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FEN BİLİMLERİ ENSTİTÜSÜ



MUSUL, SÜLEYMANİYE, ERBİL VE DUHOK ŞEHİRLERİNDE
NÜFUS VE SOSYOEKONOMİK GELİŞMİŞLİK ÜZERİNE
İSTATİSTİKSEL BİR İNCELEME

Vian Adeeb MOHAMMED KARIM

Yüksek Lisans Tezi

İSTATİSTİK ANABİLİM DALI

TEMMUZ 2025

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ELAZIĞ

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ÖNSÖZ

Bu tez çalışması Fırat Üniversitesi Fen Bilimleri Enstitüsü İstatistik Bölümü Anabilim Dalı Yüksek Lisans Programında yazılmıştır.

Gerçekleştirilen bu tez çalışmasında mevcut verilere dayanarak Musul, Süleymaniye, Erbil ve Duhok şehirlerindeki sosyoekonomik gelişme düzeylerinin ve nüfus dağılımının analiz edilmesi hedeflenmiştir.

Bu çalışmanın konusunun belirlenmesinden en son aşamasına kadar bana yol gösteren, bilgi ve tecrübelerinden yararlandığım saygı değer hocam Doç. Dr. Gökhan GÖKDERE'ye ve Dr. Alan Ghafur Rahim'e teşekkürlerimi ve saygılarımı sunarım.

Ayrıca eğitim hayatım boyunca maddi ve manevi desteklerini esirgemeyen aileme teşekkür ederim.

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İÇİNDEKİLER

Sayfa

ÖNSÖZ	IV
İÇİNDEKİLER	V
ÖZET	VII
ABSTRACT	VIII
ŞEKİLLER LİSTESİ	IX
TABLolar LİSTESİ	X
KISALTMALAR	XI
1. INTRODUCTION	1
1.1. Background of the Study	2
1.1.1. Ongoing Conflict and Displacement	3
1.1.2. Informal Settlements	3
1.1.3. Access to Drinking Water and Basic Services	4
1.1.4. Demographic Challenges	4
1.1.5. Spatial Disparities	5
1.1.6. Urban Mobility	5
1.1.7. Economic	6
1.2. Research Problem	6
1.3. Objectives of the Study	7
1.4. Significance of the Study	7
2. LITERATURE REVIEW	8
2.1. Studies on Population Distribution	8
2.2. Socioeconomic Development Indicators	9
2.2.1. Socioeconomic Development Indicators of Mosul	9
2.2.2. Socioeconomic Development Indicators of Sulaymaniyah	10
2.2.3. Socioeconomic Development Indicators of Erbil	12
2.2.4. Socioeconomic Development Indicators of Duhok	13
2.3. Multivariate Statistical Methods in Urban Studies	14
2.4. Case Studies in Iraq or Similar Regions	14
3. METHODOLOGY	16
3.1. Geographic and demographic overview with population and socioeconomic data of Mosul	16
3.1.1. Demographics	16
3.1.2. Economy	16
3.1.3. Living conditions	17
3.1.4. Education	17
3.1.5. Health	17
3.2. Geographic and demographic overview with population and socioeconomic data of Sulaymaniyah	
21	
3.2.1. Demographics	21
3.2.2. Economy	22
3.2.3. Employment	22
3.2.4. Education	22
3.2.5. Health	23
3.3. Geographic and demographic overview with population and socioeconomic data of Erbil	26

3.3.1. Demographics	26
3.3.2. Economy	26
3.3.3. Employment	27
3.3.4. Education.....	27
3.3.5. Health	27
3.4. Geographic and demographic overview with population and socioeconomic data of Duhok	31
3.4.1. Demographics	31
3.4.2. Economy	32
3.4.3. Health	32
3.4.4. Education.....	33
4. RESULTS AND DISCUSSION.....	37
4.1. Population Distribution Patterns Spatial analyses of population density and growth trends	37
4.2. Socioeconomic Development Levels.....	38
4.2.1. Demographics	39
4.2.2. Economy	39
4.2.3. Education.....	40
4.2.4. Health	41
4.3. Determining Factors Affecting Development Using Statistical Findings.....	42
4.3.1. Population growth	43
4.3.2. The emergence of European urban style	43
4.3.3. Area extending and variety of land uses.....	44
4.3.4. Technological evolution and car emergence	44
4.4. Implications for urban development recommendations for balanced regional development.....	45
5. CONCLUSION AND RECOMMENDATIONS	47
Summary of Key Findings	47
Policy Recommendations Strategies For Addressing Socioeconomic Disparities	49
Limitations of the Study.....	50
Suggestions for Future Research.....	51
KAYNAKLAR	52
ÖZGEÇMİŞ	

ÖZET

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Bu tez çalışması, mevcut veriler ışığında istatistiksel yöntemleri kullanarak Musul, Süleymaniye, Erbil ve Duhok şehirlerindeki sosyoekonomik gelişme düzeylerini ve nüfus dağılımını analiz etmeyi amaçlamaktadır.

