

Changes in Population Growth and Urban Space in Makkah City, Saudi Arabia

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ABSTRACT

This study focused on changes in population growth and urban space in Makkah city. The research examined population size and growth based on the 1974, 1992, 2004 and 2010 census data. It concerned with studying the stages of urban growth in Makkah city, identify the directions of its horizontal growth and development through the addition of built-up area. The study's most important methodological approach was to blend data on population and urban growth from Makkah Al-Mukarramah's evolution over time, analyze the relationship between these aspects, and identify the extent of built-up area's capacity to absorb population increases. The results indicate the extent of the balance between supply (urban growth) and demand (population growth), as well as the evolution of urban density and per capita built-up area, which helps to identify population densification processes. The study's findings include future scenarios for this city with regard to population and built-up area, including estimates of the city's future population size and trends in urban growth. [Bul. Soc. Géog. d'Égypte, 2016, 89: 1-58]

Key Words: Population growth, urban space, Makkah Al-Mukarramah, Saudi Arabia.

Introduction

Geographers are more often concerned with local changes in population than with national change, and are interested in interpreting the complex patterns of population growth and decline (Clarke, 1972). Over time, a population grows and declines due to natural increase and net migration (United Nations, 2011). Growth and decline are essential topics in many national and sub-national population studies; they often serve as a starting point in identifying demographic trends and their implications for planning and policy making (Rowland, 2003). Challenges related to the spatial distribution of a population include rapid urbanization and population concentration, rural depopulation, urban management and slum dwelling (United Nations, 2013).

During the twentieth century, urbanization has been a major transforming force in most countries of the world (United Nations, 2010). Urbanization will be one of the most important demographic trends of the twenty-first century

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(United Nations, 2001). Globally, more people live in urban areas than in rural areas. In 2007, for the first time in history, the global urban population exceeded the global rural population (United Nations, 2014). Almost all of this growth in urban population is expected to occur in developing countries (United Nations, 2013). Reducing or even reversing the flow of migrants from rural areas to cities has been the most common type of policy intervention pursued by Governments (United Nations, 2008).

The Kingdom of Saudi Arabia (KSA) has passed through three major stages over the course of the country's modern history. The first stage may be referred to as the unification of the kingdom, from 1902 to 1938. The second stage involves the discovery of oil and extends from 1939 to 1969. The third stage involves a period of economic boom and planning that has spanned from 1970 to the present (Al-Seryane, 1991). During the 1970s and 1980s, employment opportunities grew due to infrastructure development project implementation in response to the economic boom that the KSA was experiencing (Al-Hajri, 2002). This process of increased employment opportunity primarily emerged after a rise in the country's income from oil revenues, which consequently increased spending on infrastructure projects and social development (Al-Thomaley, 1988). The population size of the KSA was 6,726,466 in 1974 and continued to rise until it reached 27,136,977 in 2010.

One of the most important cities of the Makkah Al-Mukarramah region, Makkah city has the second largest population in the area and includes 60 districts. These districts show considerable variation in urban space and population size and growth. In the present study, each district was treated as a unit of analysis. Overall, migration has been an important influence on the population growth of Makkah city. The changes in population growth and urban space in Makkah appear to be mostly influenced by the environmental and geographical conditions that resulted in the increased migration that accompanied the oil boom, from both inside and outside of the KSA. Makkah's population size was 1,534,731 in 2010—5.7% of the total population of the KSA.

Makkah is the location of the Holy Mosque and some holy sites (Mina, Muz-dalifa and Arafat), making it a destination for many migrants from inside and outside the KSA (Al-Jabri, 2008). The Holy Mosque is the central point of Makkah city, and the cultural, religious, spiritual and trade center and life of the city depend on its presence (Al-Saleh, 1991). The pilgrimage (Hajj) plays a major role in the revitalization of trade in the holy city, and pilgrimage is an important source of income in Makkah (Al-Seryane, 1986). The religious importance embodied in the presence of the Holy Mosque and holy sites is the major cause of the growth and prosperity for this city (Al-Gabbani, 1999).

Research Problem

In terms of demography, Makkah city is currently facing high rates of population growth while still receiving large numbers of immigrants and in-migrants, resulting in a conflict between its urban space and population growth rate. This study examined past trends of population size and growth between 1974 and 2010 and factors that affect population growth, as well as the evolution of built-up area in approximately the same period. Projections were also made for the next 20 years to highlight the city's challenges.

Study Relevance

The topic under discussion is crucial since extremely few demographic studies have been carried out on Makkah city and none have focused on the conflict between the city's urban space and population growth rate. Therefore, the present study is not only important but also necessary because it seeks to address this research gap.

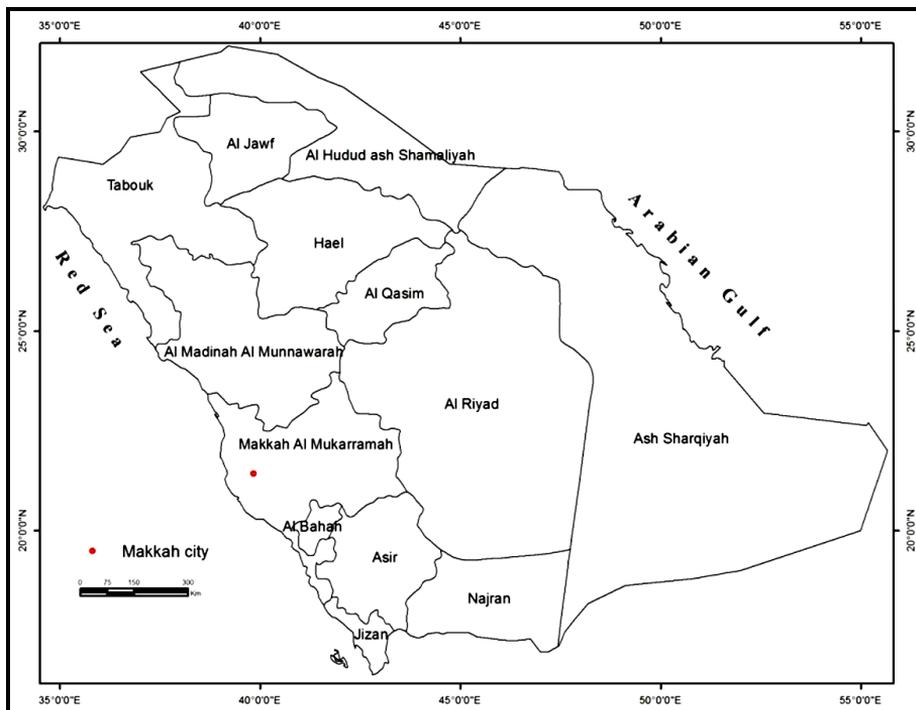


Figure 1. Administrative divisions of KSA and location of Makkah city.

Source: The central department of statistics & information, ministry of economy and planning, KSA, 2010.

Study Objectives

The main objectives of the study can be summarized as follows:

- To analyze the current levels and trends of population growth in Makkah city.
- To determine the factors responsible for these observed levels and trends of population growth.
- To predict the city's future population trends.
- To study the stages of urban growth in Makkah city.
- To identify the directions of its horizontal growth and developments in the addition of built-up area.
- To blend population and urban growth data on the historical development of Makkah and to analyze the relationship between these two aspects.
- To identify the extent of this urban cluster's capacity to absorb population increase.

Literature Review

Al-Seryane (1986) studied population change in Makkah city from 1974 to 1983. His research revealed that the city had already experienced significant changes in demographic, economic, and population distribution. Al-Jabri (2008), in turn, studied the geography of settlement centers in the administrative region of makkah Al-Mukarramah.

Study Hypothesis

The main hypotheses are as follows:

- Immigration has an important role in population growth.
- The religious function of Makkah city has a significant impact on its attractiveness to international migrants.
- Population growth in Makkah is related to the city's level of development.
- A conflict exists between the city's population and urban growth that will continue into the future.

Geographical Location of The Study Area

Makkah city is located in the southwest part of the KSA, about 80 kilometers (km) east of the Red Sea. The city extends between the longitudes of 39° 35' and 40° 02' east and latitudes of 21° 09' and 21° 37' north, as shown in Figures (1) and (2).

Methodology

This study used statistics and data tabulation of population growth rates. A projection technique was implemented to estimate future population size for different scenarios of population growth rate over a period of 20 years, as discussed in more detail in section four below.

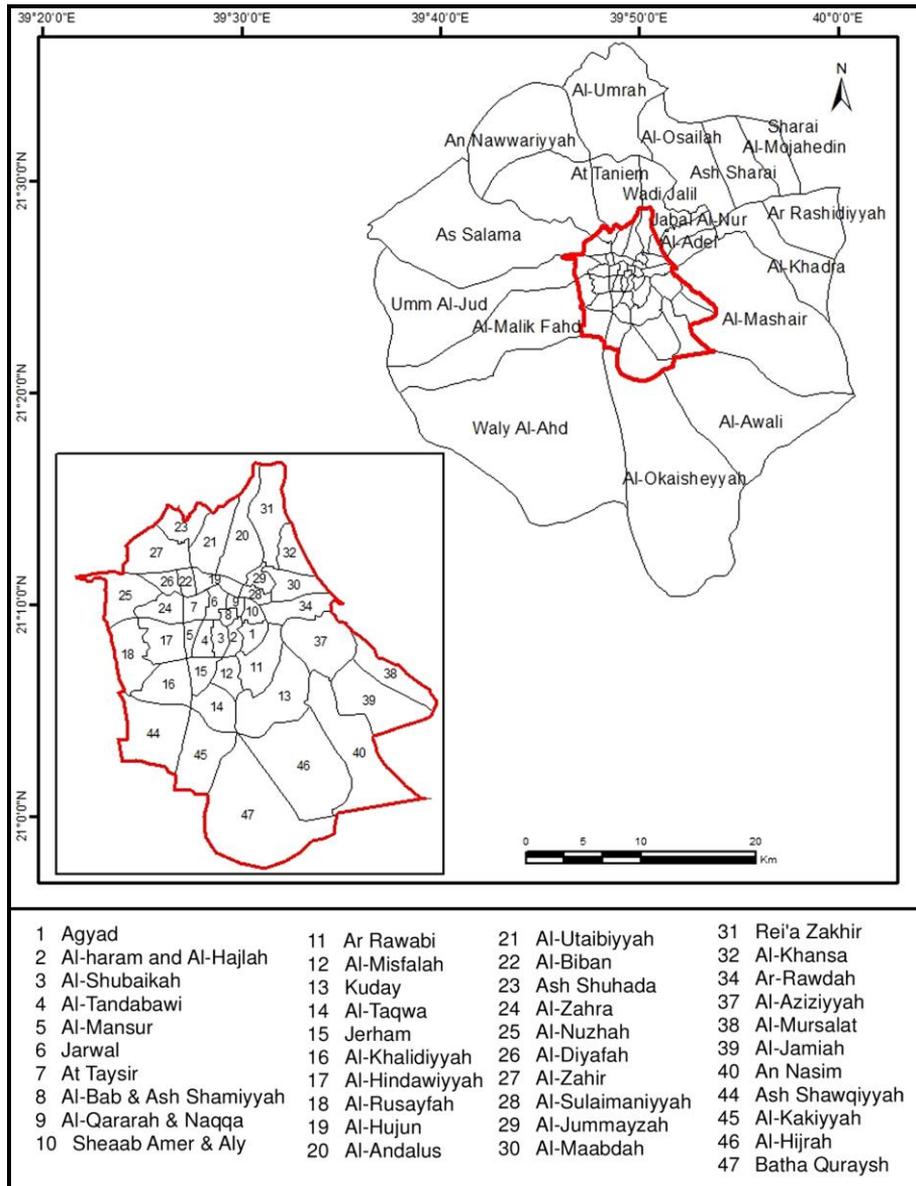


Figure 2. Administrative districts of Makkah city in 2010.

Source: Makkah region development authority, 2010.

The following exponential equation (Siegel and Swanson, 2004) was used to compute population growth rates and projections:

$$r = 1/n \ln P_n/P_0 \quad (1a)$$

$$P_n = P_0 e^{r n} \quad (1b)$$

In which r is the exponential rate of growth, n is the length of the interval in years, \ln is the natural logarithm, P_n is the population at the end of the interval, P_0 is the initial population, and e is the base of natural logarithms.

The software used in this research was mainly the GIS software package ESRI ArcGIS. This included the ArcMap/ArcCatalog package, of which version 10.1 was used.

Data Sources

The data used in this research fall into the two categories described in the subsections below.

- Population Data

The KSA does not have a long history of census taking. The census of 1974 was the first of its kind, and, since then, the practice of census taking has continued more or less once every 10 years. By 2010, the KSA had completed four successive censuses.

The KSA's central department of statistics and information was the ultimate source of the population data used in this study. The data were obtained primarily from four censuses conducted from 1974 to 2010.

- Remote Sensing Data

The remote sensing data used in this study were obtained from Landsat images. These images were acquired in 1972, 1990, 2000, 2007, and 2013.

Study Organization

This study is organized into four sections following the above introductory statements and followed by conclusions and recommendations based on the findings. Section one deals with changes in population size and growth. The second section discusses the evolution of the built-up area under study. The third section blends population and urban growth data and analyzes the relationship between these aspects. The last section presents projections of future population growth and built-up area.

Study Limitations

The study's results are limited by the absence of data, in particular, on vital statistics. The study used data that only cover the period from the 1970s to late 2013.

1. Changes in Population Size and Growth

Changes in Population Size

This section's main goal is to examine Makkah's population size and growth based on the 1974, 1992, 2004 and 2010 census data. The city's population size increased from 366,509 in 1974, to 1,534,731 in 2010, for a total increase of 1,168,222 over the entire 36 years. This means that the population size increased approximately 4.2-fold during this period (Table 1). The rise was due to internal migration from rural and Bedouin areas to the city, as well as international migrants who came to work in the city. By 2010, 46.52% of the city's population was non-Saudi.

Table 1. The absolute evolution of Makkah's population (1974-2010).

Census year	No. of population	Size of population increase		Ratio of population increase	
		Total	Annual	Total	Annual
1974	366,509	-	-	-	-
1992	965,697	599,188	32,224	163.5	8.8
2004	1,294,168	328,471	26,633	34	2.8
2010	1,534,731	240,563	41,596	18.6	3.2

Source: Calculated by the author from Makkah's population censuses (1974-2010), central department of Statistics and information, KSA.

Some important reasons for this increase include, first, the oil boom in the KSA that resulted in a social, urban, and economic renaissance and, second, the concentration of overall development in Makkah city. The largest proportion of the total increase (163.5%) occurred during the first census period, so the population size increased approximately 2.6-fold during this period.

Table (2) presents the geographical distribution of population and changes in size over time of the 22 cities of the surrounding region that maintained the highest populations from 1974 to 2010. It shows an unequal distribution of population across the cities, and only two cities (Jiddah and Makkah) contained more than half of the total population of these cities, in 2010. This dominance is due to the concentration of most regional development in these cities.

The data on the population numbers and percentage distribution in these cities show that Jiddah has dominated with more than half of the total population of these cities. Its population increased from 2,801,481 in 2004—55.3% of the total population of these cities in that year—to 3,430,697 in 2010—56.4% of the total population of these cities in that year. This is a total increase of 629,216 and an approximately 1.2-fold increase of this city's population size during the specified period. The steady rise in Jiddah's population can be attributed to economic prosperity resulting from development programs, which increased the availability of job opportunities and attracted large numbers of migrants from inside and outside the KSA.

Table 2. The evolution of the absolute and percentage distribution of population size among the major cities of the Makkah Al-Mukarramah Region (2004-010).

City	2004		2010	
	No.	%	No.	%
Jiddah	2,801,481	55.3	3,430,697	56.4
Makkah Al-Mukarramah	1,294,168	25.5	1,534,731	25.2
At-Taif	521,273	10.3	579,970	9.5
Al-Huwaya	132,078	2.6	148,151	2.4
Bahrah	59,809	1.2	75,213	1.2
Rabigh	40,986	0.8	55,304	0.9
Al-Khurmah	24,026	0.5	27,032	0.4
Turubah	22,836	0.5	25,937	0.4
Al-Jumum	21,825	0.4	25,601	0.4
Al-Qunfidhah	20,317	0.4	24,512	0.4
Al-Qouz	20,248	0.4	23,391	0.4
Ranyah	19,643	0.4	21,656	0.4
Khulays	16,879	0.3	19,331	0.3
Al-Lith	15,591	0.3	18,430	0.3
Thuwal	8,075	0.2	17,792	0.3
Adham	9,063	0.2	10,484	0.2
Ashayrah	7,276	0.1	8,425	0.1
Al-Muwayh	7,237	0.1	8,553	0.1
Al-Muzaylif	7,083	0.1	8,508	0.1
Al-Hada	6,767	0.1	8,819	0.1
Mastorah	6,489	0.1	7,034	0.1
Dhahban	5,260	0.1	7,161	0.1
Total	5,068,410	100.0	6,086,732	100.0

Source: Calculated by the author from the Makkah Al-Mukarramah Region's population censuses (2004-2010).

Makkah came in second place with an increase in population size from 1,294,168 in 2004—25.5% of the total population of these cities in that year—to 1,534,731 in 2010—25.2% of the total population of these cities in the same year—for a total increase of 240,563. These changes in Makkah appear to be mostly influenced by environmental and geographical conditions that accompanied the oil boom, resulting in increased migration from both inside and outside of the KSA. In addition to internal and international migration, the developmental activities primarily concentrated in Makkah may have also caused the population distribution to shift in favor of this city.

At-Taif came in third place, with its portion of the population increasing from 10.3% of the 22 cities' total population, in 2004, to 9.5%, in 2010. Sixteen of the cities maintained their places in the top sixteen highest populations from 2004 to 2010. Ashayrah, after it was ranked seventeenth in 2004, fell to twentieth, in 2010. Al-Muwayh and Al-Muzaylif maintained their rank of eighteenth and nineteenth, respectively, from 2004 to 2010. Al-Hada, after it was ranked twentieth, in 2004, rose to seventeenth, in 2010. Mastorah was ranked twenty-first but fell to twenty-second, in 2010, and Dhahban's rank of twenty-second, in 2004, changed to twenty-first, in 2010.

Geographical Distribution of the Population (2004-2010)

Table (3) shows that Makkah included 60 districts in 2010, including eight districts ranking at the top, in 2010. Al-Hindawiyah comes first with 5.3% of the city's population, followed by the districts of Al-Jamiah, Al-Zahra, Al-Taqwa, Al-Khalidiyyah, Al-Tandabawi, Ar Rashidiyyah, and Al-Andalus with the ratios, respectively, of 4.2%, 3.8%, 3.7%, 3.6%, 3.5%, 3.2%, and 3.1%. The rest of the districts each contain less than 3% of the city's total population for the same year.

Makkah's districts can be divided into five groups according to the geographical distribution of population from 2004 to 2010, as follow:

- **Group 1:** These districts' population includes more than 70,000 people. The city included, in 2004, only one such district: Al-Hindawiyah. its population was 70,564, and this continued until 2010, when its population grew to 81,742. This was equivalent to 5.3% of the city's total population in that year and was due to this district receiving more immigrants, especially from Africa.
- **Group 2:** These districts' population ranges from 50,000 to 70,000. The city experienced a steady increase in the number of these districts, as, in 2004, the city included only one such district—Al-Jamiah, with a population size of 54,076 which is equivalent to 4.2% of the total population of the city in that year. The number of districts in this group then grew to five, in 2010, including 18.8% of the city's total population.

