanded the urbanized area in the vicinity and to other neighboring districts. New housing societies covers the large areas of the city and creating the huge pressure on the local resources and causing congestion and accelerating conurbation process of Lahore. There are total 241 new hosing schemes developed in Lahore during the period of 1980 to 2010, which are covered the extensive area around the Lahore. The spatial presentation of urban sprawl of the Lahore reveals the described fact by exploiting the land use dynamics. The difference of urban sprawl on the temporal basis with the help of two remotely sensed processed images showing the urban area of Lahore in the year of 2000 and 2015 in figure 1 and 2. According to the land use map the total urbanized area of Lahore was 25 % in 2000 and increased from 25% to 35% in 15 years. Due to increase in urban area, vegetation and water resources are shrinking continuously. Lahore is becoming like shrinking cities in terms of natural resources and vegetation.

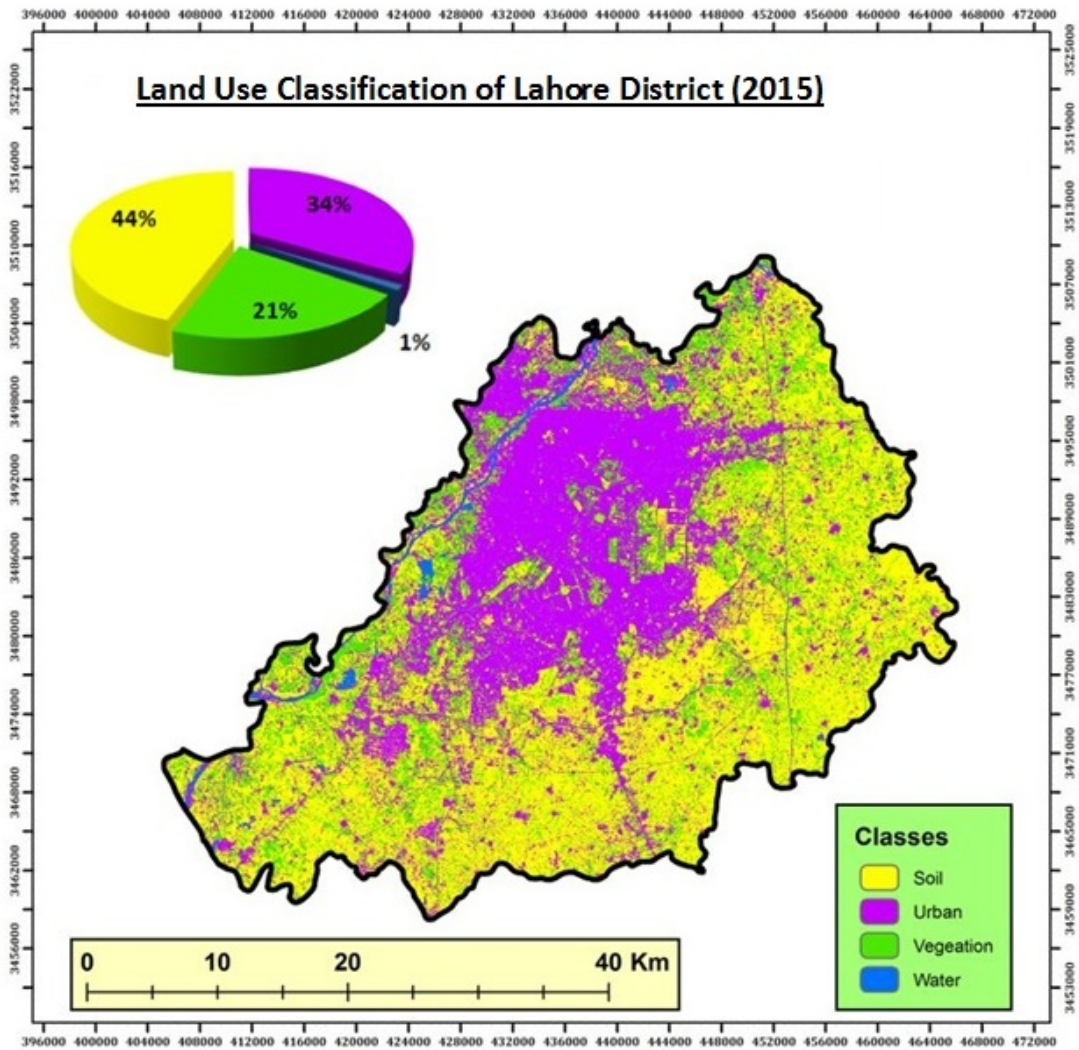
**Figure 1: Land Use classification of Lahore District 2000.**