Çalışmada kullanılan veriler, gelecekteki sosyoekonomik gelişmeyi ve bunun kalkınma üzerindeki etkisini tahmin etmek için kullanılabilir, böylece gelecek için değerli bilgiler sağlar. Bulgular, sosyal hizmetlerin ve altyapının güçlendirilmesi gibi kalkınma girişimlerinin, nüfus ve ekonomik büyüme arasında bir denge kurulmasına odaklanması gerektiğini göstermektedir. Genel olarak, stratejik karar vermeyi ve gelecekte sürdürülebilir kalkınmanın sağlanmasını destekleyebilecek kavramsal bir çerçeve sunarak, bu çalışma Irak'ta demografik değişiklikler ve kalkınma arasındaki karmaşık ilişkiyi anlamamıza yardımcı olmaktadır.

Anahtar Kelimeler: Nüfus dağılımı, Musul, Süleymaniye, Erbil, Duhok, İstatistiksel yöntemler

ABSTRACT

A Statistical Study on Population and Socioeconomic Development in the Cities of Mosul, Sulaymaniyah, Erbil, and Duhok

Vian Adeeb MOHAMMED KARIM

Master's Thesis

FIRAT UNIVERSITY
Graduate School of Natural and Applied Sciences
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This thesis aims to analyze the socio-economic development levels and population distribution in the cities of Mosul, Sulaymaniyah, Erbil, and Duhok using statistical methods based on existing data.

The data used in the study can be used to predict future socio-economic development and its impact on development, thus providing valuable information for the future. The findings indicate that development initiatives, such as strengthening social services and infrastructure, should focus on establishing a balance between population and economic growth. Overall, by providing a conceptual framework that can support strategic decision-making and ensure sustainable development in the future, this study helps us understand the complex relationship between demographic changes and development in Iraq.

Keywords: Population distribution, Mosul, Sulaymaniyah, Erbil, Duhok, Statistical methods

ŞEKİLLER LİSTESİ

	Sayfa
Figure 3.1. The population density of Mosul from 1975 to 2015	29
Figure 3.2. The population change percentage between Mosul or Nineveh and Iraq	30
Figure 3.3. Analyzing the Population by Age and Gender.....	31
Figure 3.4. Estimated Ancient Population of Mosul until 2100.....	31
Figure 3.5. Statistical composite index of life expectancy, education, and per capita income	32
Figure 3.6. The population density of Sulaymaniyah from 1975 to 2015.....	35
Figure 3.7. The population change percentage between Sulaymaniyah and Iraq.....	35
Figure 3.8. Analyzing the Population by Age and Gender.....	36
Figure 3.9. Estimated Ancient Population of Sulaymaniyah until 2100	36
Figure 3.10. Statistical composite index of life expectancy, education, and per capita income	36
Figure 3.11. The population density of Erbil from 1975 to 2015.....	39
Figure 3.12. The population change percentage between Erbil and Iraq	40
Figure 3.13. Analyzing the Population by Age and Gender.....	41
Figure 3.14. Estimated Ancient Population of Erbil until 2100	41
Figure 3.15. Statistic composite index of life expectancy, education, and per capita income	42
Figure 3.16. The population density of Duhok from 1975 to 2015.....	45
Figure 3.17. The population change percentage between Duhok and Iraq	46
Figure 3.18. Analyzing the Population by Age and Gender.....	46
Figure 3.19. Estimated Ancient Population of Duhok until 2100	47
Figure 3.20. A statistical composite measure of per capita income, education, and life expectancy	47

TABLÖLAR LİSTESİ

	Sayfa
Tablo 3.1. Geographic and demographic overview with population data of Mosul	29
Tablo 3.2. The population density of Mosul from 1975 to 2015	29
Tablo 3.3. Population change percentage between Mosul or Nineveh and Iraq	30
Tablo 3.4. Geographic and demographic overview with population data of Sulaymaniyah.....	34
Tablo 3.5. The population density of Sulaymaniyah from 1975 to 2015	35
Tablo 3.6. Population change percentage between Sulaymaniyah and Iraq	35
Tablo 3.7. Geographic and demographic overview with population data of Erbil.....	39
Tablo 3.8. The population density of Erbil from 1975 to 2015.....	40
Tablo 3.9. Population change percentage between Erbil and Iraq	40
Tablo 3.10. Geographic and demographic overview with population data of Duhok.....	45
Tablo 3.11. The population density of Duhok from 1975 to 2015.....	45
Tablo 3.12. Population change percentage between Duhok and Iraq	46
Tablo 4.1. Area and percentage of Mosul, Sulaymaniyah, Erbil, and Duhok cities.....	48
Tablo 4.2. Population distribution by environment during the years 2010–2020 AD in the cities of Mosul, Sulaymaniyah, Erbil, and Duhok.	49

KISALTMALAR

Kısaltmalar

UN	: United Nations
TFR	: Total Fertility Rate
LULC	: Land use and Land Cover
IDP	: Internally Displaced Persons
IOM	: International Organization for Migration
NGO	: None Governmental Organization
GIS	: Geographical Information System
WHO	: World Health Organization
PDS	: Public Distribution System
CSO	: Central Statistical Organization
PHCs	: Primary Health Care Centers
ISIL	: Islamic State of Iraq and the Levant
AUI-S	: American University of Iraq – Sulaymaniyah
ESL	: English as a Second Language
UNHCR	: United Nations High Commissioner for Refugees
PSETC	: The Psycho-Social Education and Training Center
CMH	: Child Mental Health
MHH	: Mental Health House
GDP	: Gross Domestic Product
IMR	: Infant Mortality Rate
UNDP	: United Nations Development Program
ONS	: Office for National Statistics