Table 3. Evolution of the absolute and percentage distribution of Makkah's population (2004-2010).

District	2004		2010		District	2004		2010	
	No.	%	No.	%		No.	%	No.	%
Aiyad	12,643	1	15,087	1	Al-Khansa	33,746	2.6	40,242	2.6
Al-Haram & Al-Hajlah	16,538	1.3	20,266	1.3	Al-Adel	24,093	1.9	28,707	1.9
Al-Shubaitkah	22,914	1.8	27,117	1.8	Ar-Rawadh	10,761	0.8	12,747	0.8
Al-Tandabawi	46,225	3.6	53,685	3.5	Jabal Al-Nur	35,925	2.8	42,998	2.8
Al-Mansur	15,078	1.2	17,631	1.1	Wadi Jailil	31,840	2.5	37,690	2.5
Jarwal	8,822	0.7	10,597	0.7	Al-Aziziyah	16,050	1.2	19,122	1.2
At Taysir	12,154	0.9	14,408	0.9	Al-Mursalat	11,231	0.9	13,692	0.9
Al-Bab & Ash Shamyyah	5,185	0.4	6,259	0.4	Al-Jannah	54,076	4.2	64,431	4.2
Al-Qararah & Naqqa	3,258	0.3	3,953	0.3	An Nasim	13,969	1.1	16,410	1.1
Sheaab Amer & Aly	3,840	0.3	4,645	0.3	Al-Awail	25,777	2	30,503	2
Ar Rawabi	5,537	0.4	6,536	0.4	Al-Mashair	1,137	0.1	1,471	0.1
Al-Mistalah	33,832	2.6	39,882	2.6	Al-Malik Fahd	19,130	1.5	24,158	1.6
Kuday	10,754	0.8	12,749	0.8	Ash Shawgqiyah	30,690	2.4	35,947	2.3
Al-Tagwa	48,310	3.7	56,545	3.7	Al-Kakyyah	9,941	0.8	11,847	0.8
Jerham	13,909	1.1	16,399	1.1	Al-Hijrah	5,418	0.4	6,163	0.4
Al-falidiyyah	47,356	3.7	55,218	3.6	Baha Quraysh	4,778	0.4	5,650	0.4
Al-Indawiyah	70,564	5.5	81,742	5.3	Al-Kasheyah	10,236	0.8	13,584	0.9
Al-Rusayfah	34,070	2.6	39,580	2.6	Waly Al-Ahd	22,946	1.8	26,988	1.8
Al-Hujun	24,935	1.9	29,902	1.9	Ash Sharai	24,997	1.9	29,826	1.9
Al-Andalus	39,946	3.1	47,349	3.1	Al-Khadra	23,246	1.8	27,755	1.8
Al-Uraibiyah	36,557	2.8	43,416	2.8	Al-Osailah	543	0.0	713	0.0
Al-Biban	8,378	0.6	10,087	0.7	Sharai Al-Mojahedin	7,665	0.6	9,168	0.6
Ash Shuhada	12,652	1	15,165	1	Ar Rashidiyyah	41,747	3.2	49,502	3.2
Al-Zahra	49,899	3.9	58,942	3.8	Al-Umrath	27,781	2.1	33,138	2.2
Al-Nuzhah	12,170	1.8	27,301	1.8	At Tantiem	20,432	1.6	24,239	1.6
Al-Diyafah	12,035	0.9	14,279	0.9	Al-Buhayrat	33,565	2.6	40,004	2.6
Al-Zahir	30,001	2.3	35,203	2.3	An Nawwariyyah	9,385	0.7	11,139	0.7
Al-Sulaimniyyah	5,379	0.4	6,356	0.4	As Salama	10,402	0.8	12,322	0.8
Al-ummayzah	12,476	1	14,912	1	Umm Al-Jud	8,326	0.6	9,910	0.6
Al-Maabdah	31,387	2.4	37,380	2.4					
Re'ia Zakhir	26,803	2.1	32,074	2.1	Total city	1,294,168	100 %	1,534,731	100 %

Source: Calculated by the author from Makkah City population censuses, 2004-2010.

This trend was due to increases in the population, from 2004 to 2010, and the growth of some districts, such as Al-Tandabawi, Al-Taqwa, Al-Khalidiyyah, Al-Zahra, and Al-Jamiah, which put them in a higher category of population size during that period. This was due to immigration into these districts of people with limited income.

- **Group 3:** These districts' population ranges from 30,000 to 50,000. This group shrunk from 16 district, in 2004, with 46.8% of the city's total population in that year, to 15 districts, in 2010, with 38.1% of the city's total population in that year. This trend was due to an increase in the population size from 2004 to 2010 and the movement of some districts, such as Al-Tandabawi, Al-Taqwa, Al-Khalidiyyah, and Al-Zahra, to a higher category of population size during that period.
- **Group 4:** These districts' population ranges from 10,000 to 30,000. This group included 27 districts, in 2004—37% of the city's total population in that year—and increased to 28, in 2010—33.8% of the city's total population in that year. This was due to an increase in the overall population from 2004 to 2010, moving some districts, such as Rei'a Zakhir, Al-Awali, and Al-Umrah, into a higher category of population size during that period. This trend was the result of the growing prosperity of urbanized settlements along roads and intra-city migration from older to planned districts in the city.
- **Group 5:** These districts' population is less than 10,000. This group included 15 districts, in 2004, including 6.7% of the city's total population in that year. The number dropped to 11 districts in 2010, to 3.9% of the city's total population in that year. This trend was due to an increase in the population size from 2004 to 2010, as a result of which, some districts, such as Jarwal, Al-Biban, Al-Kakiyyah, and An Nawwariyyah, moved into a higher category of population size during that period (Figure 3).

The data on the proportional increase in districts' population size in Makkah, from 2004 to 2010, show that 30 districts have experienced proportional increases greater than the city's general increase of 18.6%, including four districts that occupied the top four ranks during that period. Al-Okaisheyah experienced the largest relative increase (32.7%), followed by Al-Osailah, Al-Mashair, and Al-Malik Fahd with increase ratios, respectively, of 31.3%, 29.4%, and 26.3%. These changes were due to increased intra-city migration and developmental activities concentrated primarily in these planned districts.

The districts of Kuday, Al-Diyafah, Ar Rashidiyyah, and At Taniem achieved proportional increases equal to the city's general increase. While the remaining districts recorded proportional increases less than the city's overall ratio, their ratios ranged from 13.8% in Al-Hijrah to 18.5% in At Taysir, Al-Andalus, Ar-Rawdah, and As Salama (Table 4).

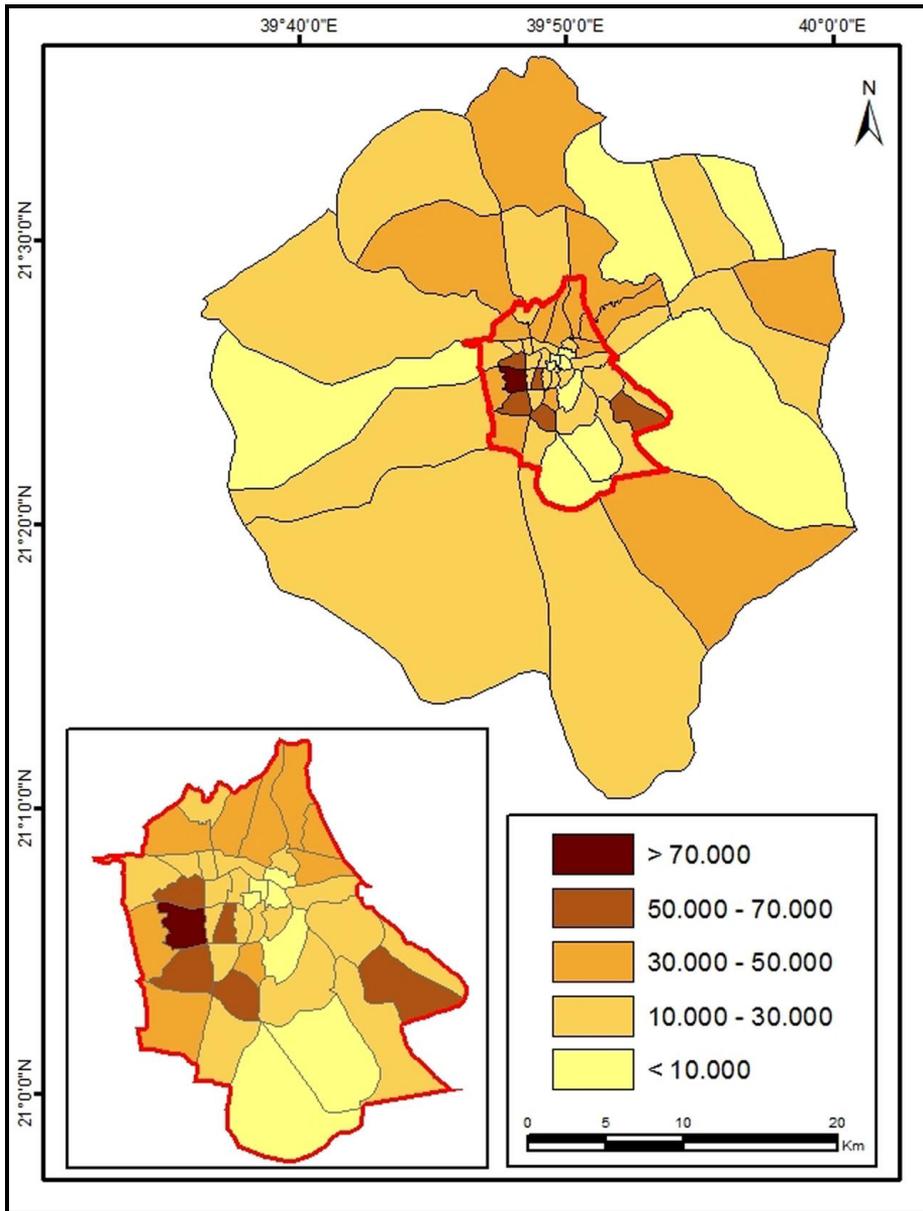


Figure 3. Geographical distribution of the population in Makkah's districts: 2010.

Table 4. Ratios of population size increases in Makkah's districts (2004-2010).

District	Population size			Ratio of total increase %	District	Population size			Ratio of total increase %
	2004	2010	Total increase			2004	2010	Total increase	
Aiyad	12,643	15,087	2,444	19.3	Al-Khansa	33,746	40,242	6,496	19.2
Al-haram & Al-Hajlah	16,538	20,266	3,728	22.5	Al-Adel	24,093	28,707	4,614	19.2
Al-Shubaikah	22,914	27,117	4,203	18.3	Ar-Rawdah	10,761	12,747	1,986	18.5
Al-Tandabawi	46,225	53,685	7,460	16.1	Jabal Al-Nur	35,925	42,998	7,073	19.7
Al-Mansur	15,078	17,631	2,553	16.9	Wadi Jalil	31,840	37,690	5,850	18.4
Jarwal	8,822	10,597	1,775	20.1	Al-Aziziyah	16,050	19,122	3,072	19.1
Al-Taysir	12,154	14,408	2,254	18.5	Al-Mursalat	11,231	13,692	2,461	21.9
Al-Bab & Ash Shamiyyah	5,185	6,259	1,074	20.7	Al-Jamiah	54,076	64,431	10,355	19.1
Al-Qararah & Naqqa	3,258	3,953	695	21.3	An Nasim	13,969	16,410	2,441	17.5
Sheaab Amer & Aly	3,840	4,645	805	21	Al-Awali	25,777	30,503	4,726	18.3
Ar Rawabi	5,537	6,536	999	18	Al-Mashair	1,137	1,471	334	29.4
Al-Misfalal	33,832	39,882	6,050	17.9	Al-Malik Fahd	19,130	24,158	5,028	26.3
Kuday	10,754	12,749	1,995	18.6	Ash Shawqiyyah	30,690	35,947	5,257	17.1
Al-Taqwa	48,310	56,545	8,235	17	Al-Kakiyyah	9,941	11,847	1,906	19.2
Jerham	13,909	16,399	2,490	17.9	Al-Hijrah	5,418	6,163	745	13.8
Al-Khalidiyyah	47,356	55,218	7,862	16.6	Batha Quraysh	4,778	5,650	872	18.3
Al-Hindawiyyah	70,564	81,742	11,178	15.8	Al-Okaisheyyah	10,236	13,584	3,348	32.7
Al-Rusayfah	34,070	39,580	5,510	16.2	Waly Al-Ahd	22,946	26,988	4,042	17.6
Al-Hujun	24,935	29,902	4,967	19.9	Ash Sharai	24,997	29,826	4,829	19.3
Al-Andalus	39,946	47,349	7,403	18.5	Al-Khadra	23,246	27,755	4,509	19.4
Al-Utaibiyyah	36,557	43,416	6,859	18.8	Al-Osailah	543	713	170	31.3
Al-Biban	8,378	10,087	1,709	20.4	Sharai Al-Mojahedin	7,665	9,168	1,503	19.6
Ash Shuhada	12,652	15,165	2,513	19.9	Ar Rashidiyyah	41,747	49,502	7,755	18.6
Al-Zabra	49,899	58,942	9,043	18.1	Al-Umrar	27,781	33,138	5,357	19.3
Al-Nuzhah	23,170	27,301	4,131	17.8	Al Taniem	20,432	24,239	3,807	18.6
Al-Diyafah	12,035	14,279	2,244	18.6	Al-Buhayrat	33,565	40,004	6,439	19.2
Al-Zahir	30,001	35,203	5,202	17.3	An Nawwariyyah	9,385	11,139	1,754	18.7
Al-Sulaimaniyyah	5,379	6,356	977	18.2	As Salama	10,402	12,322	1,920	18.5
Al-Jummayzah	12,476	14,912	2,436	19.5	Umm Al-Jud	8,326	9,910	1,584	19
Al-Maabdah	31,387	37,380	5,993	19.1	Total city	1,294,168	1,534,731	240,291	18.6%
Re'ia Zakhir	26,803	32,074	5,271	19.7					

Source: Calculated by the author from Makkah City population censuses, 2004-2010.

Changes in Population Growth

The data on population growth rates in Makkah show that, during the first census period (1974-1992), the city recorded its highest population growth rate (5.35%), which then decreased to 2.40% in the second census period (1992-2004). The rate then increased again to 2.99% during the last census period (2004-2010). The main reason for this high population growth rate is the concentration of development projects in the city, which has led to increased job opportunities and consequently increased immigration and migration streams from rural areas.

Population growth rates of the KSA have declined between 1974 and 2010, during which time the rate declined from 5% from 1974 to 1992 to 2.4% from 1992 to 2004 and then rose to 3.1% during the last census period from 2004 to 2010. The major reason for this decline in the population growth rate is attributable the Kingdom's adoption of a policy that replaced international labor with Saudi employees. Nonetheless, the trend still exhibits a relatively high rate of growth (Table 5).

Table 5. Population growth rate in Makkah city and KSA (1974-2010).

Census period	Growth rate (%)	
	Makkah city	KSA
1974 - 1992	5.35	5
1992 - 2004	2.40	2.4
2004 - 2010	2.99	3.1

Source: Calculated by the author from population censuses, 1974-2010.

Geographical Distribution of The Population Growth (2004-2010)

The data on population growth rates in Makkah's districts show that, during the census period of 2004 to 2010, 34 districts recorded rates higher than the city's general growth rate of 2.94% during the same period. These included four districts that occupied the top four ranks during that period: Al-Okaisheyyah with the largest population growth (4.89%), followed by Al-Osailah, Al-Mashair, and Al-Malik Fahd with the respective rates of 4.71%, 4.45%, and 4.04%. This was due to increased intra-city migration from older districts and developmental activities concentrated primarily in planned districts.

The districts of At Taysir, Kuday, and Al-Andalus experienced a population growth equal to the city's overall growth rate, while the remaining districts recorded a population growth of less than the overall rate. These rates ranged from 2.23%, in Al-Hijrah, to 2.93%, in Ar-Rawdah and As Salama (Table 6 and Figure 4).

Table 6. Differential population growth rates in Makkah's districts (2004-2010).

District	Growth rate (%) 2004-2010	District	Growth rate (%) 2004-2010
Ajyad	3.06	Al-Khansa	3.04
Al-haram & Al-Hajlah	3.51	Al-Adel	3.03
Al-Shubaikah	2.91	Ar-Rawdah	2.93
Al-Tandabawi	2.59	Jabal Al-Nur	3.11
Al-Mansur	2.70	Wadi Jalil	2.92
Jarwal	3.17	Al-Aziziyyah	3.03
At Taysir	2.94	Al-Mursalat	3.43
Al-Bab & Ash Shamiyyah	3.26	Al-Jamiah	3.03
Al-Qararah & Naqqa	3.34	An Nasim	2.78
Sheaab Amer & Aly	3.29	Al-Awali	2.91
Ar Rawabi	2.87	Al-Mashair	4.45
Al-Misfalah	2.84	Al-Malik Fahd	4.04
Kuday	2.94	Ash Shawqiyyah	2.73
Al-Taqwa	2.72	Al-Kakiyyah	3.03
Jerham	2.85	Al-Hijrah	2.23
Al-Khalidiyyah	2.66	Batha Quraysh	2.90
Al-Hindawiyyah	2.54	Al-Okaisheyyah	4.89
Al-Rusayfah	2.59	Waly Al-Ahd	2.81
Al-Hujun	3.14	Ash Sharai	3.05
Al-Andalus	2.94	Al-Khadra	3.07
Al-Utaibiyyah	2.97	Al-Osailah	4.71
Al-Biban	3.21	Sharai Al-Mojahedin	3.10
Ash Shuhada	3.13	Ar Rashidiyyah	2.95
Al-Zahra	2.88	Al-Umrah	3.05
Al-Nuzhah	2.84	At Taniem	2.95
Al-Diyafah	2.96	Al-Buhayrat	3.03
Al-Zahir	2.76	An Nawwariyyah	2.96
Al-Sulaimaniyyah	2.89	As Salama	2.93
Al-Jummayzah	3.08	Umm Al-Jud	3.01
Al-Maabdah	3.02	Total city	2.94
Rei'a Zakhir	3.10		

Source: Calculated by the author from Makkah city population censuses, 2004-2010.

A study of the number of years required for the population of Makkah's districts to double in size showed that 33 districts needed less time than the number of years required for the city's overall population to double (23.8 years). These included three districts occupying the top three ranks, among which Al-Okaisheyyah recorded the lowest number of years (14.3), followed by Al-Osailah, and Al-Mashair with 14.9 and 15.7 years, respectively.