Source: - Author



**Figure 2: Land Use Classification of Lahore District 2015.**



**Source: - Author**

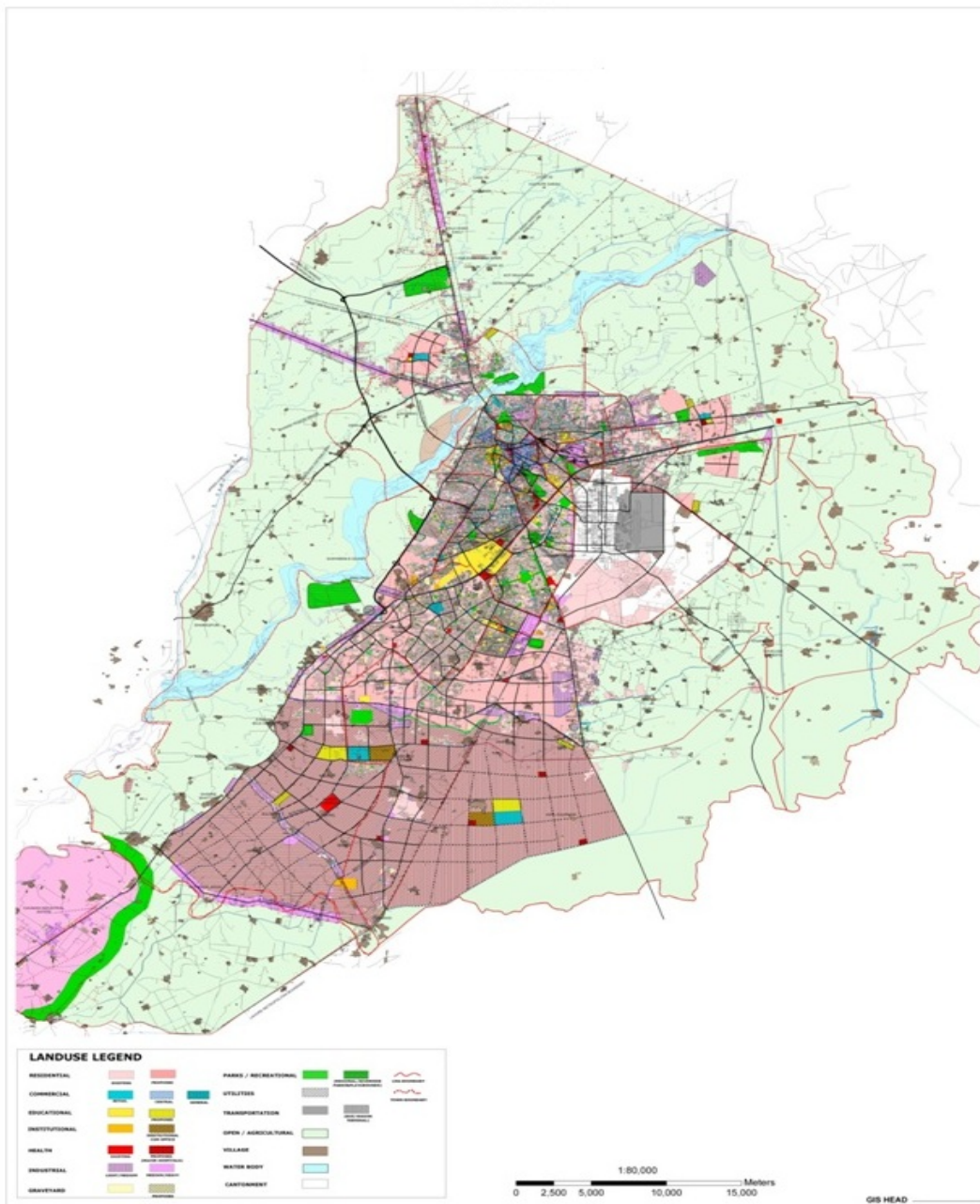
In current perspective, the inclination of population towards Lahore district is increasing rapidly. The land cover space or soil is consumed up to 4% in these fifteen years. Water bodies are reduced to half from 2000 to 2015 due to the process of urban sprawl. If this process continued with the same speed it will become very difficult to breathe a fresh air and water for drinking.

**Master Plan of Lahore for 2021 and Establishing the New Housing Societies**

There are numerous colonies and housing societies developing in Lahore due to high rate of urbanization. New housing societies covers the large areas of the city and creating the huge pressure on the local resources. According to Lahore Development Authority (LDA,2015) total 241 new hosing schemes were developed in the Lahore from 1980 to 2010, covering the extensive area around the Lahore. According to the LDA officials, some schemes are completed and some in under process. The master plan of new approved schemes will cover the vast urban area till 2021. The estimation of master plan 2021 clearly depicts of futuristic urban sprawl acceleration of conurbation process as shown in figure 3.



**Figure 3:** Master plan of Lahore of 2021 by LDA



**Source:** (LDA Lahore 2015)

### **Conclusion**

The spatiotemporal diversification of population growth reveals the trends of population, land use dynamics and urban sprawl process in the mega city of Lahore. The available urban opportunities proved the fundamental pull factors to attract the attention of surrounding, neighboring districts other national regional population towards Lahore according to the time and space. It seems that the spatial demographic growth has a mania to increase. Natural increase of population and urbanization are two main factors of population growth. Urbanization is a fundamental factor of increase in population of Lahore. Migration from the different areas towards the city in search of jobs, education opportunities and good quality civic

life has pushed a giant rise in population. This has caused the city of gardens Lahore as shrinking city in context of natural resources and expanding city in context of built up area population density, infrastructure and depletion of natural resources. All stake holders should take the situation under consideration, otherwise it will be too late. They should develop the proper strategies of urban planning to balance the land cover, green spaces, agricultural lands built up area and water bodies to make the city a livable place in a sustainable way.

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