1. INTRODUCTION

Mosul, also known as the Nineveh Governorate, is popular among Iraqis and has the second-largest population after Baghdad. It is the birthplace of an old civilization that dates back thousands of years. There is so much religious and sectarian diversity among the populace that Mosul's towns and villages represent every aspect of Iraq. Known as the "mother of two springs," Mosul is the most picturesque city in Iraq. It is well-known for its tourist attractions, recreational areas, and stunning historical and religious sites. It is situated on the banks of the Tigris River. The ruins of ancient civilizations and its archeological sites would astound you if you were to relocate outside of Mosul. It should come as no surprise that these regions have been subjected to a wide range of crimes, including forced relocation, looting, demolition, devastation, and murder. However, the Iraqi Security Forces and the fervent citizens of Mosul and throughout Iraq will ensure that goodwill ultimately prevails and that the sun of freedom rises once more on the plains of Nineveh. Since ISIL's occupation is nothing more than a destructive enterprise, the international coalition will assist in achieving this [1].

The 2019 edition of the World Population Prospects anticipated that 42.165 million people lived in Iraq in 2022. Iraq's population has grown at an average annual rate of 2,97 percent during the past ten years, which is substantially greater than that of West Asia (1,84 percent) and middle-income nations (1,09 percent). The growth rate is expected to stay positive at 1,45 percent by 2050 (UN, 2019). Fertility rates and mortality rates are the two main causes of the pattern of robust but slowing natural population increase (apart from migration). From 8,11 children per woman in 1950 to 3,45 children per woman in 2022, the Total Fertility Rate (TFR) fell by about 60%. By 2050, it is predicted to drop even more, to 2,61 children per woman (UN, 2019).

Over the past ten years, Duhok, a hilly city in northern Iraq, has experienced tremendous urban growth as a result of both population increase and economic advancements. Due to the rising demand for housing, these factors have put a lot of strain on the lands and have been the main causes of changes in land use and land cover (LULC). Rapid urban growth is the outcome of this as well as the lack of effective urban planning systems [2].

By tracking population growth, distribution, and structure over the previous three decades, demographic factors created the impetus for a significant shift in Iraq's perspective toward the formal adoption of national population policies and programs that are integrated with sustainable development strategies. The population's welfare suffered in the 1980s due to this demographic situation, which coincided with worsening environmental and economic conditions. This is predicted to continue to be a major worry in the years to come. Numerous effects have been identified by this study, including high rates of illiteracy, worsening health conditions, high mortality rates, poor nutrition, high fertility, and unemployment, especially among young people,

in addition to poverty and low rural productivity, as well as a lack of food and water security and regional and global conflicts.

According to historical development patterns, development is a continual structural process that frequently results in changes in patterns of production, distribution, and consumption. It also likely has a significant impact on the social and individual behaviors of the populace. Such a shift affects the distribution, composition, and growth of the population directly as well as indirectly. However, no definitive historical data nor proof have ever resolved the theoretical dispute over the relationship between population expansion and progress [3].

Given that rising birth rates are a direct effect of economic expansion, population growth is more often the product of development than its cause. When decreasing mortality rates are the driving force behind population expansion, the population may be viewed as an external component in the development process. As a result, in the early phases, there is a positive and direct proportionality between the rates of population expansion and development. Accordingly, population studies assume a demographic change pattern that aligns with economic and social change patterns and emphasize the significance of identifying the relative importance of various economic and social factors that are unique to or linked to particular fertility patterns [4].

1.1. Background of the Study

Planning laws are thought to be useful for structuring urban areas and granting executive authority to master plans. The growth of the city-region's present and its future are shaped by urban plans, master plans, and structural plans. The presence of laws entails the establishment of specialized organizations, organizations that operate in accordance with them, and others that strive to implement them. Due to the various circumstances that have shaped the Iraqi cities of Mosul, Sulaymaniyah, Erbil, and Duhok over time, Iraq has been characterized by civilized elements appropriate for the establishment and development of cities and civilizations. Plans to control the use of urban land have been developed by government agencies [5].

Mosul, Sulaymaniyah, Erbil, and Duhok all have planning practices that are not new; rather, they are extensions of the laws of earlier civilizations. Natural conditions, religion, customs, and traditions all influenced its formulation, and as it was the most appropriate at the time, it was made into law. Before establishing their borders in the early 1900s, several empires controlled the cities in northern Iraq, and they were subject to the laws, rules, and regulations of the ruling state.

The historical study concentrated on the laws enacted in the newly established Iraqi state in the early 1920s. The development and administration of Iraqi cities, particularly those in the north, such as Mosul, Sulaymaniyah, Erbil, and Duhok, are specifically the responsibility of the institutions and legislative system.

1.1.1. Ongoing Conflict and Displacement

One of the most complicated humanitarian crises in the world right now is the one in Iraq. The country's growing number of internally displaced people (IDPs), security-related problems and worries, and the difficulty of reaching vulnerable populations are the biggest obstacles to humanitarian assistance. The recent development of the group identifying as Islamic State (IS) and its spread in Iraq, particularly in Mosul, which has led to the huge displacement of people fleeing violence and fear, is one of the most prominent reasons of this extraordinary disaster.

The Mosul City Displacement Tracking Matrix, maintained by the International Organization for Migration (IOM), estimates that between January 1, 2014, and March 31, 2016, around half a million individuals were internally displaced [6].