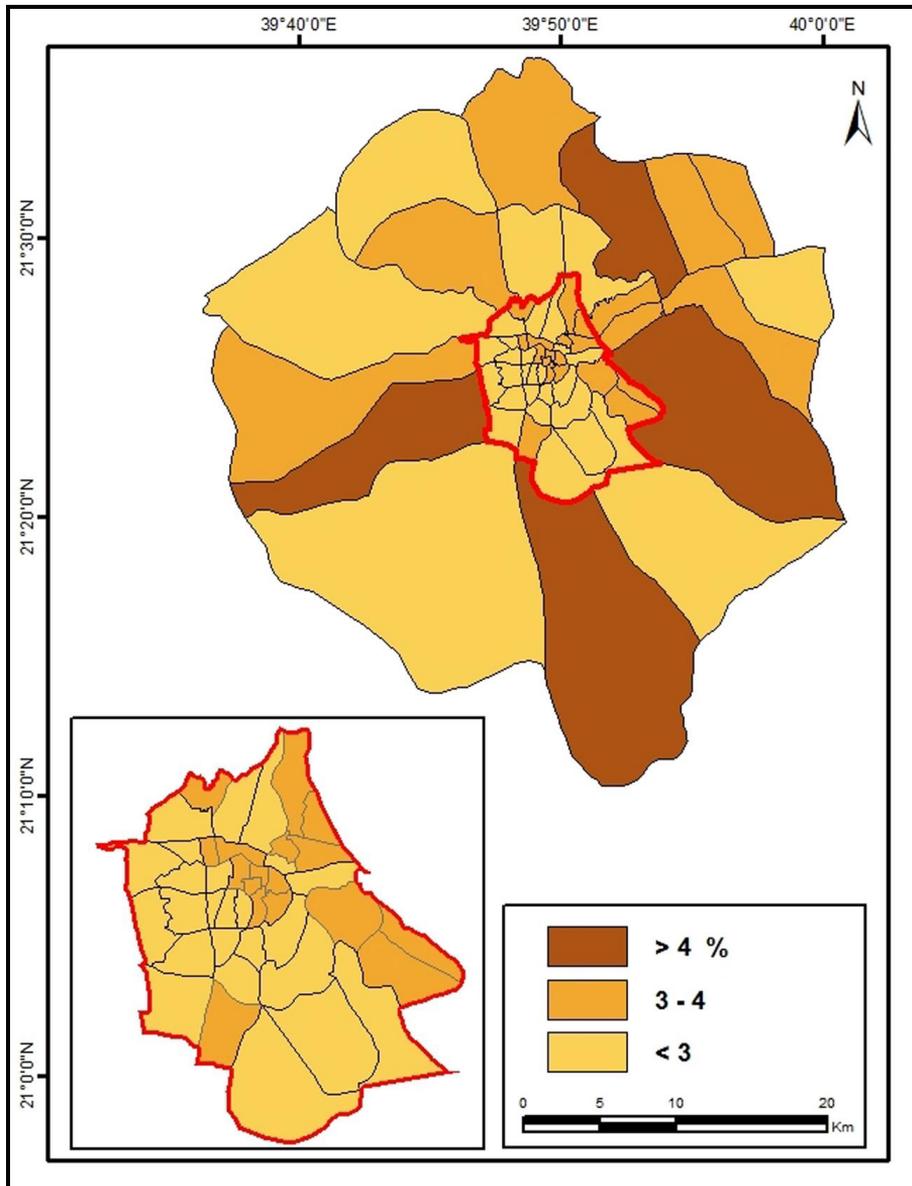


Figure 4. Population growth rates in Makkah's districts: 2004-2010.

The districts of At Taysir, Kuday, Al-Andalus, and Ar Rashdiyyah matched the overall city's growth in the same number of years as the city as a whole. The remaining districts recorded a number of years greater than the city's overall number of years, ranging from 31.4 years, in Al-Hijrah, to 23.9 years, in Ar-Rawdah and As Salama (Table 7).

Table 7. Annual growth rate of the population in Makkah's districts and population doubling time (2004-2010).

District	Population size			doubling time	District	Population size			doubling time
	2004	2010	growth rate			2004	2010	growth rate	
Ajyad	12,643	15,087	3.06	22.9	Al-Khansa	33,746	40,242	3.04	23
Al-haram & Al-Hajlah	16,538	20,266	3.51	19.9	Al-Adel	24,093	28,707	3.03	23.1
Al-Shubaitkah	22,914	27,117	2.91	24	Ar-Rawdah	10,761	12,747	2.93	23.9
Al-Tandabawi	46,225	53,685	2.59	27.1	Jabal Al-Nur	35,925	42,998	3.11	22.5
Al-Mansur	15,078	17,631	2.70	25.9	Wadi Jalil	31,840	37,690	2.92	24
Jarwal	8,822	10,597	3.17	22.1	Al-Aziziyah	16,050	19,122	3.03	23.1
Al-Taysir	12,154	14,408	2.94	23.8	Al-Mursalat	11,231	13,692	3.43	20.4
Al-Bab & Ash Shamiyyah	5,185	6,259	3.26	21.5	Al-Jamiah	54,076	64,431	3.03	23.1
Al-Qararah & Naqqa	3,258	3,953	3.34	20.9	An Nasim	13,969	16,410	2.78	25.1
Sheaab Amer & Aly	3,840	4,645	3.29	21.3	Al-Awali	25,777	30,503	2.91	24
Al-Rawabi	5,537	6,536	2.87	24.4	Al-Mashair	1,137	1,471	4.45	15.7
Al-Misfalah	33,832	39,882	2.84	24.6	Al-Malik Fahd	19,130	24,158	4.04	17.3
Kuday	10,754	12,749	2.94	23.8	Ash Shawqiyyah	30,690	35,947	2.73	25.6
Al-Taqwa	48,310	56,545	2.72	25.7	Al-Kakiyyah	9,941	11,847	3.03	23.1
Jerham	13,909	16,399	2.85	24.6	Al-Hijrah	5,418	6,163	2.23	31.4
Al-Khalidiyyah	47,356	55,218	2.66	26.4	Batha Quraysh	4,778	5,650	2.90	24.1
Al-Hindawiyyah	70,564	81,742	2.54	27.5	Al-Okaisheyyah	10,236	13,584	4.89	14.3
Al-Rusayfah	34,070	39,580	2.59	27	Waly Al-Ahd	22,946	26,988	2.81	25
Al-Hujun	24,935	29,902	3.14	22.3	Ash Sharai	24,997	29,826	3.05	22.9
Al-Andalus	39,946	47,349	2.94	23.8	Al-Khadra	23,246	27,755	3.07	22.8
Al-Utaibiyyah	36,557	43,416	2.97	23.5	Al-Osallah	543	713	4.71	14.9
Al-Biban	8,378	10,087	3.21	21.8	Sharai Al-Mojahedin	7,665	9,168	3.10	22.6
Ash Shuhada	12,652	15,165	3.13	22.3	Ar Rashidiyyah	41,747	49,502	2.95	23.8
Al-Zahra	49,899	58,942	2.88	24.3	Al-Umrh	27,781	33,138	3.05	23
Al-Nuzhah	23,170	27,301	2.84	24.7	Al-Tanem	20,432	24,239	2.95	23.7
Al-Diyafah	12,035	14,279	2.96	23.7	Al-Buhayrat	33,565	40,004	3.03	23.1
Al-Zahir	30,001	35,203	2.76	25.3	An Nawwariyyah	9,385	11,139	2.96	23.6
Al-Sulaimaniyyah	5,379	6,356	2.89	24.3	As Salama	10,402	12,322	2.93	23.9
Al-Jummayzah	12,476	14,912	3.08	22.7	Umm Al-Jud	8,326	9,910	3.01	23.2
Al-Maabdah	31,387	37,380	3.02	23.2					
Rei'a Zakhir	26,803	32,074	3.10	22.5	Total city	1,294,168	1,534,731	2.94	23.8

Source: Calculated by the author from Makkah City population censuses, 2004-2010.

2. Evolution of Built-up Area

This section focuses on the stages of urban growth in Makkah city. This includes identifying horizontal urban growth directions and the development of added built-up areas.

Stages of Urban Growth

An analysis of the data shown in Appendix (1) and the compound map of horizontal urban growth of Makkah (Figures 5-10) clearly shows that the city has passed through four stages of urban growth from its inception until the present. The following subsections highlight the spread of urban sprawl in each stage.

- Early Stage before 1972

Urban sprawl during this stage reached out more than five kms from the core (the Holy Mosque) to the east-southeast (ESE) and south-southwest (SSW). In the ESE, the growth was contained in the Ajyad and Al-Jamiah districts. To the SSW, the sprawl appeared in the Al-Misfalah, Al-Taqwa and Al-Kakiyyah districts.

Urban sprawl ranged from three to five kms from the core to the north-northeast (NNE), northeast (NE), east-northeast (ENE), east (E), west-northwest (WNW), northwest (NW), and north-northwest (NNW). In the NNE, the sprawl reached into the districts of Sheaab Amer & Aly, Al-Sulaimaniyyah, Al-Jummayzah, and Rei'a Zakhir. To the NE, the growth spread in the Sheaab Amer & Aly, Al-Sulaimaniyyah, Al-Maabdah, and Jabal Al-Nur districts. In the ENE, the sprawl appeared in the Sheaab Amer & Aly, Al-Maabdah, and Al-Adel districts. To the E, the growth extended into both Ajyad and Al-Aziziyyah. In the WNW, the sprawl reached the Al-Bab & Ash Shamiyyah, Jarwal, At Taysir, Al-Zahra, and Al-Nuzhah districts. To the NW, the growth was in the districts of Al-Bab & Ash Shamiyyah, Jarwal, At Taysir, Al-Hujun, Al-Biban, and Al-Zahir. In the NNW, the sprawl was detectable in the Al-Bab & Ash Shamiyyah, Jarwal, Al-Qararah & Naqqa, Al-Hujun, and Al-Utaibiyyah districts.

Urban sprawl ranged from one to three kms from the core to the north (N), southwest (SW), west-southwest (WSW), and west (W). To the N, the growth appeared in the districts of Al-Qararah & Naqqa, Al-Hujun, and Al-Andalus. In the SW, the sprawl reached into the Al-Shubaikah and Jerham districts. To the WSW, the growth was found in the Al-Shubaikah, Al-Tandabawi, Al-Mansur, and Al-Hindawiyyah districts. In the W, the sprawl was in the districts of Al-Shubaikah, Al-Tandabawi, Al-Mansur, and Al-Hindawiyyah.

Urban sprawl reached less than one km from the core to the southeast (SE), south-southeast (SSE), and south (S). To the SE, the growth appeared in the Ajyad district. In the SSE, the sprawl also reached into the Ajyad district. To the S, the growth was only in the Al-haram & Al-Hajlah district. As can be observed from the above, the urban growth of the city during this stage took a circular form around the Holy Mosque (Figure 5).

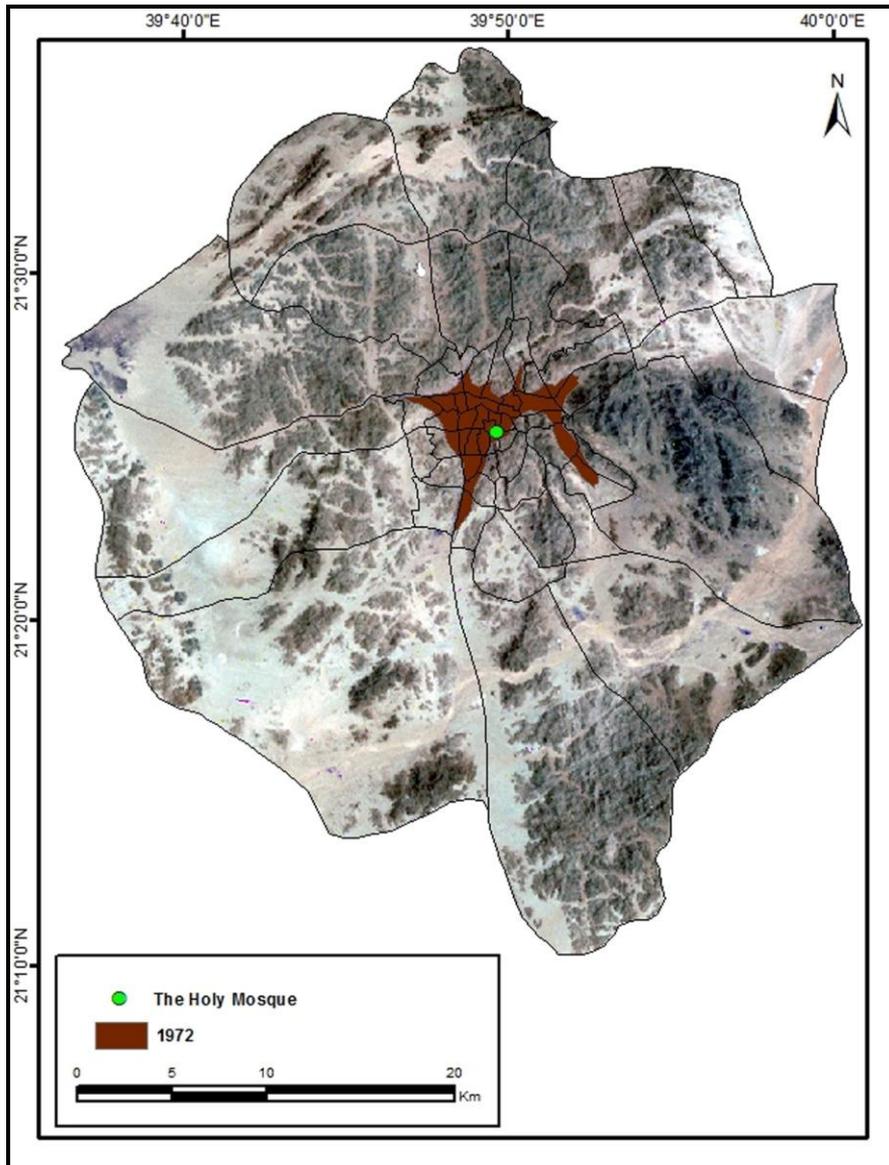


Figure 5. Built-up area of Makkah city: until 1972.

- First Urban Boom Stage (1972-1990)

The incremental growth in the city's urban sprawl during this stage reached more than 10 kms in three directions: ENE, SE, and NNW. In the ENE, the sprawl extended into the districts of Al-Khadra and Ar Rashidiyyah and filled in spaces in the Al-Adel district. To the SE, the growth appeared in the An Nasim and Al-Awali districts. In the NNW, the sprawl was in the Ash Shuhada, At Taniem, Al-Buhayrat, and An Nawwariyyah districts. In these three directions, the urban sprawl was associated with growth in the ENE along the Al-Sail road; in the SE, with the Al-Taif road; and, in the NNW, with the Al-Madina Al- Monawara road.

The urban sprawl's growth also ranged from five to 10 kms to the ESE and S. To the ESE, the sprawl extended into the districts of Al-Aziziyyah and Al-Mursalat, as well as filling spaces in Al-Jamiah. The urban growth in this direction was associated with the Al-Taif road. In the S, the sprawl went into the Kuday and Batha Quraysh districts.

The incremental growth in urban sprawl ranged from one to five kms to the N, NE, E, SSE, SSW, SW, WSW, and W. In the N, the sprawl was in the At Taniem district and filled in spaces in the Al-Andalus district. To the NE, the sprawl appeared in the district of Al-Khansa, filling in spaces in the Al-Maabdah and Jabal Al-Nur districts. In the E, the growth filled spaces left in the Al-Aziziyyah district, and the urban growth in this direction was stopped by the boundaries of the holy sites. To the SSE, the sprawl entered the districts of Ar Rawabi, Kuday, and Al-Hijrah. In the SSW, the sprawl extended into the Waly Al-Ahd district, as well as filling in spaces in the Al-Kakiyyah district. The urban growth in this direction was associated with the Al-Laith road. To the SW, the sprawl was in the Al-Khalidiyyah and Ash Shawqiyyah districts, and the urban growth in this direction was also associated with the Al-Laith road. In the WSW, the sprawl ran into the Al-Rusayfah and Al-Malik Fahd districts. To the W, the sprawl extended into the districts of Al-Rusayfah and Umm Al-Jud, while this urban growth was associated with the Jiddah road.

The growth of urban sprawl reached less than one km to the NNE, WNW, and NW. In the NNE, spaces were filled in the Rei'a Zakhir district. To the WNW, the sprawl was in the As Salama district and filled spaces in the districts of Al-Nuzhah and Al-Zahra. In the NW, the sprawl extended into the Al-Buhayrat district, filling spaces left in the Al-Zahir district (Figure 6).

- Retreat Stage (1990-2007)

The incremental growth in urban sprawl during this third stage reached more than two kms in one direction (NNE), and the sprawl appeared in the Wadi Jalil district. The sprawl also filled spaces in the district of Rei'a Zakhir.

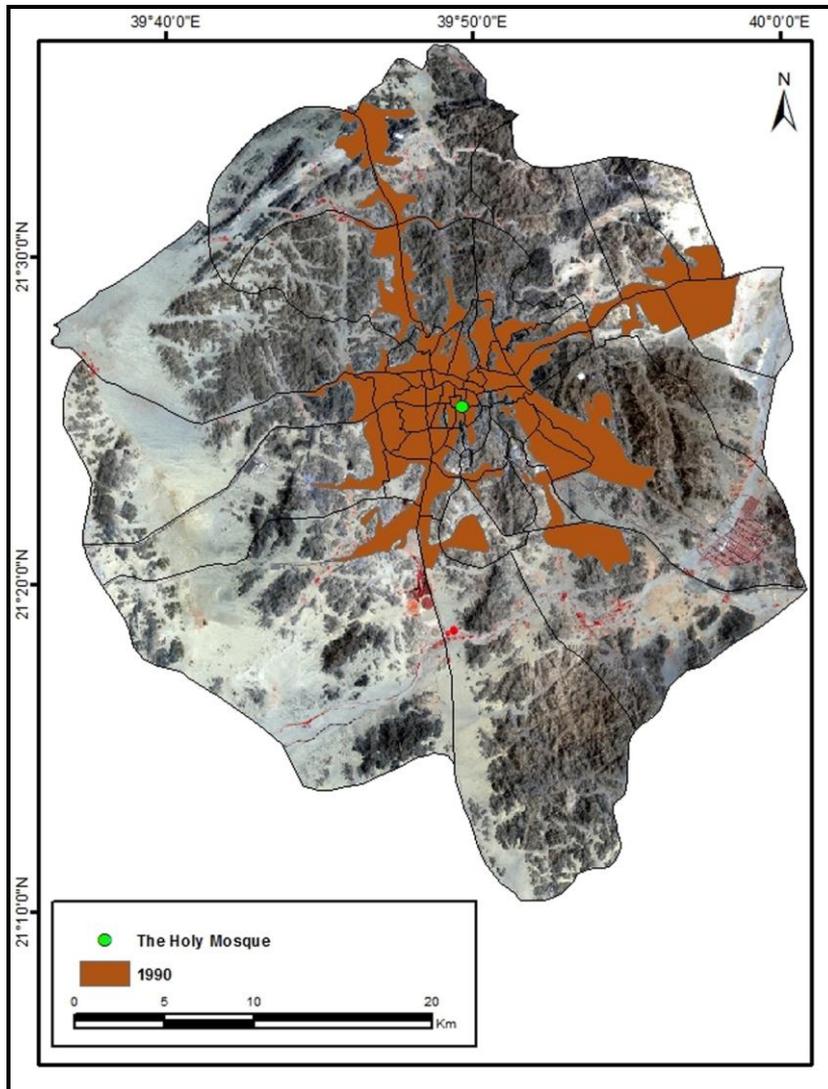


Figure 6. Built-up area of Makkah: 1990.

The urban sprawl ranged from one to two kms to the NE, WNW, and NW. In the NE, it filled spaces in the districts of Al-Khansa and Jabal Al-Nur. To the WNW, the sprawl spread into the spaces left in the As Salama district. In the NW, it filled other spaces in the Al-Zahir district.