Mosul has the greatest IDP population (7 percent, or 220,398 people), followed by Sulaymaniyah (5 percent, or 162,678 people), Erbil (10 percent, or 329,472 people), and Duhok (13 percent, or 409,170 people). Furthermore, Iraq has been taking in almost 245,000 Syrian refugees, most of whom are living in the country's north. Large numbers of internally displaced people still require housing and basic services, even though some are able to rent apartments or stay temporarily with family. As part of their emergency response, the Iraqi government, United Nations agencies, and foreign nongovernmental organizations have been offering camps and temporary shelters to meet these requirements [7].

1.1.2. Informal Settlements

According to a report by the Central Statistical Organization of Iraq, Ministry of Planning, the number of informal communities in Mosul, Sulaymaniyah, Erbil, and Duhok is growing. The Ministry of Planning believes that there are already over 360 settlements in these cities. According to government officials, Mosul, Sulaymaniyah, Erbil, and Duhok did not have as many informal settlements prior to 2003, and the 2006 sectarian conflict made matters worse. There are currently 328 informal communities in Mosul, Sulaymaniyah, Erbil, and Duhok, making up over 2.9 percent of all Iraqi neighborhoods [4].

IDPs and economic migrants who came to those cities in pursuit of better economic opportunities make up a large portion of the settlements; however, their inability to pay for housing has forced them to live in unofficial settlements with limited or no access to electricity, water, sanitary facilities, schools, or medical care. In metropolitan areas, these informal settlements-where migrants, internally displaced people, and homeless returnees reside-are growing far more quickly than the short-term or long-term fixes offered by the government, UN organizations, and non-governmental organizations. IDPs currently prioritize livelihood over shelter, and local integration is thought to be the most popular settlement option among them. Although informal settlers should

be seen as a resource rather than a threat, their rise will continue in the absence of a thorough plan to integrate IDPs. [8]. In terms of employment prospects offered by the housing and productive sectors, infrastructure restoration, and various services and amenities, the city-wide approach defines the city's development chances for Iraqi inhabitants.

1.1.3. Access to Drinking Water and Basic Services

Since 1990, there have been no notable advancements in the availability of drinking water and other services. Just 60% of the population had water transported to their home or the surrounding area via a piping system, while 89% of homes used potable water sources in 2011 because to an unreliable water supply. Access to sources of drinkable water varies greatly between governorates and between urban and rural areas. For instance, almost 97% of people in urban regions have access to drinkable water, compared to 76% in rural areas [3].

Due to restricted access to public networks, households in remote areas frequently purchase water from unofficial water vendors. Compared to 67 percent of homes in metropolitan regions, just 47 percent of households in rural areas use public networks. Sixty-six percent of Iraqi households are located in metropolitan areas, mostly Sulaymaniyah and Erbil, and around one-third of these households have access to public sanitation facilities. It is also influenced by socioeconomic class; according to the data, 53% of homes with high per capita spending rates have access to public networks, while only 9% of households with low per capita spending rates do the same. Septic tanks and covered sewage holes are frequently used by households without access to public networks. This indicates that an improper sanitation method is used in 65% of households. It should be mentioned that 83 percent of wastewater is not adequately treated, which results in major environmental issues that endanger public health and obstruct the pursuit of sustainable development [2].

1.1.4. Demographic Challenges

Mosul, Sulaymaniyah, Erbil, and Duhok's rapid population increase presents a problem for northern Iraqi development in general and urban development in particular. The population of the nation was ten times more in 2007 than it was in 1927. The Arab League-endorsed Arab Strategy for Housing and Urban Development estimates that there would be about 46 million people living in Iraq overall in 2024. The proportion of young people, which was 28 percent of the population in 2014, has also significantly increased. The economy's capacity to offer good work opportunities will be constrained by this percentage, which is predicted to keep rising over the next 20 years. This expanding workforce in the private sector has not yet been absorbed by the Iraqi economy [9].

1.1.5. Spatial Disparities

In northern Iraq, the degree of urbanization is directly correlated with the quality of life. Because different social classes have differing access to and quality of infrastructure, health care, education, and security, poverty rates are generally greater in rural areas. Poverty is at its lowest in larger cities because poverty decreases as urban agglomeration increases. This served as a primary driving force behind Iraqi internal migration to bigger cities, particularly in the 1950s and 1960s.

Additionally, villages and rural areas have deteriorated as a result of coercive actions. For example, when the government dried up marshes in the countryside in the 1990s, many people were forced to leave their villages because they suddenly ran out of water, which was essential to their livelihood [10]. According to the standard of living index, poverty rates in rural areas, which reached 58%, were significantly higher than those in cities and metropolitan areas, which had poverty rates of only 17%, in 2012. The remaining fundamental fields also show disparities, demonstrating the definite superiority of cities over rural places.

1.1.6. Urban Mobility

Iraq's road and rail system runs longitudinally, paralleling the paths of the Euphrates and Tigris rivers. This has historically resulted in the concentration of activities and human settlements along these two pathways. These ancient routes suffered from heavy traffic and put further strain on the nation's key roads because other parts of Iraq, particularly Mosul, Sulaymaniyah, Erbil, and Duhok, lacked major transportation hubs.

The high expenses of travel delays and their detrimental effects on other transportation-related economic sectors were indicative of this circumstance. As a result, there is an urgent need to address the rising rates of traffic accidents and rise funding for road upkeep. In order to link small and medium-sized cities and generate new development hubs in the northern part of Iraq, a network of radial highways should be built. Additionally, this would fortify the Iraqi transportation network's longitudinal extension, which connects several industrial and economic sectors [11].

The roads of Duhok, Erbil, Sulaymaniyah, and Mosul are also in bad shape. For every 100 residents per km² of population density, 1 km/km² of roads are needed, according international norms. The road network in northern Iraq should be approximately 86,000 km in length, as the current road length is approximately 0.19 km/km². This is in line with 2011 estimates that the population density in the region is 39.5 people per km². According to the previously stated criteria, the necessary new roads would be roughly 8,000 km long if uninhabited desert regions were to be eliminated. Iraq's road system has also been subjected to severe abrasion, with the majority of its sections destroyed by military operations. Inadequate emergency and routine maintenance has further weakened the system.

As a result, road networks' ability to handle large traffic loads has significantly decreased, which has decreased their efficiency. Damaged or missing traffic, warning, and direction signs on international roads and expressways further exacerbate the situation. Thus, it is imperative that Iraq's current road networks be repaired [12].

1.1.7. Economic

Iraq's economy is steadily strengthening as global oil markets rebound, yet structural impediments pose serious challenges to this recovery. Risks include the sluggish collection of arrears, particularly those pertaining to public wages, the central bank's and state-owned banks' significant exposure to the sovereign, and limitations on public investment management that have affected the provision of public services [9]. Fragile political conditions, a poor healthcare system, and widespread corruption all contribute to these fragilities and continue to fuel discontent throughout the nation, particularly in Mosul, Sulaymaniyah, Erbil, and Duhok.

1.2. Research Problem

The research problem of this study is the starting point for any regional economic planning, which is the existence of the regionalization of the economy. These, by and large, have already been determined by political and administrative processes. However, these considerations of those cities in the north of Iraq have to be judged on whether they are also economically suitable as well.

It is well recognized that the specification of the north of Iraq has a strong connection with the economic and social development and conditions. So, in order to specify a region, one has to take into consideration economic, social, and political criteria. There is a particular characteristic for each case, and little common agreement has been reached with regard to the comprehensive general criteria for each purpose. It is a well-known fact that we may have many sets of regions, as there are many criteria that might be considered. In this case, we may have natural regions, nodal systems, administrative units, polarized centers, etc.

However, and for the purpose of this study on the Iraqi economy, we have started fresh by regionalizing the socioeconomic and population according to well-established criteria selected as relevant to the Iraqi northern cities' case and conditions [13]. Accordingly, we are not considering a single factor for such regionalization; rather, a comprehensive combination of different selected criteria and indicators is being adopted.

1.3. Objectives of the Study

The research aims to analyze and understand population and demographic changes in the north of Iraqi cities, Mosul, Sulaymaniyah, Erbil, and Duhok , assessing socioeconomic development levels and application of multivariate statistical methods, and that is by providing valuable contributions to policies and planning in various areas through the following objectives:

1. Demographic Change Analysis: Understand how fertility and mortality rates have changed in the northern Iraqi cities of Mosul, Sulaymaniyah, Erbil, and Duhok.
2. Exploration of Relationships: Analyze the relationships between socioeconomic development and mortality rates.
3. Prediction of Future Changes: Use the analysis to predict how demographic changes will evolve in the future.
4. Policy Guidance: Provide advice and recommendations to governmental entities and international organizations based on the results to guide policies and ongoing programs in Mosul, Sulaymaniyah, Erbil, and Duhok [14].

1.4. Significance of the Study

The significance of this research lies in understanding population and demographic changes in the north of Iraq, especially in Mosul, Sulaymaniyah, Erbil, and Duhok. Several aspects highlight the importance of studying the research, particularly in the realm of population planning. Through population planning, a better understanding of demographic changes can be achieved, facilitating the planning of public services. Additionally, examining economic and social policies helps comprehend the relationship between fertility rates, mortality rates, and economic and social growth, contributing to the development of effective policies.

Furthermore, the research holds importance in the context of public health. It provides insights into how changes in mortality and fertility rates contribute to improvements in public health and guide healthcare efforts. Overall, the study is crucial for informed decision-making in population-related planning, public services, economic and social policies, and public health initiatives [15].

2. LITERATURE REVIEW

In this part of the research, we discuss some other studies on population distribution in Iraq and those cities in the north of that country and the socioeconomic development indicators with multivariate statistical methods in urban studies, with the case studies in Iraq or similar regions, in four different sections.

2.1. Studies on Population Distribution

The term "population distribution," which has its theoretical roots in Marshall and Weber's groundbreaking writings (2017), [16] describes the regional concentration of socioeconomic development. But thanks primarily to Krugman's (2003) important contributions-especially the introduction of the concept of increasing returns to scale, which has profoundly influenced our understanding of demographic challenges and urban mobility-it gained considerable prominence and theoretical foundation within the framework of New Economic Geography [17]. Agglomeration of urban mobility facilities is important from several angles of urban development. In contrast, Basher Faisal (2004) uses the available data to examine the practical aspects of population and demographic trends in Iraq from 2015 to 2020 [18]. Because of the social and political changes that have occurred in Iraq, this is a sensitive and important time period.

From a different angle, Zeki Fattah (2021) seeks to demonstrate how Iraq's rapid population expansion is seriously impeding its economic progress [19].