The urban sprawl reached less than one km to the N, ENE, E, ESE, SE, SSE, S, SSW, SW, and W. In the N, the growth extended into spaces in the At Taniem district. To the ENE, the sprawl filled spaces in the Ar Rashidiyyah

district. In the E, it filled spaces in the Al-Aziziyah district. To the ESE, the growth filled spaces in the Al-Mursalat district. In the SE, the sprawl filled spaces in the districts of An Nasim and Al-Awali. To the SSE, it filled spaces in the Ar Rawabi, Kuday, and Al-Hijrah districts. In the S, the growth filled spaces in the Batha Quraysh district. To the SSW, it filled spaces in the Waly Al-Ahd district. In the SW, the sprawl filled spaces in the districts of Al-Khalidiyyah, Ash Shawqiyyah, and Al-Malik Fahd. To the W, the growth also filled spaces in the Al-Rusayfah and Umm Al-Jud districts (Figures 7 & 8).

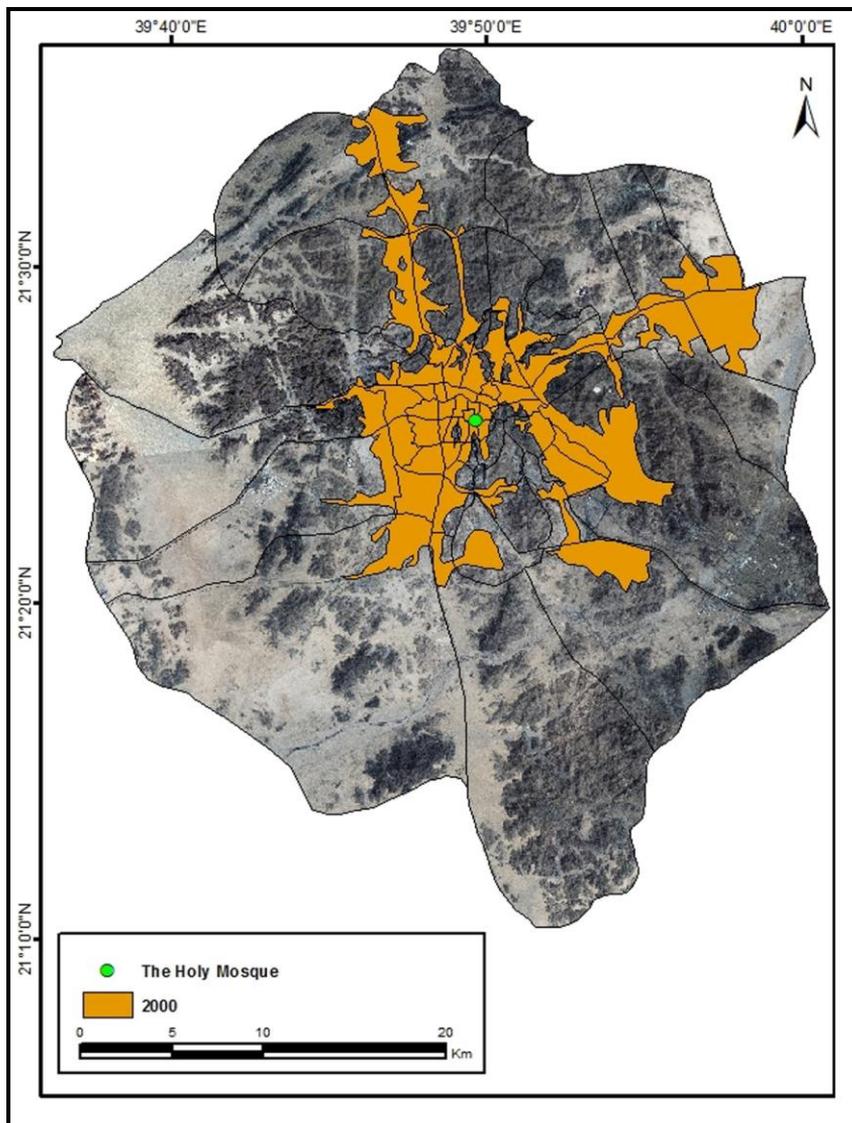


Figure 7. Built-up area of Makkah: 2000.

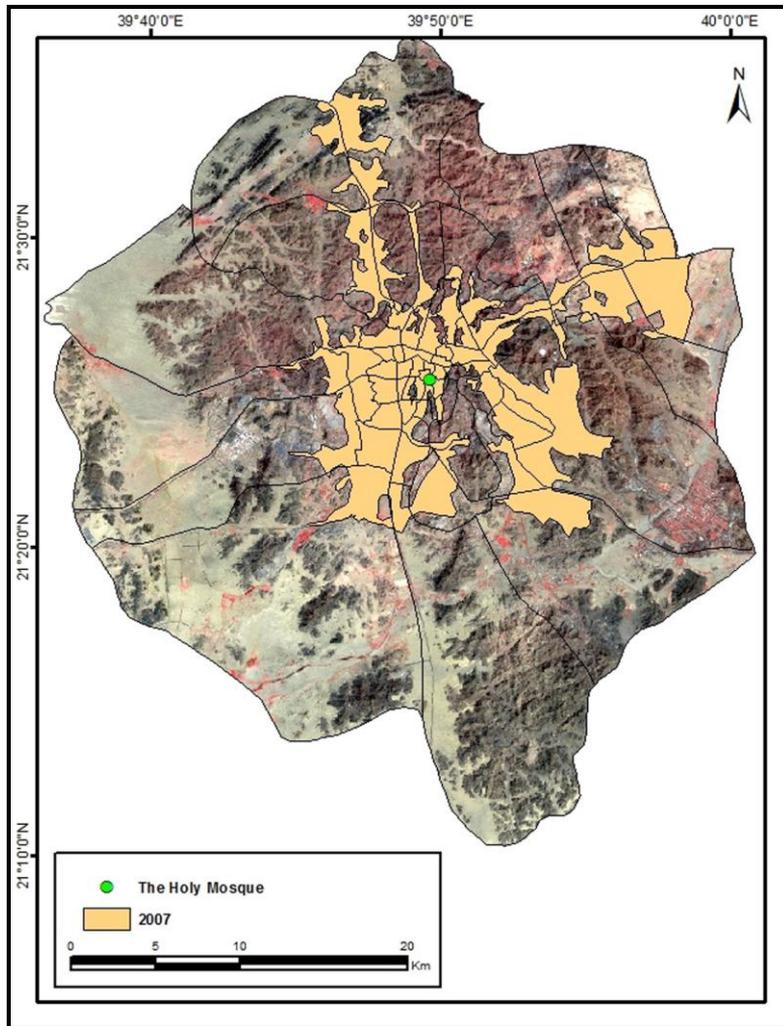


Figure 8. Built-up area of Makkah: 2007.

- Second Urban Boom Stage (2007-2013)

The relatively extensive growth in urban sprawl during this stage reached more than 10 kms in two directions (SSE and W). To the SSE, the sprawl filled spaces in the Al-Hijrah and Al-Awali districts. In the W, it filled spaces in the districts of Al-Rusayfah and Umm Al-Jud.

The urban sprawl ranged from five to 10 kms to the SW and WSW. In the SW, the growth filled spaces in the Al-Khalidiyyah, Ash Shawqiyyah, and Al-Malik Fahd districts. To the WSW, it filled spaces in the Al-Rusayfah and Al-Malik Fahd districts.

The incremental growth of urban sprawl ranged from one to five km to the ENE, ESE, SE, WNW, and NW. In the ENE, the sprawl filled spaces in the Ar Rashidiyyah district. To the ESE, it filled spaces in the Al-Mursalat district. In the SE, the growth filled spaces in the districts of An Nasim and Al-Awali. To the WNW, it filled spaces in the As Salama district, while, in the NW, it filled spaces in the Al-Buhayrat district.

The urban sprawl reached less than one km to the N, NNE, NE, S, SSW, and NNW. In the N, the sprawl extended into the Al-Umrah district. To the NNE, it filled spaces in the Wadi Jalil district. In the NE, the sprawl expanded in the Sharai Al-Mojahedin district. To the S, it filled spaces in the Batha Quraysh district. In the SSW, the growth filled in spaces in the districts of Al-Kakiyyah and Waly Al-Ahd. To the NNW, it filled spaces in the Al-Buhayrat and An Nawwariyyah districts (Figure 9).

The most important characteristic of urban growth during this stage was expansion to the planned districts that occupied spaces starting from the SE and moving toward the W. This growth was associated with the Al-Taif and Jiddah roads (Appendix 1 & Figure 10).

Development of Added Built-up Areas

The built-up area of Makkah during its early stage covered about 25 km² or 8.9% of the built-up area in 2013. About 130 km² were urbanized during the first urban boom stage (1972-1990), covering about 155 km², which represented about 55% of the built-up area in 2013. This expansion occurred because of the increased migration from both inside and outside of the KSA that accompanied the oil boom reflected by urban developments. During the retreat stage (1990-2007), the city added only 38 km², increasing the city's area to 193 km² or 68.7% of the built-up area in 2013. In the second urban boom stage (2007-2013), further development added about 88 km² to the built-up area and thereby increased its area to 281 km², a figure which represents the cumulative value of urban growth since the city's origin up to 2013. This last expansion was due to developmental activities concentrated primarily in the city's planned districts (Table 8).

Table 8. Development stages for Makkah (1972-2013).

Stage	added area		annual rate of addition
	Km ²	%	Km ² /year
until 1972	25	8.9	-
1972 - 1990	130.15	46.3	7.2
1990 - 2007	37.93	13.5	2.2
2007 - 2013	88.06	31.3	14.7
Total area 2013	281.14	100%	-

Source: Calculated by the author from satellite images of the city (1972, 1990, 2007, 2013).

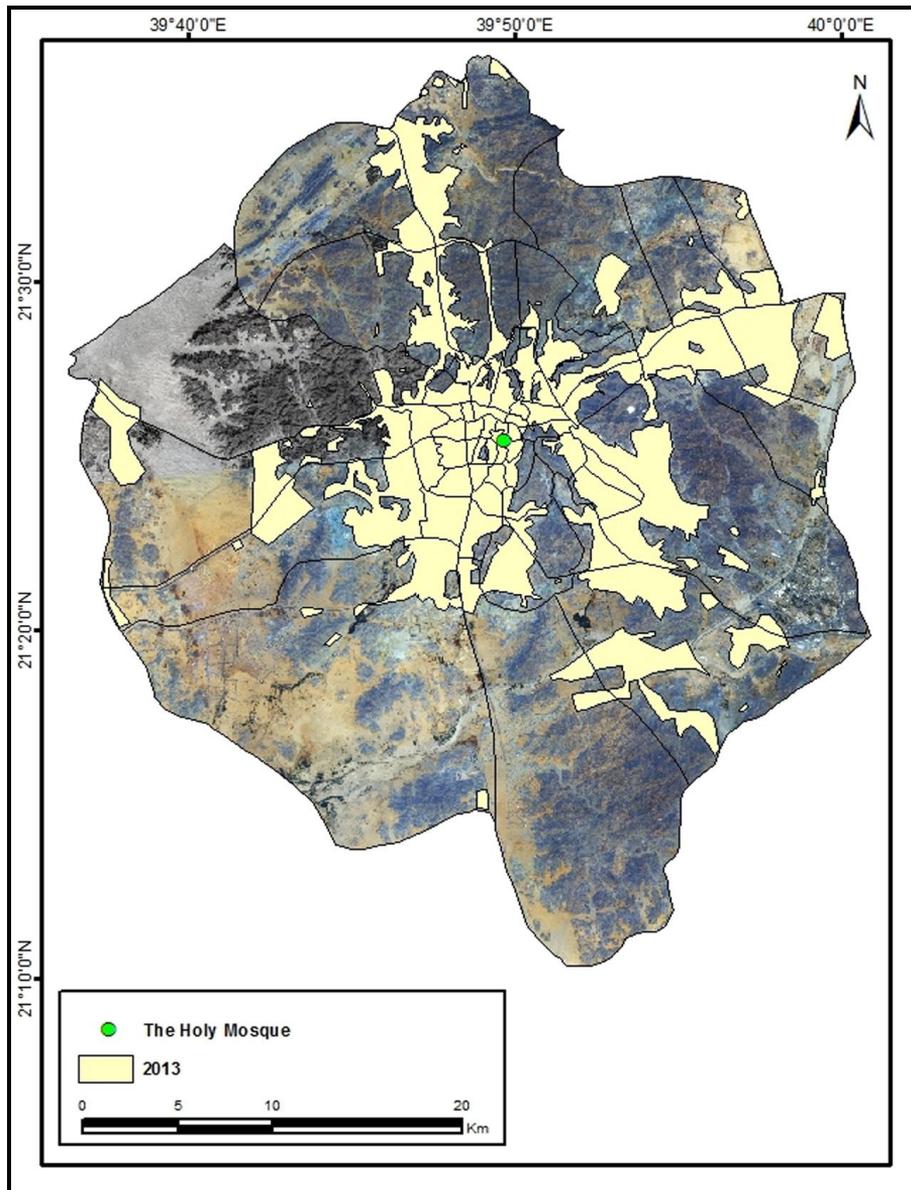


Figure 9. Built-up area of Makkah: 2013.

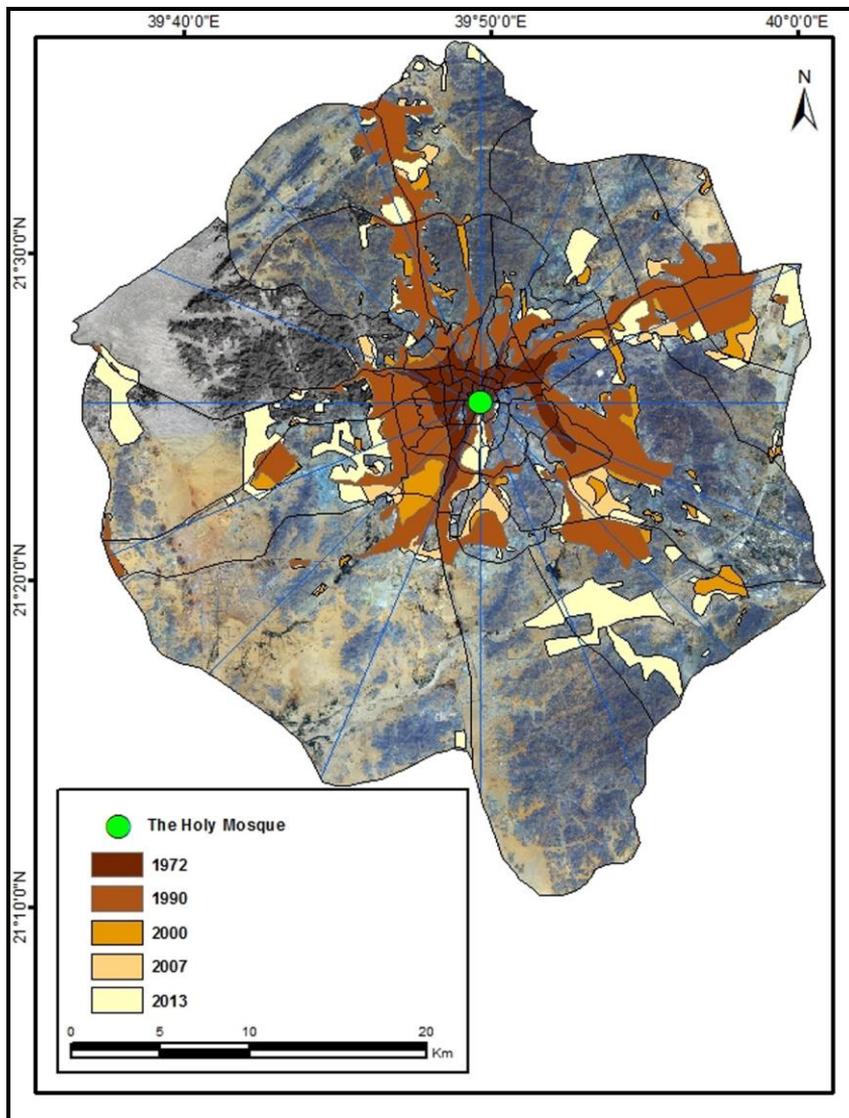


Figure 10. Built-up area of Makkah: 1972-2013.

The research's findings reveal that nearly half of the area added to the city's built-up area (46.3% of the area in 2013) was developed during the first urban boom stage (1972-1990). Another large portion was added (31.3% of the area in 2013) during the second urban boom stage (2007-2013).

The data on annual rates of growth in the city's built-up area emphasize that the city experienced the highest rate of added areas during the second

urban boom stage when the rate reached 14.7 km²/year. In contrast, the rate during the first urban boom stage was only 7.2 km²/year, while the retreat stage had the lowest rates of additions to the built-up area.

Directions of Urban Growth

- Horizontal Urban Growth Rates

The characterization of urban growth rates in terms of geographical directions has benefits that reverberate in the urban planning of cities. This approach is useful in identifying the incentives to develop urban areas versus the obstacles presented by other areas (Meselhy, 2009). According to the data presented in Table (9), the general horizontal urban growth rate in the city under study reached 3,487 meters/year, with the average horizontal urban growth rate reaching its highest values during the second urban boom stage (2007-2013) at 575 meters/year. During the first urban boom stage (1972-1990), the rate was only 271.7 meters/year.

Table 9. Horizontal growth rate (urban sprawl) in the geographical directions (1972-2013).

Period	1972-1990	1990-2000	2000-2007	2007-2013	Total
Direction	Meter	Meter	Meter	Meter	Meter
N	178.9	36.6	10.6	7.5	90.3
NNE	55.4	196.7	12.4	13.3	76.4
NE	76.8	4.9	193.7	1.7	68.2
ENE	705.9	2.8	4.1	415.5	372.1
E	255.7	45	18	0	126.3
ESE	290	5.3	1.6	365.2	182.3
SE	662	9.8	2.3	791.3	409.2
SSE	204.4	5.9	2.9	1,773.8	351.3
S	408.9	2.8	0	11	181.8
SSW	157.9	4.2	87.7	9.3	86.7
SW	226.5	3.2	86	1,156.7	284.2
WSW	174.7	0	0	1,611.3	312.5
W	184.2	17.4	0	2,425.5	440
WNW	28.5	33.9	185.7	210.2	83.2
NW	34.2	14.8	205.7	311	99.3
NNW	703.4	0	0	97.2	323
Total	271.7	23.9	50.7	575	3,487

Source: Calculated by the author based on appendix 1 and satellite images of the city (1972, 1990, 2007, 2013).

The city's horizontal urban growth rates can be divided by overall rate into four groups:

- **Group 1:** Directions with horizontal urban growth rates of more than 400 meters/year, represented by the directions of SE and W.
- **Group 2:** Directions with horizontal urban growth rates ranging from 300 to 400 meters/year, including ENE, SSE, WSW, and NNW.
- **Group 3:** Directions with horizontal urban growth rates ranging from 200 to 300 meters/year, represented by the SW direction.
- **Group 4:** Directions with horizontal urban growth rates less than 200 meters/year, including all other directions.

Overall, the horizontal urban growth rates ranged in the first urban boom stage from 28.5 meters/year to the WNW to 705.9 meters/year to the ENE. In the second urban boom stage, the rates varied from 0 meter/year to the E to 2,425.5 meters/year to the W.

The above analysis makes clear that the highest horizontal urban growth rates are represented by those in the W, SW, and SE because urban sprawl in these directions was in the planned districts that occupied spaces, starting from the SE direction and moving toward the W direction, associated with the Al-Taif, Al-Laith and Jiddah roads. This research indicates that horizontal growth will continue in the future along those directions.