A high fertility rate brought on by several adverse socioeconomic factors that require immediate attention is the main driver of its rapid population increase. Since the nation's population growth is not consistent, action should be done to lower the trend where it is high and to reinforce it where it is low. Lastly, in order to address its high fertility rate and stop its unchecked population increase, Iraq needs to implement legislation and construct infrastructure immediately [20].

However, the politics of population movements from the beginning of the modern Iraqi state to the present were the main emphasis of Amjad Rabi, (2022) [21]. Primarily derived from secondary sources, it poses inquiries, proposes theories, and opens up several conceptual avenues, partially referencing Michel Foucault's concept of governmentality. It is suggested to take into account the ways in which the state and other political actors influenced population movements, especially throughout the nation-building process and in more recent conflicts for state authority. Within this paradigm, measures that restrict people's movement or force them to relocate could be interpreted as types of control that political actors have exercised over populations [22]. In contrast, Saad Mahdi (2016) researched the Nineveh Governorate, namely Mosul, which is popular with Iraqis and is second in population after Baghdad. Residents of Mosul are eagerly and tenaciously

anticipating the beginning of the liberation of their cities and territory, as well as the removal of ISIL members from them [23]. Additionally, in his study on population distribution evaluation, Sabah Hussein (2020) stated that the goal of his work was to quantify the spatial correlation of the population distribution with residential neighborhoods on both sides of Mosul city by using a semi-variogram model and a geographical information system (GIS) for geostatistical analysis [24]. Lastly, research by Liao and Li (2009) highlights how it promotes innovation, increases urban competitiveness, and stimulates regional growth [25]. According to studies by Huang et al. (2015) [26] and Chen et al. (2019), [27] urban mobility is crucial for understanding the dynamics of urban economic growth, optimizing spatial structures, bolstering competitive advantages, and promoting sustainable development. Simultaneously, Jambally Mohammed's (2013) study addresses the city of Duhok, a mountainous metropolis in northern Iraq, and its fast urban growth [28]. Over the past ten years, this city has experienced tremendous urban growth as a result of both population increase and economic advancements [29].

2.2. Socioeconomic Development Indicators

For discussing this section, we should talk about each city in a separate part and that for understanding the indicators of socioeconomic development for each city in the north of Iraq, which include Mosul, Sulaymaniyah, Erbil, and Duhok.

2.2.1. Socioeconomic Development Indicators of Mosul

Mosul is well known for its ethnic, religious, socioeconomic, and cultural diversity. Arabs (mainly Muslim Sunnis), Kurds (primarily Sunnis), Turkomans (both Sunnis and Shi'ites), Shabak (Shi'ites), Assyrians, Armenians, and Chaldeans (Christians), and Yazidis were among its diverse population in the past. However, given the sectarian and ethnic war in Iraq, demographic data is a delicate subject. It is challenging to find trustworthy information about the number of the population and the ethnoreligious makeup. In 1997, the nation's last formal census was carried out [20]. Despite its inaccuracy, the Public Distribution System (PDS) Ration Card has remained the primary source of demographic information in subsequent years. Accurate census data is extremely difficult to get because of the massive population transfers that the city experienced under the previous regime, especially in the decade that followed its fall. In 2009, the city had 1,137,000 residents, according to the Nineveh Governorate's Statistics Department. Before ISIL seized over the city in 2014, the headcount rose to 1,377,000. Approximately two-thirds of the city's population resided on the right bank until the early 1990s. However, during the Iraq-Kuwait conflict, the left-bank urban districts progressively grew and drew more inhabitants; after 2003, however, they

experienced a substantial expansion, reaching a population level that was comparable to that of the right-bank [30].

Certain groups were more prevalent in particular neighborhoods than others, despite Mosul's traditionally diverse ethnic and religious makeup. The majority of the city's Christian residents lived on the right bank, which is the older and less affluent area with the most of the city's historic churches and Christian places of worship. The left bank was home to the majority of the other minorities, specifically the Shabaks and Kurds. The Kurds dwelt in the areas of Jaza'ir and Al-Nour, while the Shabak mostly lived in Kokjla, Al-Sadada, and Baoizh, as well as Al-Wihda and Prophet Jonah [31].

Prior to June 10, the majority of the rural migrants and internally displaced people who arrived in Mosul between 2003 and 2014 made their homes in some of the most underserved and impoverished areas of the city. In the southwestern zone or part of Mosul, migrants of rural areas of the southern districts and regions established themselves. Additionally, people from Tal Afar settled on the right bank, specifically in the areas of 17 Tamouz, Al-Harmat, Al-Nahrawan, and Al-Eslah Al-Zeraee.

Long before the current wave of ISIL-caused displacements, the Nineveh Governorate saw widespread displacements of its minority groups, as has happened in other regions of Iraq. In particular, the former regime's "Arabization" policies manipulated the governorates' demographics between 1975 (after the Kurdish rebellion ended due to the Algiers Agreement between Iraq and Iran) and 1991 (after the Iraq-Kuwait war ended and Iraqi forces left the Kurdish Governorates), especially in the Sinjar district, the Nineveh Plain, and areas near the north) [32]. Many Kurdish, Turkoman, and Yazidi Iraqis were forcibly uprooted from their hometowns, while Arab groups from the central and southern regions of Iraq took their place. Because the majority of Mosul's population was Arab, the city itself was unaffected by the "Arabization" programs. However, a large number of its Kurdish families chose to go to the northern Iraqi cities of Erbil, Sulaymaniah, and Duhok after 1991. After the previous dictatorship fell in 2003, very few families returned. The nation's rising costs have forced those families and others to relocate once more.