- Added Value to Built-up Area in Geographical Directions

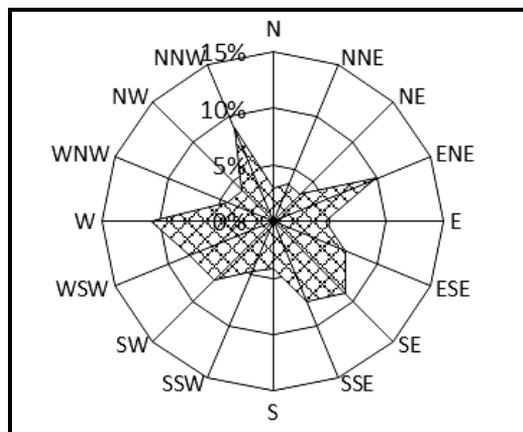
The percentage distribution of horizontal urban growth directions in the city (Table 10 & Figure 11) emphasize that the rate was highest in the W (10.7%) compared to the cumulative growth in all directions—followed by growth rates in the ENE (9.9%) and then the SE (9%). The proportions decreased in the remaining directions of the city to less than 9% for each direction.

A combination of factors has contributed either directly or indirectly to the city's urban sprawl. The mountains are an important influencing natural factor, which is directly responsible for aspects of the city's urban growth particularly in the first stage (Figures 12 and 13), when the areas surrounding the Holy Mosque were developed. The prosperity achieved by the KSA since the beginning of the oil boom resulted in the development of new activities such as digging tunnels through the mountains. Thus, aspects of the city's urban growth changed after overcoming these mountain barriers (Picture 1). The construction of several roads across the mountains has facilitated access to the city from all directions, as well as urban development along these roads.

Table 10. The percentage distribution of the cumulative growth in different geographical directions for Makkah (1972-2013).

Period	until 1972	1972-1990	1990-2000	2000-2007	2007-2013	% of cumulative growth
Direction	%	%	%	%	%	
N	3.9	4.1	9.5	1.3	0.1	2.9
NNE	7.4	1.3	51.3	1.5	0.1	3.6
NE	7.4	1.8	1.3	23.9	0.0	3.4
ENE	7.8	16.2	0.7	0.5	4.5	9.9
E	7.6	5.9	11.7	2.2	0.0	4.7
ESE	11.7	6.7	1.4	0.2	4.0	6.9
SE	1.1	15.2	2.6	0.3	8.6	9.0
SSE	1.1	4.7	1.5	0.4	19.3	7.7
S	1.2	9.4	0.7	0.0	0.1	4.2
SSW	11.4	3.6	1.1	10.8	0.1	4.8
SW	5.1	5.2	0.8	10.6	12.6	7.3
WSW	5	4.0	0	0.0	17.5	7.9
W	5.5	4.2	4.5	0.0	26.4	10.7
WNW	9.7	0.7	8.8	22.9	2.3	4.3
NW	6.6	0.8	3.9	25.4	3.4	3.8
NNW	7.7	16.2	0	0	1.1	8.9
Total	100	100	100	100	100	100

Source: Calculated by the author based on appendix 1 and satellite images of the city (1972, 1990, 2007, 2013).

**Figure 11.** Geographical directions of horizontal urban growth in Makkah city since its origin up to 2013.

Migrations from inside and outside the KSA have an important role in the city's growth since migrants prefer to live in certain districts with compatriots who immigrated earlier to the city. The concentration of populations in the old city according to migrants' ethnic origins has resulted in slums.

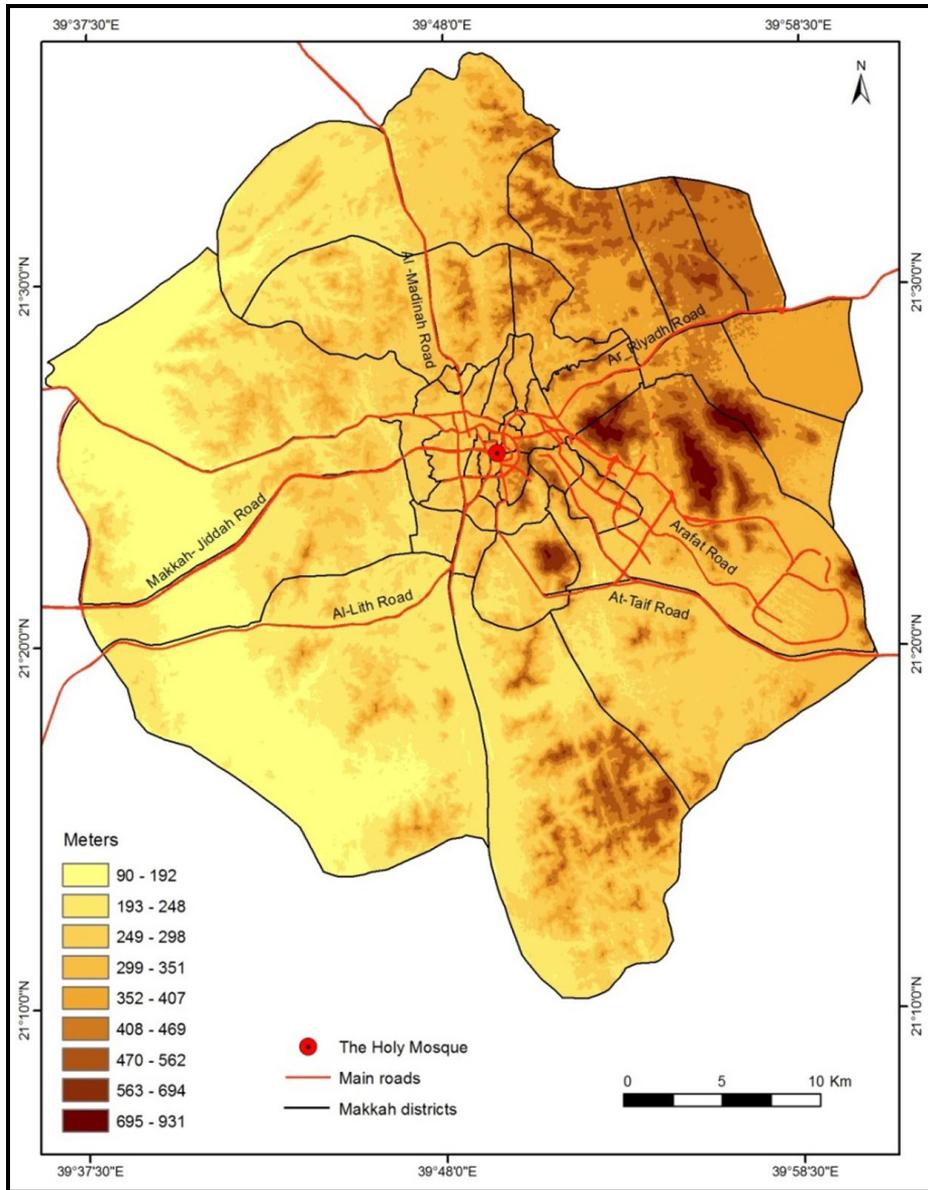


Figure 12. Topography of Makkah city.

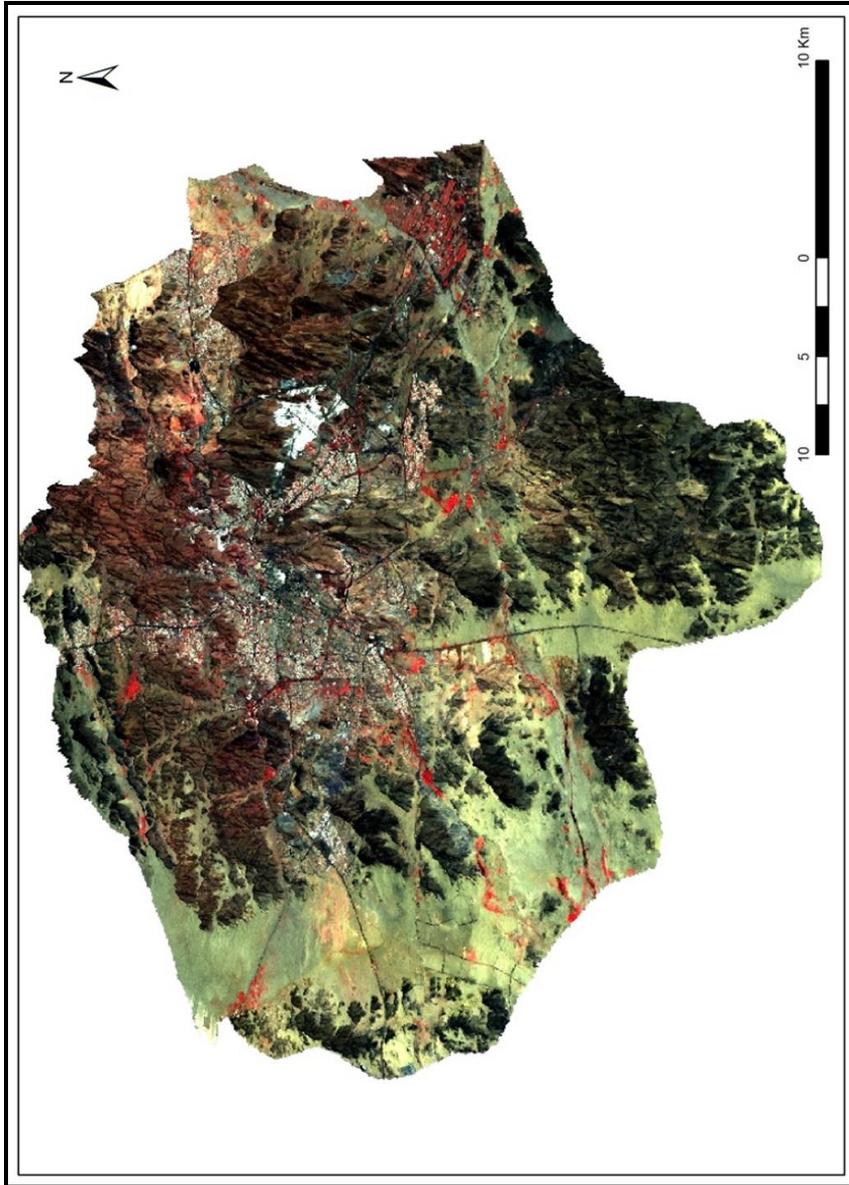


Figure 13. Makkah city by a three-dimensional surface model.
Source: The author created it by draping a Landsat ETM+ image over (SRTM) Digital Elevation Model.



Source: The field work, 2014.

Picture 1. Urban sprawl toward the mountainous areas in Makkah city.

Successive projects expanding the Holy Mosque have led to the demolition of some parts of the old districts surrounding the Holy Mosque. This has resulted in population movements from the central business district toward the new planned districts, causing further changes in aspects of urban growth. In addition, the Umm Al-Qura University has played an important role in the city's urban expansion since this institution has spurred the growth of the Al-Aziziyah and Al-Awali districts.

Added Rates of The Built-up Area of Makkah

The data in Table (11) indicate that the city's built-up area doubled in size during the first urban boom stage or about five times the space occupied in 1972 (the base year). Then, during the retreat stage, the area doubled again to about seven times the area in the base year, and then doubled once more during the second urban boom stage to 10 times the area in the base year.

Table 11. Cumulative value of the built-up area and number of times the value doubled.

Stage	Built-up area (km ²)	Growth index of built-up area (%)
Until 1972	25	100
1972 - 1990	155.15	620.6
1990 - 2000	174.47	697.9
2000 - 2007	193.08	772.3
2007 - 2013	281.14	1,124.6

Source: Calculated by the author based on satellite images of the city (1972, 1990, 2007, 2013).

3. Evolution of Population and Urban Growth

This section seeks to blend data on urban and population growth showing Makkah's evolution over time, to analyze the relationship between them, and to identify the extent of the built-up area's capacity to absorb population increases. This indicates the extent of the balance between supply (urban growth) and demand (population growth), as well as revealing the evolution of urban density, including the per capita of urban clusters, which helps to identify population densification processes.

The city has experienced an urban and population boom since the 1970s due to increased migration associated with the oil boom, from inside and outside of the KSA. With the construction of car tunnels that ended the natural barriers between the Holy Mosque and other holy sites, the city has experienced significant prosperity, including expanded urbanism along the main roads and the appearance of planned districts in all areas. Developmental activities have concentrated primarily in these planned districts.

According to the data shown in Table (12), the city's population size increased from 733,761 in 1990 to 1,654,877 in 2013. Thus, its population size more than doubled, or 2.25 times, during a quarter of a century, while its built-up area almost doubled during the same period, or about 1.81 times.

Based on an analysis of Makkah's periods of changing urban and population development (Figure 14), the city's population growth was greater than its urban growth during the periods of 1990–2000 and 2000–2007. However, during the last period studied (2007–2013), urban growth was greater than population growth, which indicates that the city's population has

not had to complain about a lack of urban space. This means that no housing problem currently exists in the city as a result of a greater supply than demand, which is confirmed by the indicators of evolution of the city's population and built-up area. Therefore, the city will be able to accommodate a higher population in the future.

Table 12. Developmental indicators of Makkah's population size and built-up area (1990-2013).

Year	Population size	population growth (%)	population index (%)	built-up area (km ²)	built-up area growth (%)	built-up area index (%)	urban density inhabitants/km ²	per capita built-up area (m ²)/inhabitant
1990	733,761	-	100	155.15	-	100	4,729.4	211.4
2000	1,134,246	4.45	154.6	174.47	1.18	112.4	6,501.1	153.8
2007	1,414,586	3.21	192.8	193.08	1.46	124.4	7,326.4	136.5
2013	1,654,877	2.65	225.5	281.14	6.46	181.2	5,886.3	169.9

Source: Calculated by the author from satellite images of the city(1990, 2007, 2013).

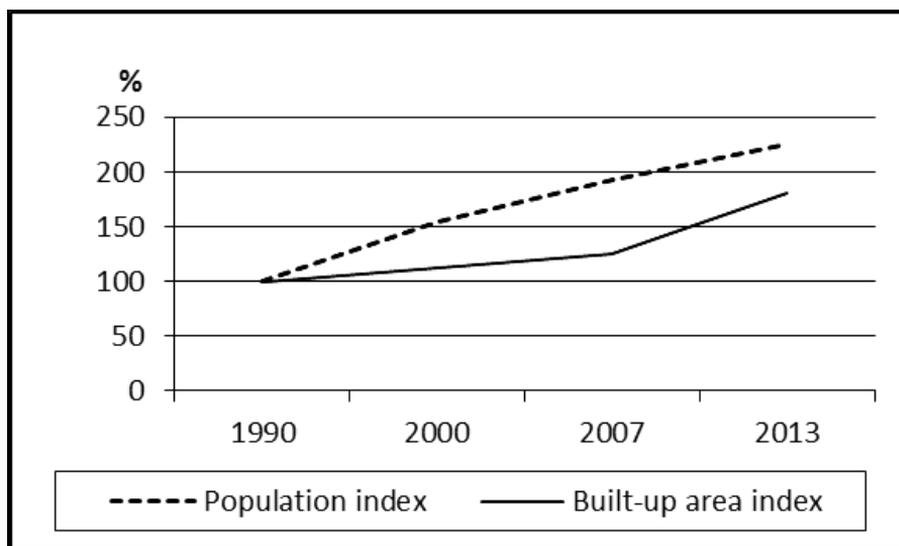


Figure 14. Developmental indicators of Makkah's population and built-up area (1990-2013).

The data shown in Table (12) reveal clearly that the city's urban density increased from 4,729.4 inhabitants/km² in 1990 to 7,326.4 inhabitants/km² in 2007 (the retreat stage). Then, the density decreased to 5,886.3 inhabitants/km² in 2013 (the second urban boom stage). This can be explained by how the continuing flow of immigrants from inside and outside the KSA to the city was not offset by the city's urban growth during the retreat stage. During the second urban boom stage, the greater urban growth compared to population growth, resulting from the building of new planned districts, allowed the population to occupy a larger urban area in the city.

An analysis of the per capita built-up area (Table 12) shows that the per capita built-up area decreased from 211.4 square meters (m²)/inhabitant, in 1990, to 136.5 m²/inhabitant, in 2007. It then increased to 169.9 m²/inhabitant, in 2013.

Population Size (1990-2013)

Based on Appendix 2, Makkah's districts can be divided into five groups according to the geographical distribution of their population from 1990 to 2013, as follows:

- **Group 1:** Districts having a population of less than 10,000: This group included 31 districts, in 1990, but this number dropped to 20 districts, in 2000, and then fell further to 13, in 2007 and 10, in 2013, due to increases in population size causing districts to move to a higher category.
- **Group 2:** Districts having a population ranging from 10,000 to 30,000 included 28 districts, in 1990, but declined to 25, in 2013.
- **Group 3:** Districts having a population ranging from 30,000 to 50,000 experienced a continuous increase from one district, in 1990 (Al-Hindawiyah with 44,482 people), to 17 districts, in 2013, due to the aforementioned factors.
- **Group 4:** Districts with a population ranging from 50,000 to 70,000. This group had also experienced a steady increase from one district only (Al-Hindawiyah with 63,112 people), in 2000, to seven districts, in 2013. These are Al-Tandabawi, Al-Taqwa, Al-Khalidiyyah, Ar Rashidiyyah, Al-Andalus, Al-Zahra, and Al-Jamiah.
- **Group 5:** Districts with a population of more than 70,000 included only one such district in 2007 (Al-Hindawiyah with 76,153 people), and continued to grow to 87,331 in 2013.

Built-up Area (1990-2013)

Based on the data presented in Appendix (2), Makkah's districts can be divided into five groups according to the geographical distribution of built-up areas from 1990 to 2013, as follows:

- **Group 1:** Districts each have less than 500 acres of built-up area. This group included 29 districts, in 1990, but this number declined gradually until it reached 25, in 2013.
- **Group 2:** Districts ranging from 500 to 1,000 acres included 19 districts, in 1990, and 2007, but dropped to 16, in 2013.
- **Group 3:** Districts ranging from 1,000 to 1,500 acres included seven districts in 1990, but declined to five, in 2007. However, the number rose back to seven, in 2013.
- **Group 4:** Districts ranging from 1,500 to 2,000 acres included only three districts, in 1990, and continued without change until 2013.
- **Group 5:** Districts with a built-up area of more than 2,000 acres included only two districts, in 1990 (Al-Mashair and Ar Rashidiyyah), to which were add two more (Al-Awali and Al-Umrah), in 2000. Waly Al-Ahd and Ash Sharai districts were added, in 2007, and continued to rise until it reached nine, in 2013, by adding the districts of Al-Malik Fahd, Al-Buhayrat, and Umm Al-Jud. This growth was due to new planned districts development during the second urban boom stage, which occupied large urban areas in the city.

Urban Density (1990-2013)

Based on an analysis of the data shown in Appendix 2, Makkah's districts can be divided into five groups according to the geographical distribution of urban density from 1990 to 2013, as follows:

- **Group 1:** Districts having an urban density of less than 25 inhabitants/acre included 31 districts, in 1990, but dropped to 22, in 2000, and to 20, in 2007, which continued until 2013.
- **Group 2:** Districts having an urban density ranging from 25 to 50 inhabitants/acre included 19 districts in 1990, continued until 2000 but dropped to 15, in 2007, and 10 districts in 2013.
- **Group 3:** Districts have an urban density ranging from 50 to 75 inhabitants/acre. This group has continuously grown from four, in 1990, to 13, in 2013.
- **Group 4:** Districts have an urban density ranging from 75 to 100 inhabitants/acre. This group has experienced a continuous expansion from three districts, in 1990, to seven, in 2013.
- **Group 5:** Districts have an urban density of more than 100 inhabitants/acre. This group started with three districts in 1990 (Al-Tandabawi, Al-Misfalah, and Al-Taqwa). Then, four other districts were added, in 2000 (Al-haram & Al-Hajlah, Al-Shubaikah, Al-Hindawiyyah, and Al-Zahra). A further three districts were added (Al-Mansur, Al-Hujun, and Al-Khansa), and this number continued until 2013.