2.2.2. Socioeconomic Development Indicators of Sulaymaniyah

The governorate's population was expected by the Iraqi Central Statistical Organization (CSO) to be 2,336,191 in 2021, with around 450,295 residing in rural regions and 1,276,114 in urban areas. Sulaymaniyah's economy may benefit from its natural water supplies, pleasant climate, and relatively low level of security. But bureaucratic and infrastructure obstacles stand in the way of the private sector's growth. The city sustains robust economic ties between Baghdad and Tabriz, Iran, and is a major hub for local agricultural products. Furthermore, smuggling—including the illicit traffic in drugs, organs, and livestock—was cited in a number of press stories as a problem

in Sulaymaniyah [33]. Men in Sulaymaniyah City had greater entrepreneurial chances than women, according to a study published in August (Summer) 2022 that looked at a sample of 30 business owners. As a result, there were significantly more male entrepreneurs (67.3%) than female entrepreneurs (36.7%). The most active age group in the entrepreneurial field was 18 to 24 years old. Forty percent of business owners rely on their families for financial help. Entrepreneurs reported that managing taxes, registering their businesses, and navigating government processes were very difficult [13]. A portion of the agricultural output of Sulaymaniyah is rainfed. Winter cereal production was hampered by insufficient rainfall in November 2020 and March and early April 2021. Droughts were brought on by exceptionally high temperatures in May 2021.

As a result, it "is expected that winter cereal production will significantly decline compared to the previous year." According to a June 2020 poll conducted in Sulaymaniyah and other northern cities, businesses drastically cut back on their hours of operation, and 15% of them shut down completely till further notice because of the COVID-19 pandemic. 75% of the companies questioned reported lower sales, and many of them responded by cutting wages, firing employees, or ceasing to pay workers' health insurance and social security. Businesses experienced a decline in production activity and a decline in their economic standing.

According to a June 2020 study, household earnings were affected by the pandemic and the response actions that followed, but coping strategies were few. In northern governorates, 84% of households lacked savings. Instead, they took out loans from friends or family (70%) and/or borrowed money from a local business owner (66%). Most did not receive in-kind or monetary support [22].

The Ministry of Health's 2020 Annual Statistical Report [34] states that there were 492 PHCs in the Sulaymaniyah governorate, comprising 377 health sub-centers and 115 primary health care centers. The governorate had the highest density of primary health facilities in the country, with a statistically significant 21.6 health centers per 100,000 people. Physicians ran 13.2% of all primary health care centers (PHCs), with other medical professionals running the great majority (86.8%).

The governorate also has 30 specialty health centers, including 24 with additional specializations, 1 for respiratory disorders, and 5 dentistry centers. There were 63 hospitals in Sulaymaniyah: 25 private and 38 public, including one that provided tertiary care. 3,080 general beds were among the 3,519 total beds available in public hospitals, while 3,847 general beds were available overall (3,080 public beds plus 767 beds in private hospitals). There was no information provided about the number of "emergency beds" available at private hospitals. Prenatal mortality was 0.1 per 1,000 births in 2020, whereas no woman was recorded to have died after childbirth [9].

2.2.3. Socioeconomic Development Indicators of Erbil

Agriculture, construction, wholesale and retail trade, and government employment make up the majority of the Erbil economy. Its oil industry is expanding as well. The World Bank stated in a 2016 report that the Erbil economy was heavily dependent on the oil industry and that government employment accounted for over 50% of all jobs. A 2017 analysis by the Minority Rights Group International states that the oil and gas industry accounts for 90% of the income in all northern Iraqi communities. The administrative and commercial hub of the northern Iraqi cities is the Erbil governorate. While the food supply is reliant on agriculture and food supplies imported from Turkey and Iran, it is abundant in natural resources, particularly oil and gas. The majority of imported goods that come into Iraq from overseas, especially Turkey, pass through the city of Erbil, which is a trading hub in Iraq, according to IOM.

Erbil is the most frequented area in the northern Iraqi cities, accounting for two-thirds of all visitor arrivals due to its allure. An analysis conducted in 2017 by Mark A. DeWeaver, [35] an economist at the American University of Iraq in Sulaymaniyah, indicates that the local government there has entered the third year of an economic recession that began with the global oil price collapse in 2014 (which saw a 50% drop in the second half of that year). The New Arab claims that the economic problem in the local government has been made worse by the recent decline in oil prices. All areas of the economy were impacted by the crisis, including private companies and the services sector. In mid-May, there were also plans to diversify the economy and make investments in industries, tourism, and agriculture in addition to oil.

The government hospital to population ratio was much greater in Sulaymaniyah, Erbil, and Duhok, with one hospital for every 60,000–75,000 inhabitants. The WFP reports that the Erbil governorate had a higher rate of 15.1-19 physicians per 10,000 people and a range of 27-49 public and private institutions. 396 Furthermore, Erbil has 10.1–20% child mortality rates for children under five. 397 Furthermore, Reuters noted that there were 1.5 hospital beds for every 1,000 residents in Sulaymaniyah, Erbil, and Duhok. 398 Based on statistics from 2016, the National Development Plan 2018–2022 states that there was a surplus of 96 primary health care units in Erbil and a deficiency of 11 governmental hospitals. Although not consistently, many of the fundamental primary care services were offered by those cities' municipal administrations [36].