Per Capita Built-up Area (1990-2013)

The data in Appendix 2 also allows Makkah's districts to be divided into four groups according to the geographical distribution of per capita built-up area from 1990 to 2013, as follows:

- **Group 1:** Districts having a per capita built-up area of less than 100 m²/person included 11 districts, in 1990, which then increased to 32 districts, in 2013.
- **Group 2:** Districts with a per capita built-up area from 100 to 300 m²/person included 31 districts, in 1990, but decreased gradually until the number reached 14, in 2013.
- **Group 3:** Districts have a per capita built-up area from 300 to 500 m²/person included seven districts, in 1990, but increased to nine, in 2000, and then began to decline until it reached six districts, in 2013.
- **Group 4:** Districts having a per capita built-up area of more than 500 m²/person included 11 districts, in 1990, then decreased to three, in 2007. The number rose again to eight, in 2013, with the Al-Awali, Al-Mashair, Al-Malik Fahd, Batha Quraysh, Al-Osailah, Sharai Al-Mojahedin, An Nawwariyyah, and Umm Al-Jud districts.

4. Future of Population and Built-up Area

This section seeks to develop future scenarios for the city under study with regard to population and built-up area. The research results are used to estimate the city's population size and determine its future trends in urban growth.

Future Population Size

To estimate the city's population in the future (until 2035), three different hypotheses are used to formulate a high, medium, and low estimations. Future trends are likely to fall within the range between high and low hypotheses, but the research's findings indicate that the medium hypothesis should be used for predictions. Projection assumptions are usually based on analyses of recent demographic trends, with the exclusion of major abnormal events, such as war and political upheavals (Woods, 1979).

Based on an analysis of the city's population growth rates over four decades, the medium estimate was calculated using an assumed constant population growth rate at 2.94%, based on the last census period (2004-2010). The low estimate was calculated by lowering the city's population growth rate to 2.44%, while the high estimate was calculated based on the assumption that the population growth rate could reach 3.44%. The same

method was followed to estimate the population size of the region and the KSA (Table 13 and Figure 15).

As Table (13) show, the city's population is expected to be 3,170,199 in 2035, according to the medium estimate (Figure 14). The population was 1,534,731 in 2010, so this is a projected increase of 1,635,468 people, which is equivalent to 106.6% of the city's population size in 2010. In addition, an analysis of the population projections based on low and high estimates showed that the city's population at the end of the projection period (2035) will range from 2,806,880 to 3,578,434.

Table 13. Future estimates of Makkah's population size (until 2035).

Year	projections based on hypotheses of population growth		
	High	Medium	Low
2015	1,817,877	1,774,366	1,731,692
2020	2,153,261	2,051,417	1,953,930
2025	2,550,520	2,371,728	2,204,688
2030	3,021,071	2,742,052	2,487,629
2035	3,578,434	3,170,199	2,806,880

Source: Calculated by the author based on population census, 2010.

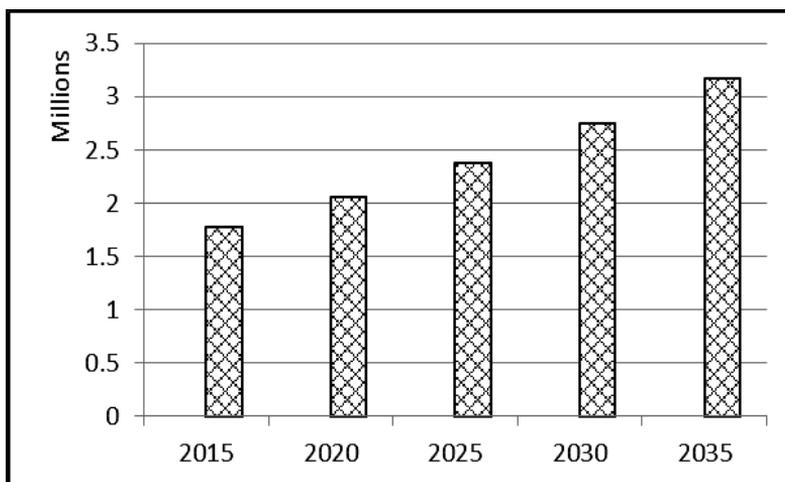


Figure 15. Future population size of Makkah according to the medium estimate (until 2035).

Future of The Geographical Distribution of The Population (2015-2035)

Based on the data shown in Appendix (3), Makkah's districts can be divided into five groups according to the geographical distribution of the population from 2015 to 2035, as follows:

- **Group 1:** These districts' future population is expected to remain stable, according to a medium estimate of less than 10,000. This group will include nine districts in 2015. Then, its numbers will decline gradually until it reaches the end of the projection period to three districts only, including Al-Qararah & Naqqa, Al-Mashair, and Al-Osailah.
- **Group 2:** These districts' future population is expected to range, according to the medium estimate, from 10,000 to 30,000. This group will include 23 districts, in 2015, after which the number will decline gradually until it reaches the end of the projection period and 17 districts.
- **Group 3:** These districts' future population size is expected to range, according to the medium estimate, from 30,000 to 50,000. This group will include 18 districts, in 2015, and then, this number will decline gradually until it reaches the end of the projection period and 10 districts.
- **Group 4:** These districts' future population size is expected to range, according to the medium estimate, from 50,000 to 70,000. This group will include eight districts, in 2015, and then, this number will increase gradually until it reaches the end of the projection period and 12 districts.
- **Group 5:** These districts' population size is expected to increase in the future, according to the medium estimate, to more than 70,000. This group will include only two districts, in 2015 (Al-Hindawiyah, and Al-Jamiah), then the number of districts will increase gradually until the end of projection period is reached and the group has 18 districts.

Future of Built-up Area

Based on three estimates of future population growth, the city's population is expected to increase in the future based on the medium estimate. The medium hypothesis (2.94%) is considered the most reliable for projections of the future of the city's urban and population growth until 2035.

According to the medium estimate, the city's population is projected to reach 3,170,199, in 2035. This means that the total added population during the period (2010-2035) will reach 1,635,468 (Table 14), which is equivalent to 106.6% of the city's population in 2010.

Without doubt, the city's responsibility to provide the required space in the built-up area that meets the requirements of the total increased population must be evaluated accurately, according to the expected average per capita built-up area. This projected ratio can be estimated from the developmental processes of the built-up area from 1972 to 2013, which involves three proposed alternatives:

- High alternative, which reflects only the city's period of rapid urban expansion, from 1972 to 1990, or 300 m²/person.
- Medium alternative, which suggests 189 m²/person based on the entire period studied, from 1972 to 2013.
- Low alternative, which refers to the period of decline in the city's urban expansion, from 1990 to 2007, or 55.7 m²/person.

According to the stage that the city has reached in urban and population growth, the medium alternative will most likely be used. The study's results (Table 14) clearly show that the projected urban space required in the future can be narrowed down to the most likely alternative of 62,812.5 acres to resettle 1,395,833 people until 2035. This period can be divided into four sub-phases:

- **Near-term (2015-2020):** The urban space required during this period is 12,467.3 acres to resettle 277,051 people (55,410 families).
- **Short-term (2020-2025):** The urban space required during this period is 14,414 acres to resettle 320,311 people (64,062 families).
- **Medium-term (2025-2030):** The urban space required during this period is 16,664.6 acres to resettle 370,324 people (74,065 families).
- **Long-term (2030-2035):** The urban space required during this period is 19,266.6 acres to resettle 428,147 people (85,629 families).

This population increase, which exceeds the city's population in 2010, will need development projects in the service sector in various fields (e.g., health, trade, and education). These will need to be exceptionally well planned, including expansions according to observed land use patterns.

Projections can be based on the above-mentioned findings and the city's composed horizontal urban growth map, which shows the areas that have been added to the nucleus area in different geographical directions and the relative proportion of the horizontal urban sprawl in each direction. A field study was also carried out that revealed no impediments to the city's horizontal urban growth in the future except in the east, where the holy sites are located.

Table 14. Future additions to Makkah's population and built-up area (until 2035).

Period	addition in population	urban area required according to the proposed alternatives (acre)		
		High	Medium	Low
2010 - 2015	239,635	17,116.8	10,783.6	3,178
2015 – 2020	277,051	19,789.4	12,467.3	3,674.2
2020 – 2025	320,311	22,879.4	14,414	4,247.9
2025 – 2030	370,324	26,451.7	16,664.6	4,911.2
2030 – 2035	428,147	30,581.9	19,266.6	5,678
Total addition	1,635,468	116,819.2	73,596.1	21,689.3

Source: Calculated by the author, Acre = 4200 m²

Therefore, the results suggest that the best urban expansion area in the near-term (2015-2020) is the As Salama area, which is located in the WNW. As illustrated in Figure (16), this is one of the areas stimulating urban growth, and it will accommodate a population increase until 2020, estimated at 277,051 people (Table 14). In the short-term (2020-2025), the best option is Waly Al-Ahd, which is located in the SSW and is also one of the areas stimulating urban growth. This area will accommodate a population increase until 2025, estimated at 320,311 people. In the medium-term (2025-2030), the urban expansion area is Umm Al-Jud, which is located in the W and is a further district stimulating urban growth. This area will accommodate a population increase until 2030, estimated at 370,324 people. Finally, in the long-term (2030-2035), the best option is Al-Malik Fahd, which is located in the SW and WSW. This is one of the areas stimulating urban growth, and it will accommodate a population increase until 2035, estimated at 428,147 people.

The conflict between the city's urban and population growth will remain in case of a deficit in the growth of either aspect. If the population growth rate exceeds the urban growth rate, a housing problem will appear, and, if the converse happens, an excess of planned housing will develop or non-residential land use will expand.

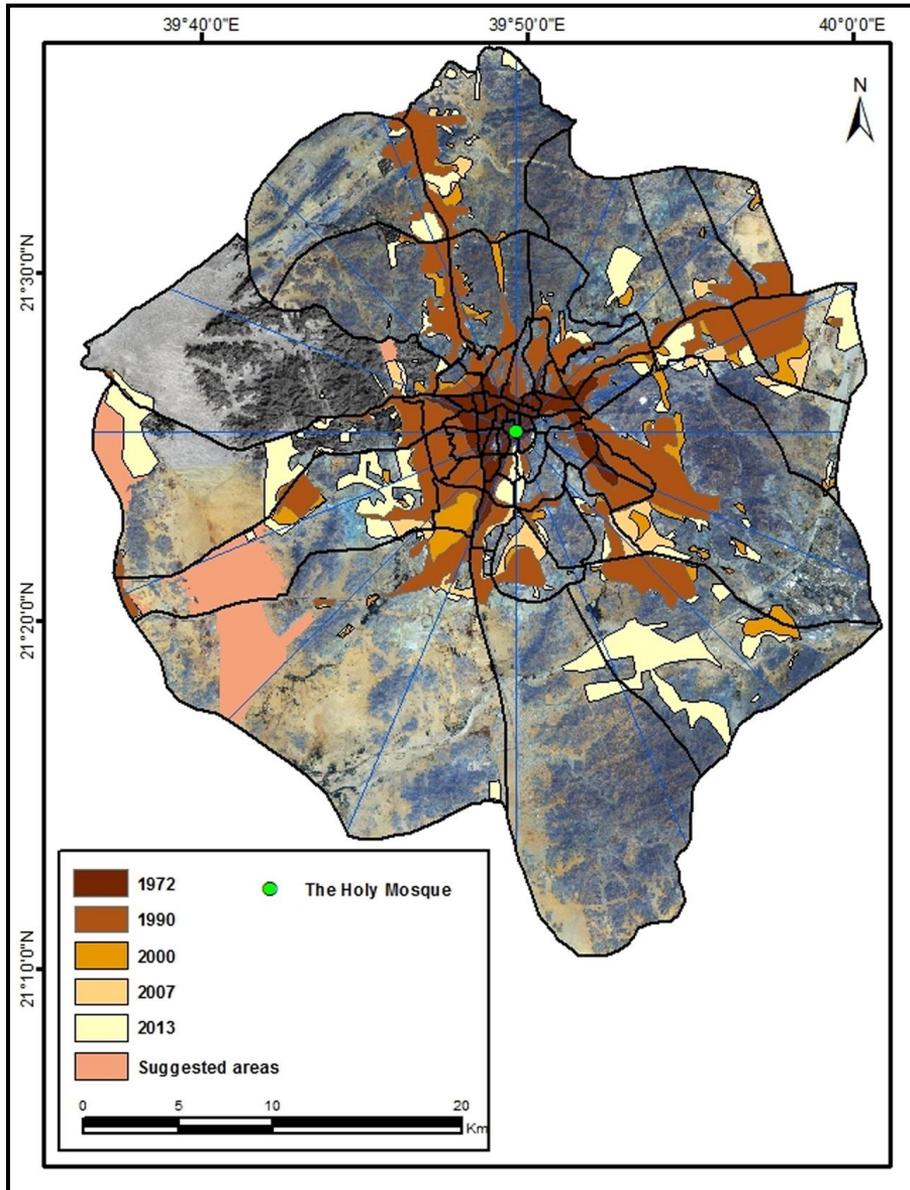


Figure 16. Suggested areas for urban expansion in Makkah: until 2035.

Conclusion

Makkah city's population size was 366,509, in 1974, and continued to rise until it reached 1,534,731, in 2010. This rise was due to internal migration from rural and Bedouin areas, as well as international migrants who came to work in the city.

An unequal distribution of population across the region's cities was maintained in the top 22 most populated cities, from 1974 to 2010. Of these, only two cities (Jiddah and Makkah Al-Mukarramah) constituted three-quarters of the total population of these major cities in 2010.

Makkah came in second place even with an increase in population size from 1,294,168, in 2004—25.5% of the total population of the 22 cities in that year—to 1,534,731, in 2010—25.2% of the total population of these cities in the same year—for a total increase of 240,563. The development projects primarily concentrated in Makkah Al-Mukarramah may have also caused the pattern of distribution to change in favor of this city.

Makkah included 60 districts, in 2010, of which eight districts occupied the top eight ranks for population size, in 2010. Al-Hindawiyah came first with 5.3%, followed by the following districts: Al-Jamiah, Al-Zahra, Al-Taqwa, Al-Khalidiyyah, Al-Tandabawi, Ar Rashidiyyah, and Al-Andalus. The other districts each account for less than 3% of the city's total population in the same year.

Makkah's population growth rate decreased from 5.35%, in 1974, to 2.99%, in 2010. The main reason for this initially higher population growth rate was the concentration of development projects in the city, which led to increased job opportunities and, consequently, increased immigration and migration from rural areas.

From 2004 to 2010, 34 districts recorded population growth rates higher than the city's general rate (2.94%), including four districts occupying the top four slots during that period. More specifically, Al-Okaisheyyah experienced the largest population growth (4.89%), followed by Al-Osailah, Al-Mashair, and Al-Malik Fahd with growth rates of, respectively, 4.71%, 4.45%, and 4.04%. An analysis of the number of years required for Makkah's population to double in size revealed that, in 23.8 years, the city's population will double.

The city has passed through four stages of urban growth since its inception until present time. The origination stage (until 1972) included urban sprawl that reached more than five kms from the core (the Holy Mosque) to the ESE and SSW. The first urban boom stage (1972-1990) included urban sprawl that reached more than 10 kms in three directions (ENE, SE, and NNW). The retreat stage (1990-2007) involved urban sprawl

that reached more than two kms in one direction (NNE). During the second urban boom stage (2007-2013), the growing urban sprawl reached more than 10 kms in two directions (SSE and W).

The built-up area of Makkah in the origination stage (until 1972) was 25 km², after which it grew to 281.14 km², a figure representing the cumulative value of urban growth from the city's origin until 2013. Nearly half of the area added to the city's built-up area (46.3% of the area in 2013) was developed during the first urban boom stage (1972-1990), while another large segment was added to the city's built-up area (31.3% of the area in 2013) during the second urban boom stage (2007-2013).

The data on annual rates of additions to the city's built-up area emphasize that the city has the highest rate of added area during the second urban boom stage, which reached a top rate of 14.7 km²/year. The average horizontal urban growth rate was recorded at its highest during the second urban boom stage (2007-2013), reaching 575 meters/year. The highest horizontal urban growth rates were found to the W, SW, and SE, and the city's future horizontal growth is expected to continue in those directions.

The built-up area doubled during the first urban boom stage to about five times the space, in 1972 (the base year). Then, during the retreat stage, the area doubled again to about seven times the area in the base year and doubled once again during the second urban boom stage, which was 10 times the area in the base year. The per capita built-up area decreased from 211.4 m²/inhabitant, in 1990, until it reached a low of 169.9 m²/inhabitants, in 2013.

Of the city's districts, 31 had a population, in 1990, of less than 10,000. This group shrank to 10, in 2013, due to on-going increases in the population size and the loss of districts to higher categories of population size. The number of districts with a population ranging from 30,000 to 50,000 experienced a continuous increase from only one district, in 1990—Al-Hindawiyyah (44,482 people)—to 17 districts, in 2013. Districts with a population ranging from 50,000 to 70,000 also steadily increased in number from when the city included only one such district, in 2000—Al-Hindawiyyah with a population of 63,112—to seven districts, in 2013: Al-Tandabawi, Al-Taqwa, Al-Khalidiyyah, Ar Rashidiyyah, Al-Andalus, Al-Zahra, and Al-Jamiah.

The number of districts with a built-up area of less than 500, 500–1,000, and 1,000–1,500 acres declined, while the number of districts with a built-up area of more than 2,000 acres increased. This was due to population movements from old to new districts at the edge of the city.

Half of the city's districts, in 2013, had an urban density of less than 50 inhabitants/acre. Notably, their numbers decreased from 50 districts, in 1990, to 30 districts, in 2013, while the other half of the districts' urban density with more than 50 inhabitants/acre increased in number from 10 districts, in 1990, to 30 districts, in 2013, because of the city's continually growing population.

More than half of the city's districts, in 2013, had a per capita built-up area of less than 100 m²/person. This number increased from 11 districts, in 1990, to 32 districts, in 2013. The rest of the districts' per capita built-up area was more than 100 m²/person, but their numbers decreased from 49 districts, in 1990, to 28 districts, in 2013, because of the city's growing population.

The city's population is expected to reach 3,170,199 in 2035, according to the medium estimate calculated. Since the population was 1,534,731 in 2010, this projection represents an increase of 1,635,468 people. The urban space required to provide for this increase, according to the most likely scenario, is 62,812.5 acres to resettle 1,395,833 people, until 2035.

Recommendations

Based on these results, the city should reconsider the new planned areas already existing that occupy large areas of the city's urban space but provide a relatively small number of housing spaces within each planned area. This has caused the scattering of built-up areas in different directions in the city and has put greater demands on infrastructure and basic services, including sanitation, clean drinking water, electricity, and healthcare and educational facilities. Overall, this has created obstacles to the city's development.

Geographers must be given a role in the city's planning and development, including, in particular, population geographers. In addition, planners need to consider the nature of the strong relationship between the city's population and the area's holy sites, to plan successfully for the city's religious activities.

The authorities need to publish data on births and deaths at the city and district level, because of the vital importance of these data to analyses of population changes. Furthermore, the city needs to encourage vertical expansion in its urban growth to overcome its harsh topography and natural barriers such as mountains, rather than removing these or settled on them. The central business district's replanning needs to continue, clearing the old districts of slums and relegating the district's population gradually to the new planned districts, to allow a future expansion of the Holy Mosque. Finally, the development of approved new planned districts should continue but the adoption of any new plans for districts should stop because the city's urban reserve area is still quite large.

Appendices

Appendix 1. Incremental growth in the built-up area through Makkah's developmental stages.

Period	until 1972	1972-1990	1990-2000	2000-2007	2007-2013	Total
Direction	Meter	Meter	Meter	Meter	Meter	Meter
N	1,974	3,220	366	74	45	5,679
NNE	3,746	998	1,967	87	80	6,878
NE	3,742	1,382	49	1,356	10	6,539
ENE	3,948	12,706	28	29	2,493	19,204
E	3,837	4,602	450	126	0	9,015
ESE	5,908	5,221	53	11	2,191	13,384
SE	564	11,917	98	16	4,748	17,343
SSE	541	3,680	59	20	10,643	14,943
S	586	7,361	28	0	66	8,041
SSW	5,790	2,843	42	614	56	9,345
SW	2,564	4,077	32	602	6,940	14,215
WSW	2,513	3,144	0	0	9,668	15,325
W	2,766	3,315	174	0	14,553	20,808
WNW	4,922	513	339	1,300	1,261	8,335
NW	3,322	616	148	1,440	1,866	7,392
NNW	3,914	12,662	0	0	583	17,159
Total	50,637	78,257	3,833	5,675	55,203	193,605

Source: Calculated by the author from satellite images of the city (1972, 1990, 2007, 2013).

Appendix 2. Evolution of the geographical distribution of indicators of the population and built-up area in Makkah (1990-2013).

District	population size			District	population size		
	1990	2000	2013		1990	2000	2013
Ajyad	6,940	11,014	13,865	Al-Khansa	18,589	29,415	36,994
Al-haram & Al-Hajlah	7,839	14,053	18,402	Al-Adel	13,327	21,017	26,400
Al-Shubaikah	13,107	20,112	25,016	Ar-Rawdah	6,127	9,437	11,754
Al-Tandabawi	28,818	41,252	49,955	Jabal Al-Nur	19,421	31,210	39,462
Al-Mansur	9,121	13,376	16,355	Wadi Jalil	18,190	27,940	34,765
Arwal	4,680	7,639	9,710	Al-Aziziyah	8,882	14,002	17,586
At Taysir	6,895	10,651	13,281	Al-Mursalat	5,489	9,590	12,462
Al-Bab & Ash Shamiyyah	2,679	4,469	5,722	Al-Jamiah	29,914	47,173	59,254
Al-Qararah & Naqqa	1,636	2,795	3,606	An Nasim	8,273	12,342	15,190
Sheab Amer & Aly	1,962	3,303	4,243	Al-Awali	14,750	22,626	28,140
Ar Rawabi	3,206	4,871	6,037	Al-Mashair	358	914	1,304
Al-Misfalah	19,715	29,799	36,857	Al-Malik Fahd	7,398	15,778	21,644
Kuday	6,099	9,424	11,752	Ash Shawqiyyah	18,424	27,185	33,319
Al-Taqwa	29,095	42,820	52,428	Al-Kakiyyah	5,494	8,670	10,894
Jerham	8,099	12,249	15,154	Al-Hijrah	3,680	4,921	5,791
Al-Khalidiyyah	29,011	42,115	51,287	Batha Quraysh	2,743	4,197	5,214
Al-Hindawiyyah	44,482	63,112	76,153	Al-Okaisheyyah	2,424	8,004	11,910
Al-Rusayfah	21,213	30,397	36,825	Waly Al-Ahd	13,515	20,251	24,967
Al-Hujun	13,345	21,624	27,419	Ash Sharai	13,729	21,778	27,412
Al-Andalus	22,672	35,011	43,648	Al-Khadra	12,725	20,240	25,501
Al-Utaibiyyah	20,553	31,984	39,987	Al-Osailah	146	430	628
Al-Biban	4,390	7,239	9,233	Sharai Al-Mojahedin	4,158	6,663	8,417
Ash Shuhada	6,788	10,977	13,909	Ar Rashidiyyah	23,652	36,577	45,625
Al-Zahra	28,799	43,870	54,421	Al-Umrah	15,281	24,210	30,460
Al-Nuzhah	13,531	20,416	25,236	At Taniem	11,549	17,894	22,336
Al-Diyafah	6,799	10,539	13,157	Al-Buhayrat	18,541	29,272	36,785
Al-Zahir	17,863	26,533	32,602	An Nawwariyyah	5,292	8,216	10,262
Al-Sulaimiyyah	3,099	4,728	5,868	As Salama	5,922	9,122	11,362
Al-Jummayzah	6,792	10,852	13,694	Umm Al-Jud	4,630	7,270	9,118
Al-Maabdah	17,403	27,392	34,384	Total city	733,761	1,134,246	1,654,877
Rei'a Zakhir	14,504	23,289	29,439				

Appendix 2. (Continued)

District	population index (%)				District	population index (%)			
	1990	2000	2007	2013		1990	2000	2007	2013
Al-yad	100	158.7	199.8	235.0	Al-Khansa	100	158.2	199.0	234.0
Al-haram & Al-Hajlah	100	179.3	234.7	282.3	Al-Adel	100	157.7	198.1	232.7
Al-Shubaikah	100	153.4	190.9	222.9	Ar-Rawdah	100	154.0	191.8	224.3
Al-Tandabawi	100	143.1	173.3	199.2	Jabal Al-Nur	100	160.7	203.2	239.6
Al-Mansur	100	146.7	179.3	207.3	Wadi Jalil	100	153.6	191.1	223.3
Jarwal	100	163.2	207.5	245.4	Al-Aziziyah	100	157.6	198.0	232.6
Al Tayisir	100	154.5	192.6	225.3	Al-Mursalat	100	174.7	227.0	271.9
Al-Bab & Ash Shamiyyah	100	166.8	213.6	253.7	Al-Jannah	100	157.7	198.1	232.7
Al-Qararah & Naqqa	100	170.8	220.3	262.8	An Nasim	100	149.2	183.6	213.1
Sheaab Amer & Aly	100	168.4	216.3	257.3	Al-Awali	100	153.4	190.8	222.8
Ar Rawabi	100	151.9	188.3	219.4	Al-Mashair	100	255.6	364.6	458.0
Al-Mistalah	100	151.1	186.9	217.6	Al-Malik Fahd	100	213.3	292.6	360.5
Kuday	100	154.5	192.7	225.4	Ash Shawqiyyah	100	147.6	180.8	209.4
Al-Tagwa	100	147.2	180.2	208.5	Al-Kakiyyah	100	157.8	198.3	233.0
Jetham	100	151.2	187.1	217.9	Al-Hijrah	100	133.7	157.4	177.6
Al-Khalidiyyah	100	145.2	176.8	203.9	Batha Quravsh	100	153.0	190.1	221.8
Al-Hindawiyah	100	141.9	171.2	196.3	Al-Okaisheyyah	100	330.2	491.3	629.5
Al-Rusayfah	100	143.3	173.6	199.6	Walay Al-Ahd	100	149.8	184.7	214.6
Al-Hujun	100	162.0	205.5	242.7	Ash Sharai	100	158.6	199.7	234.8
Al-Andalus	100	154.4	192.5	225.2	Al-Khadra	100	159.1	200.4	235.8
Al-Ulaibiyyah	100	155.6	194.6	227.9	Al-Osailah	100	293.6	429.2	545.3
Al-Biban	100	164.9	210.3	249.2	Sharat Al-Mojahedin	100	160.2	202.4	238.6
Ash Shuhada	100	161.7	204.9	241.9	Ar Rashidiyyah	100	154.6	192.9	225.7
Al-Zahra	100	152.3	189.0	220.4	Al-Umrh	100	158.4	199.3	234.4
Al-Nuzhah	100	150.9	186.5	217.0	At Tamim	100	154.9	193.4	226.4
Al-Diyafah	100	155.0	193.5	226.5	Al-Buhayrat	100	157.9	198.4	233.1
Al-Zahir	100	148.5	182.5	211.6	An Nawwariyyah	100	155.2	193.9	227.0
Al-Sulaimaniyyah	100	152.5	189.3	220.8	As Salama	100	154.0	191.9	224.3
Al-Jummayzah	100	159.8	201.6	237.5	Umm Al-Jud	100	157.0	196.9	231.1
Al-Maabdah	100	157.4	197.6	232.0					
Rei'a Zakhir	100	160.6	203.0	239.3	Total city	100	154.6	192.8	225.5

Appendix 2. (Continued)

District	built-up area (acre)			District	built-up area (acre)			
	1990	2000	2007		2013	1990	2000	2007
Ajyad	167.1	167.1	167.1	206.2	343.4	343.4	343.4	343.4
Al-haram & Al-Hajlah	129.6	129.6	129.6	159.3	536.3	701.7	701.7	841.7
Al-Shubaikah	151.6	151.6	151.6	152.3	266.0	266.0	266.0	275.4
Al-Tandabawi	149.7	149.7	149.7	160.3	840.9	983.8	893.8	895.2
Al-Mansur	140.0	140.0	140.0	140.0	562.5	705.5	705.5	944.2
Jarwal	184.4	184.4	184.4	184.4	573.4	573.4	573.4	583.7
At Taysir	211.8	211.8	211.8	211.8	727.6	727.6	727.6	727.6
Al-Bab & Ash Shamiyyah	84.4	84.4	84.4	84.4	1,147.9	1,147.9	1,147.9	1,147.9
Al-Qararah & Naqqa	85.2	85.2	85.2	85.2	507.8	554.8	837.9	1,057.5
Sheaab Amer & Aly	140.2	140.2	140.2	141.6	1,987.1	2,113.3	2,129.1	6,972.4
Ar Rawabi	117.5	117.5	139.3	256.7	3,346.5	4,160.4	5,377.9	6,677.5
Al-Misfalah	156.6	156.6	156.6	293.1	1,179.9	1,234.5	1,551.5	5,181.7
Kuday	202.7	202.7	204.6	354.4	589.2	1,360.5	1,360.5	1,360.5
Al-Taqwa	240.2	240.2	242.8	514.3	671.7	671.7	824.0	829.5
Jerham	272.6	272.6	272.6	275.7	214.2	280.7	352.4	441.7
Al-Khalidiyyah	641.7	641.7	641.7	641.7	844.7	933.8	1,520.1	1,620.8
Al-Hindawiyyah	542.8	542.8	542.8	542.8	533.1	533.1	582.5	1,484.2
Al-Rusayfah	781.5	781.5	781.5	781.5	1,317.7	1,781.6	2,119.7	2,580.0
Al-Hujun	252.3	252.3	252.3	252.3	1,339.8	1,588.5	2,060.2	3,186.6
Al-Andalus	550.0	552.0	552.0	552.0	783.8	783.8	783.8	945.6
Al-Utaibiyyah	543.4	550.9	550.9	550.9	1,009.7	1,009.7	1,208.1	1,234.6
Al-Biban	146.1	146.1	146.1	146.1	322.5	331.9	331.9	1,258.5
Ash Shuhada	315.3	318.7	318.7	323.6	2,414.9	2,954.1	3,249.4	4,246.1
Al-Zabra	359.2	359.2	359.2	359.2	1,890.1	2,181.7	2,527.2	3,363.5
Al-Nuzhah	785.0	785.0	785.0	785.0	1,076.1	1,483.2	1,483.2	1,534.6
Al-Diyafah	207.9	207.9	207.9	207.9	1,661.6	1,849.9	1,849.9	2,238.9
Al-Zahr	444.7	552.0	552.0	555.0	1,062.2	1,071.6	1,071.6	1,598.0
Al-Sulaimiyyah	134.3	134.3	134.3	134.3	274.2	355.8	584.5	1,199.4
Al-Jummayzah	169.3	169.3	169.3	169.3	887.0	973.2	973.2	4,354.7
Al-Maabdah	442.7	442.7	442.7	447.7				
Rei'a Zakhir	676.0	676.0	676.0	676.0				
Total city					38,338.4	43,112.5	47,711.1	69,471.2

Appendix 2. (Continued)

District	built-up area index (%)				District	built-up area index (%)			
	1990	2000	2007	2013		1990	2000	2007	2013
Aiyad	100	100	100	123.4	Al-Khansa	100	100	100	100
Al-haram & Al-Hajlah	100	100	100	123	Al-Adel	100	130.8	130.8	157
Al-Shubaikah	100	100	100	100.5	Ar-Rawdah	100	100	100	103.5
Al-Tandabawi	100	100	100	107.1	Jabal Al-Nur	100	106.3	106.3	106.5
Al-Mansur	100	100	100	100	Wadi Jali	100	125.4	125.4	167.9
Jarwal	100	100	100	100	Al-Aziziyah	100	100	100	101.8
At Taysir	100	100	100	100	Al-Mursalat	100	100	100	100
Al-Bab & Ash Shamiyyah	100	100	100	100	Al-Jamiah	100	100	100	100
Al-Qararah & Naqqa	100	100	100	100	An Nasim	100	109.2	165	208.2
Sheaab Amer & Aly	100	100	100	101	Al-Awali	100	106.3	107.1	350.9
Ar Rawabi	100	100	118.5	218.5	Al-Mashair	100	124.3	160.7	199.5
Al-Misfalah	100	100	100	187.2	Al-Malik Fahd	100	104.6	131.5	439.2
Kuday	100	100	100.9	174.8	Ash Shawqiyyah	100	230.9	230.9	230.9
Al-Taqwa	100	100	101.1	214.1	Al-Kakiyyah	100	100	122.7	123.5
Jerham	100	100	100	101.1	Al-Hijrah	100	131	164.5	206.2
Al-Khalidiyyah	100	100	100	100	Batha Quraysh	100	110.6	180	191.9
Al-Hindawiyyah	100	100	100	100	Al-Okaisheyyah	100	100	109.3	278.4
Al-Rusayfah	100	100	100	100	Waly Al-Ahd	100	135.2	160.9	195.8
Al-Hujun	100	100	100	100	Ash Sharai	100	118.6	153.8	237.8
Al-Andalus	100	100.4	100.4	100.4	Al-Khadra	100	100	100	120.6
Al-Utaibiyyah	100	101.4	101.4	101.4	Al-Osailah	100	100	119.7	122.3
Al-Biban	100	100	100	100	Sharai Al-Mojahedin	100	102.9	102.9	390.3
Ash Shuhada	100	101.1	101.1	102.6	Ar Rashidiyyah	100	122.3	134.6	175.8
Al-Zahra	100	100	100	100	Al-Umrah	100	115.4	133.7	178
Al-Nuzhah	100	100	100	100	At Tanem	100	137.8	137.8	142.6
Al-Diyafah	100	100	100	100	Al-Buhayrat	100	111.3	111.3	134.7
Al-Zahir	100	124.1	124.1	124.8	An Nawwariyyah	100	100.9	100.9	150.4
Al-Sulaimaniyyah	100	100	100	100	As Salama	100	129.7	213.1	437.3
Al-Jummayzah	100	100	100	100	Umm Al-Iud	100	109.7	109.7	491
Al-Maabdah	100	100	100	101.1					
Re'ia Zakhir	100	100	100	100	Total city	100	112.4	124.4	181.2

Appendix 2. (Continued)

District	urban density inhabitants/acre			District	urban density inhabitants/acre		
	1990	2000	2013		1990	2000	2013
	Aiyad	41.5	65.9		83.0	Al-Khansa	54.1
Al-haram & Al-Hajlah	60.5	108.4	142.0	Al-Adel	24.9	30.0	37.6
Al-Shubaikah	86.5	132.7	165.1	Ar-Rawdah	23.0	35.5	44.2
Al-Tandabawi	192.5	275.5	333.7	Jabal Al-Nur	23.1	34.9	44.2
Al-Mansur	65.1	95.5	116.8	Wadi Jalil	32.3	39.6	49.3
Jarwal	25.4	41.4	52.6	Al-Aziziyah	15.5	24.4	30.7
Al-Taysir	32.6	50.3	62.7	Al-Mursalat	7.5	13.2	17.1
Al-Bab & Ash Shamiyyah	31.7	53.0	67.8	Al-Jamiah	26.1	41.1	51.6
Al-Qararah & Naqqa	19.2	32.8	42.3	An Nasim	16.3	22.2	18.1
Sheaab Amer & Aly	14.0	23.6	30.3	Al-Awali	7.4	10.7	13.2
Ar-Rawabi	27.3	41.5	43.3	Al-Mashair	0.1	0.2	0.2
Al-Misfalah	125.9	190.3	235.4	Al-Malik Fahd	6.3	12.8	14.0
Kuday	30.1	46.5	57.4	Ash Shawgiyyah	31.3	20.0	24.5
Al-Taqwa	121.1	178.3	215.9	Al-Kakiyyah	8.2	12.9	13.2
Jerham	29.7	44.9	55.6	Al-Hijrah	17.2	17.5	16.4
Al-Khalidiyyah	45.2	65.6	79.9	Batha Quraysh	3.2	4.5	3.4
Al-Hindawiyyah	81.9	116.3	140.3	Al-Okaisheyyah	4.5	15.0	20.4
Al-Rusayfah	27.1	38.9	47.1	Waly Al-Ahd	10.3	11.4	11.8
Al-Hujun	52.9	85.7	108.7	Ash Sharai	10.2	13.7	13.3
Al-Andalus	41.2	63.4	79.1	Al-Khadra	16.2	25.8	32.5
Al-Uraibiyyah	37.8	58.1	72.6	Al-Osailah	0.1	0.4	0.5
Al-Biban	30.0	49.5	63.2	Sharai Al-Mojahedin	12.9	20.1	25.4
Ash Shuhada	21.5	34.4	43.6	Ar Rashidiyyah	9.8	12.4	14.0
Al-Zahra	80.2	122.1	151.5	Al-Umrah	8.1	11.1	12.1
Al-Nuzhah	17.2	26.0	32.1	Al-Taniem	10.7	12.1	15.1
Al-Diyafah	32.7	50.7	63.3	Al-Buhayrat	11.2	15.8	19.9
Al-Zahir	40.2	48.1	59.1	An Nawwariyyah	5.0	7.7	9.6
Al-Sulaimaniyyah	23.1	35.2	43.7	As Salama	21.6	25.6	19.4
Al-Jummayzah	40.1	64.1	80.9	Umm Al-Jud	5.2	7.5	9.4
Al-Maabdah	39.3	61.9	77.7	Total city	19.1	26.3	29.6
Rei'a Zakhir	21.5	34.5	43.5				23.8

Appendix 2. (Continued)

District	per capita built-up area m ² /person				District	per capita built-up area m ² /person			
	1990	2000	2007	2013		1990	2000	2007	2013
Aiyad	101.1	63.7	50.6	53.1	Al-Khansa	77.6	49.0	39.0	33.2
Al-Baram & Al-Hajlah	69.4	38.7	29.6	30.2	Al-Adel	169.0	140.2	111.6	114.0
Al-Shubaikeh	48.6	31.6	25.4	21.9	Ar-Rawdah	182.4	118.4	95.1	84.2
Al-Tandabawi	21.8	15.2	12.6	11.7	Jabal Al-Nur	181.8	120.3	95.1	80.8
Al-Mansur	64.5	44.0	36.0	31.1	Wadi Jalil	129.9	106.1	85.2	97.6
Jarwal	165.5	101.4	79.8	67.4	Al-Aziziyah	271.1	172.0	136.9	118.7
Al-Taysir	129.0	83.5	67.0	57.3	Al-Mursalat	556.7	318.6	245.2	204.8
Al-Bab & Ash Shamriyyah	132.3	79.3	61.9	52.1	Al-Jamiah	161.2	102.2	81.4	69.3
Al-Qararah & Naqqa	218.6	128.0	99.2	83.2	An Nasim	257.8	188.8	231.7	251.9
Sheeab Amer & Aly	300.1	178.2	138.8	117.8	Al-Awail	565.8	392.3	317.8	891.0
Ar Rawabi	153.9	101.3	96.9	153.3	Al-Mashair	39,297.2	19,111.0	17,321.4	17,121.7
Al-Misfalah	33.4	22.1	17.8	28.7	Al-Malik Fahd	669.8	328.6	301.1	816.0
Kuday	139.6	90.4	73.1	108.3	Ash Shawqiyyah	134.3	210.2	171.5	148.1
Al-Tagwa	34.7	23.6	19.5	35.6	Al-Kakiyyah	513.5	325.4	317.7	272.2
Jerham	141.3	93.5	75.5	65.6	Al-Hitrah	244.5	239.6	255.6	283.8
Al-Khalidiyyah	92.9	64.0	52.6	45.6	Batha Quraysh	1,293.2	934.6	1,224.5	1,118.5
Al-Hindawiyyah	51.3	36.1	29.9	26.1	Al-Okaishiyah	923.6	279.7	205.4	408.6
Al-Rusayfah	154.7	108.0	89.1	77.5	Waly Al-Ahd	409.5	369.5	356.6	373.5
Al-Hujun	79.4	49.0	38.6	32.7	Ash Sharai	409.9	306.4	315.7	415.1
Al-Andalus	101.9	66.2	53.1	45.4	Al-Khadra	258.7	162.6	129.1	132.3
Al-Uraibiyah	111.0	72.3	57.9	49.4	Al-Osailah	28,978.7	9,869.4	8,079.4	6,498.0
Al-Biban	139.8	84.8	66.5	56.1	Sharai Al-Mojahedin	325.7	209.2	165.6	532.9
Ash Shuhada	195.1	121.9	96.2	82.8	Ar Rashidiyyah	428.8	339.2	299.1	334.1
Al-Zahra	52.4	34.4	27.7	23.8	Al-Umrath	519.5	378.5	348.5	394.4
Al-Nuzhah	243.7	161.5	130.7	112.3	At Tamem	391.4	348.1	278.9	246.5
Al-Diyafah	128.4	82.9	66.4	56.7	Al-Buhayrat	376.4	265.4	211.2	217.6
Al-Zahir	104.6	87.4	71.1	61.7	An Nawwariyyah	843.0	547.8	438.6	558.6
Al-Sulaimaniyyah	182.1	119.4	96.2	82.4	As Salama	194.5	163.8	216.0	379.3
Al-Jumayzah	104.7	65.5	51.9	44.1	Umm Al-Jud	804.6	562.2	448.3	1,709.0
Al-Maabbah	106.8	67.9	54.1	46.6					
Reia Zakhir	195.8	121.9	96.4	81.8					
					Total city	219.4	159.6	141.7	176.3

Source: Calculated by the author based on satellite images of the city (1972, 1990, 2007, 2013).

Appendix 3. Future distribution of Makkah's population by districts (until 2035).

District	2015			2015		
	High	Medium	Low	High	Medium	Low
Ajyad	17,967	17,537	17,116	47,897	46,751	45,628
Al-haram & Al-Hajlah	24,674	24,087	23,511	34,144	33,327	32,526
Al-Shubaikah	32,070	31,302	30,549	15,087	14,726	14,372
Al-Tandabawi	62,499	60,998	59,526	51,334	50,107	48,904
Al-Mansur	20,643	20,148	19,662	44,584	43,516	42,469
Jarwal	12,690	12,386	12,089	22,742	22,198	21,665
Al-Taysir	17,064	16,656	16,255	16,599	16,204	15,816
Al-Bab & Ash Shamiyyah	7,526	7,346	7,170	76,633	74,800	73,003
Al-Qararah & Naqqa	4,773	4,660	4,548	19,288	18,826	18,372
Sheaab Amer & Aly	5,595	5,461	5,330	36,072	35,209	34,361
Ar Rawabi	7,713	7,529	7,347	1,873	1,829	1,786
Al-Misfalah	47,013	45,887	44,782	30,156	29,441	28,741
Kuday	15,100	14,738	14,384	42,148	41,137	40,145
Al-Taqwa	66,259	64,670	63,111	14,093	13,756	13,425
Jerham	19,334	18,871	18,416	7,051	6,881	6,714
Al-Khalidiyyah	64,498	62,950	61,432	6,678	6,518	6,361
Al-Hindawiyah	94,958	92,676	90,438	17,664	17,249	16,842
Al-Rusayfah	46,089	44,983	43,897	31,753	30,992	30,246
Al-Hujun	35,757	34,902	34,065	35,516	34,667	33,834
Al-Andalus	56,072	54,730	53,414	33,069	32,278	31,503
Al-Utaibiyyah	51,498	50,266	49,057	919	897	876
Al-Biban	12,102	11,813	11,530	10,939	10,678	10,421
Ash Shuhada	18,127	17,694	17,269	58,640	57,237	55,860
Al-Zahra	69,599	67,932	66,298	39,451	38,507	37,582
Al-Nuzhah	32,170	31,399	30,644	28,725	28,037	27,363
Al-Diyafah	16,923	16,518	16,121	47,591	46,453	45,337
Al-Zahir	41,337	40,346	39,374	13,206	12,890	12,580
Al-Sulaimiyyah	7,507	7,328	7,151	14,584	14,235	13,893
Al-Jummayzah	17,783	17,358	16,941	11,776	11,495	11,219
Al-Maabdah	44,442	43,379	42,336			
Re'a Zakhir	38,286	37,371	36,474			
				1,817,877	1,774,366	1,731,692
			Total city			

Appendix 3. (Continued)

District	2020			District	2020		
	High	Medium	Low		High	Medium	Low
Aiyad	21,397	20,386	19,418	Al-Khansa	57,008	54,314	51,735
Al-Haram & Al-Hajlah	30,042	28,629	27,275	Al-Adel	40,611	38,691	36,854
Al-Shubaikah	37,927	36,133	34,415	Ar-Rawdah	17,857	17,012	16,204
Al-Tandabawi	72,760	69,307	66,002	Jabal Al-Nur	61,286	58,392	55,621
Al-Mansur	24,170	23,024	21,927	Wadi Jafit	52,738	50,243	47,855
Jarwal	15,195	14,478	13,792	Al-Aziziyah	27,047	25,769	24,545
Ar-Taysir	20,210	19,254	18,339	Al-Mursalat	20,124	19,176	18,269
Al-Bab & Ash Shammyyah	9,049	8,622	8,214	Al-Jamiah	91,145	86,838	82,715
Al-Qararah & Naqqa	5,764	5,492	5,232	An Nasim	22,671	21,597	20,569
Sheaab Amer & Aly	6,739	6,421	6,117	Al-Awali	42,658	40,640	38,708
Ar-Rawabi	9,103	8,672	8,260	Al-Mashair	2,385	2,274	2,168
Al-Misfalah	55,419	52,795	50,284	Al-Malik Fahd	37,642	35,880	34,193
Kuday	17,884	17,038	16,228	Ash Shawqiyyah	49,418	47,076	44,834
Al-Taqwa	77,642	73,962	70,440	Al-Kakiyyah	16,765	15,972	15,214
Jerham	22,794	21,715	20,682	Al-Hijrah	8,066	7,682	7,315
Al-Khalidiyyah	75,339	71,766	68,346	Batha Quraysh	7,892	7,519	7,161
Al-Hindawiyah	110,310	105,072	100,060	Al-Okaisheyyah	22,969	21,903	20,881
Al-Rusayyah	53,669	51,123	48,685	Waly Al-Ahd	37,360	35,590	33,897
Al-Hujun	42,758	40,739	38,807	Ash Sharai	42,293	40,294	38,382
Al-Andalus	66,403	63,262	60,256	Al-Khadra	39,399	37,538	35,756
Al-Uaibiyah	61,085	58,196	55,431	Al-Osailah	1,185	1,130	1,077
Al-Biban	14,520	13,835	13,179	Sharai Al-Mojahedin	13,053	12,436	11,846
Ash Shuhada	21,668	20,645	19,665	Ar Rashidiyyah	69,465	66,180	63,035
Al-Nuzhah	37,908	36,113	34,395	Al-Umrh	46,966	44,747	42,622
Al-Diyafah	20,057	19,108	18,200	At Tanem	34,041	32,431	30,890
Al-Zahir	48,541	46,241	44,040	Al-Buthayrat	56,618	53,942	51,381
Al-Sulaimaniyyah	8,867	8,448	8,046	An Nawwariyyah	15,656	14,916	14,207
Al-Jumayzah	21,206	20,205	19,246	As Salama	17,262	16,446	15,664
Al-Maabdah	52,838	50,340	47,950	Umm Al-Jud	13,994	13,333	12,700
Re'ta Zakhir	45,702	43,543	41,477				
				Total city	2,153,261	2,051,417	1,953,930

Appendix 3. (Continued)

District	2025			District	2025		
	High	Medium	Low		High	Medium	Low
Ajyad	25,481	23,697	22,030	Al-Khansa	67,851	63,099	58,660
Al-haram & Al-Hajlah	36,577	34,026	31,643	Al-Adel	48,302	44,919	41,758
Al-Shubaikah	44,855	41,709	38,771	Ar-Rawdah	21,136	19,654	18,269
Al-Tandabawi	84,705	78,747	73,183	Jabal Al-Nur	73,168	68,046	63,261
Al-Mansur	28,299	26,311	24,453	Wadi Jalil	62,384	58,010	53,923
Jarwal	18,196	16,923	15,734	Al-Aziziyah	32,167	29,914	27,809
At Taysir	23,935	22,257	20,690	Al-Mursalat	24,396	22,694	21,103
Al-Qararah & Ash Shamiyyah	10,880	10,120	9,409	Al-Jamiah	108,406	100,813	93,719
Al-Qararah & Naqqa	6,960	6,474	6,020	An Nasim	26,647	24,776	23,029
Sheaab Amer & Aly	8,117	7,549	7,019	Al-Awali	50,447	46,909	43,604
Ar Rawabi	10,743	9,989	9,285	Al-Mashair	3,038	2,828	2,631
Al-Misfalah	65,328	60,744	56,462	Al-Malik Fahd	46,988	43,727	40,679
Kuday	21,182	19,697	18,310	Ash Shawqiyyah	57,942	53,873	50,071
Al-Taqwa	90,981	84,590	78,620	Al-Kakiyyah	19,943	18,546	17,241
Jerham	26,873	24,988	23,226	Al-Hijrah	9,228	8,577	7,969
Al-Khalidiyyah	88,001	81,815	76,038	Batha Quraysh	9,328	8,673	8,062
Al-Hindawiyyah	128,144	119,127	110,705	Al-Okaisheyah	29,868	27,812	25,888
Al-Rusayfah	62,496	58,101	53,995	Waly Al-Ahd	43,956	40,871	37,989
Al-Hujun	51,130	47,552	44,209	Ash Sharai	50,362	46,835	43,540
Al-Andalus	78,637	73,124	67,974	Al-Khadra	46,942	43,655	40,584
Al-Utaibiyyah	72,456	67,378	62,634	Al-Osailah	1,527	1,422	1,323
Al-Biban	17,421	16,202	15,064	Sharai Al-Mojahedin	15,575	14,485	13,466
Ash Shuhada	25,900	24,087	22,394	Ar Rashidiyyah	82,288	76,520	71,131
Al-Zahra	97,043	90,236	83,877	Al-Umrah	55,912	51,997	48,338
Al-Nuzhah	44,669	41,535	38,606	Al-Taniem	40,341	37,513	34,872
Al-Diyafah	23,771	22,105	20,548	Al-Buhayrat	67,357	62,639	58,231
Al-Zahir	56,999	52,997	49,258	An Nawwariyyah	18,561	17,260	16,045
Al-Sulaimaniyyah	10,474	9,739	9,053	As Salama	20,432	18,999	17,661
Al-Jummayzah	25,289	23,518	21,864	Umm Al-Jud	16,630	15,465	14,377
Al-Maabdah	62,820	58,419	54,308				
Rei'a Zakhir	54,553	50,735	47,167				
				Total city	2,550,520	2,371,728	2,204,688

Appendix 3. (Continued)

District	2030			District	2030		
	High	Medium	Low		High	Medium	Low
Ayyad	30,346	27,546	24,993	Al-Khansa	80,758	73,306	66,511
Al-Baram & Al-Hajjah	44,534	40,442	36,709	Al-Adel	57,450	52,148	47,313
Al-Shubaikeh	53,047	48,147	43,678	Ar-Rawdah	25,016	22,705	20,598
Al-Tandabawi	98,612	89,474	81,144	Jabal Al-Nur	87,353	79,297	71,951
Al-Mansur	33,133	30,067	27,271	Wadi Jalil	73,794	66,977	60,761
Jarwal	21,789	19,781	17,949	Al-Aziziyah	38,257	34,726	31,506
At-Taysir	28,347	25,729	23,342	Al-Mursalat	29,576	26,857	24,376
Al-Bab & Ash Shamniyyah	13,082	11,878	10,779	Al-Jamiah	128,936	117,037	106,186
Al-Qararah & Naqqa	8,404	7,631	6,926	An Nasim	31,321	28,424	25,782
Shehab Amer & Aly	9,776	8,876	8,055	Al-Awali	59,657	54,146	49,120
Ar Rawabi	12,678	11,506	10,438	Al-Mashair	3,868	3,516	3,194
Al-Mistafalah	77,009	69,890	63,399	Al-Malik Fahd	58,654	53,291	48,395
Kuday	25,087	22,770	20,658	Ash Shawqiyyah	67,937	61,650	55,919
Al-Taqwa	106,612	96,745	87,750	Al-Kakiyyah	23,724	21,534	19,538
Jerham	31,683	28,754	26,084	Al-Hijrah	10,557	9,576	8,681
Al-Khalidiyyah	102,791	93,272	84,595	Batha Quraysh	11,024	10,005	9,077
Al-Hindawiyah	148,862	135,062	122,483	Al-Okaisheyyah	38,839	35,315	32,097
Al-Rusayfah	72,774	66,031	59,884	Waly Al-Ahd	51,717	46,935	42,574
Al-Hujun	61,141	55,504	50,363	Ash Sharai	59,970	54,437	49,391
Al-Andalus	93,124	84,523	76,680	Al-Khadra	55,929	50,769	46,064
Al-Uraibiyyah	85,944	78,008	70,772	Al-Osailah	1,969	1,790	1,626
Al-Biban	20,901	18,975	17,219	Sharai Al-Mojahedin	18,584	16,870	15,307
Ash Shuhada	30,958	28,100	25,501	Ar Rashidiyyah	97,479	88,476	80,267
Al-Zahra	114,590	104,000	94,345	Al-Ummah	66,564	60,422	54,821
Al-Nuzhah	52,636	47,770	43,333	At Tanem	47,807	43,392	39,366
Al-Diyafah	28,173	25,571	23,199	Al-Buhayrat	80,132	72,737	65,994
Al-Zahir	66,931	60,740	55,094	An Nawwarriyyah	22,005	19,973	18,120
Al-Sulaimaniyyah	12,371	11,228	10,185	As Salama	24,184	21,950	19,913
Al-Jummayzah	30,157	27,376	24,839	Umm Al-Jud	19,762	17,938	16,275
Al-Maabdah	74,688	67,794	61,509				
Re'ia Zakhir	65,119	59,114	53,637				
				Total city	3,021,071	2,742,052	2,487,629

Appendix 3. (Continued)

District	2035			District	2035		
	High	Medium	Low		High	Medium	Low
Ajyad	36,138	32,020	28,354	Al-Khansa	96,119	85,164	75,413
Al-haram & Al-Hajlah	54,221	48,067	42,587	Al-Adel	68,331	60,541	53,608
Al-Shubaikah	62,736	55,577	49,206	Ar-Rawdah	29,609	26,230	23,224
Al-Tandiabawi	114,801	101,662	89,973	Jabal Al-Nur	104,288	92,408	81,834
Al-Mansur	38,794	34,359	30,412	Wadi Jalil	87,292	77,331	68,466
Jarwal	26,091	23,121	20,476	Al-Aziyyah	45,499	40,312	35,696
At Taysir	33,573	29,743	26,334	Al-Mursalat	35,856	31,784	28,157
Al-Bab & Ash Shamiyyah	15,730	13,941	12,348	Al-Jamiah	153,354	135,872	120,313
Al-Qararah & Naqqa	10,148	8,995	7,968	An Nasim	36,814	32,608	28,865
Sheaab Amer & Aly	11,775	10,436	9,244	Al-Awali	70,549	62,498	55,334
Ar Rawabi	14,962	13,254	11,734	Al-Mashair	4,926	4,372	3,878
Al-Misfalah	90,778	80,413	71,188	Al-Malik Fahd	73,216	64,945	57,576
Kuday	29,713	26,324	23,307	Ash Shawqiyyah	79,656	70,551	62,450
Al-Taqwa	124,927	110,646	97,940	Al-Kakiyyah	28,221	25,004	22,141
Jerham	37,353	33,088	29,292	Al-Hijrah	12,078	10,691	9,457
Al-Khalidiyyah	120,067	106,334	94,115	Batha Quraysh	13,029	11,542	10,219
Al-Hindawiyyah	172,929	153,128	135,514	Al-Okaisheyyah	50,504	44,843	39,794
Al-Rusayfah	84,743	75,044	66,416	Waly Al-Ahd	60,849	53,898	47,713
Al-Hujun	73,112	64,786	57,375	Ash Sharai	71,412	63,273	56,029
Al-Andalus	110,281	97,699	86,502	Al-Khadra	66,636	59,042	52,283
Al-Utaibiyyah	101,943	90,316	79,968	Al-Osailah	2,538	2,253	1,999
Al-Biban	25,076	22,223	19,682	Sharai Al-Mojahedin	22,175	19,648	17,400
Ash Shuhada	37,005	32,791	29,039	Ar Rashidiyyah	115,473	102,300	90,576
Al-Zahra	135,308	119,863	106,118	Al-Umrah	79,244	70,212	62,173
Al-Nuzhah	62,024	54,941	48,639	At Tamiem	56,655	50,192	44,440
Al-Diyafah	33,390	29,581	26,192	Al-Buhayrat	95,330	84,464	74,792
Al-Zahir	78,595	69,614	61,623	An Nawwariyyah	26,088	23,112	20,464
Al-Sulamiyyah	14,612	12,944	11,460	As Salama	28,624	25,358	22,451
Al-Jummayzah	35,963	31,865	28,218	Umm Al-Iud	23,485	20,807	18,424
Al-Maabdah	88,797	78,674	69,664	Total city	3,578,434	3,170,199	2,806,880
Ref'a Zakhir	77,732	68,877	60,995				

Source: Calculated by the author based on population census data for 2010.

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