All Iraqis, including those who live in other Iraqi cities, are covered under the PHC [Primary Health Care] system. However, residents of other Iraqi cities who are not Iraqi citizens are not entitled to the same health care and medication benefits as residents of Sulaymaniyah, Erbil, and Duhok. "All citizens are eligible for a broad package of health care, dental, and emergency services in public hospitals and PHCs," according to the same source. The money, the medications and equipment that are available, and the staff's education and training all have an impact on the services that may be offered. Access to public healthcare was guaranteed to Syrian refugees living in the cities of

Sulaymaniyah, Erbil, and Duhok. With the majority of main PHCs serving too many people and the majority of sub-centers serving too few, the distribution of PHC centers in those three cities was not always consistent. However, compared to the sub-centers, the centers that served a greater number of people had more physicians and nurses [37].

2.2.4. Socioeconomic Development Indicators of Duhok

From 250,000 residents in 2007 to 340,400 in 2013, the city of Duhok has seen tremendous population growth (Directorate of Statistics in Duhok City, 2013). 720,000 people were anticipated to live there by 2030, according to the master plan (Municipality of Duhok, Master Plan Report, 2008) [38]. The researcher notes that after 2006, Duhok's population grew significantly as a result of the city's economic and security advancements, which forced many Iraqis from the central and southern regions to relocate there.

Housing, transportation, schools, stores, and services will all be necessary for the new socioeconomic development. Between 2012 and 2017, Duhok City's housing need grew from 43,032 to 50,600 units. As a result, 1,500 units annually are required to meet the increasing demand. Another major issue is the uneven population density, which ranges from 370 people/ha in the city center to less than 50% in the recently constructed area. Urban sprawl and unchecked urban growth have resulted from the lack of a clear land use policy and an efficient planning system [39].

The local administration created a new master plan (2008–2032) for the city of Duhok, designed by the German firm Vossing, in order to curb the city's rapid urban growth. High quality, a diverse living environment, an effective and integrated transportation system, excellent architecture, and a healthy urban landscape are the primary goals and objectives of the master plan. (Municipality of Duhok, Master Plan Report 2008), [38] and this illustrates the city's urban development strategy, which prioritizes using the Duhok River and the existing green vegetation surfaces as the foundation for an open space system and green corridor that define the city's identity.

Nonetheless, the master plan's execution necessitates the provision of a sufficient budget, a land management legal framework, and enough institutional capability. The multifamily housing that was constructed after 2006 as a result of the city's socioeconomic development in accordance with the government's new housing strategy, which aims to support the private housing sector, makes up the newly developed residential area by investors. Since four settlements were chosen—the traditional inner city settlement (Shele), which was established in the 1970s; the formally planned settlement (Grebase) in the 1980s; the legalized informal settlement (Baroshke) in the 1990s; and the formally new one (Masike) in the 2000s—the study will concentrate on this crucial point [40].

2.3. Multivariate Statistical Methods in Urban Studies

The article's primary goal is to try to evaluate urban studies for a few cities in northern Iraq. Based on the challenging implementation of urban smartness, the article attempts to demonstrate the relationships that exist between theoretical and practical factors pertaining to cities. The paper's primary purpose is to standardize the language used in the fields of urban studies and sustainability. These four Iraqi cities are frequently brought up in the article's reflection on sustainable cities. The empirical section uses factor analysis and cluster analysis to evaluate the urban studies indicators for a few chosen Iraqi cities using the ISO 37120 standard [41].

How can we measure the urban population and which variables, which cities have the highest level of urban socioeconomic development, how does city classification present in terms of urban studies, and how are the dependencies between sustainability pillars? These are some of the questions that the manuscript attempts to address. These cities provide a novel approach to urban governance [42].

The joint behavior of many random variables is analyzed using multivariate statistical approaches. The various statistical method examples below demonstrate the variety of multivariate techniques that are accessible. Multivariate statistical analysis in Statgraphics Centurion 19 can be used to accomplish these methods.

The International Organization for Standardization released the ISO 37120 standard in 2014, which aids in evaluating and contrasting urban performance in terms of quality of life and urban services. Education, energy, environment, finance, fire and emergency response, governance, health, recreation, safety, shelter, solid waste, telecommunication & innovation, transportation, urban planning, wastewater, and water & sanitation are just a few of the 17 thematic groups covered by this tool for consistent reporting on state city development [22].

2.4. Case Studies in Iraq or Similar Regions

The researcher examined a number of related publications for this work; we go over a few of them here. The first is Basher Faisal's (2024) study [18], which uses data that has been evaluated practically to examine population and demographic developments in Iraq between 2015 and 2020. Because of the social and political changes that have occurred in Iraq, this is a sensitive and important time period. The main focus of the investigation is the variables that affected Iraq's population growth and demographic shifts throughout this time. With growing birth rates and falling death rates, the data shows a notable growth in the population. The impact of societal changes and advancements in marriage and family rates is demonstrated by this demographic transition, which is a reflection of better living and healthcare conditions.

Even so, Zeki Fattah (2021) wants to demonstrate how Iraq's rapid population expansion is seriously impeding its economic progress [19]. A high fertility rate brought on by several adverse socioeconomic factors that require immediate attention is the main driver of its rapid population increase. Since the nation's population growth is not consistent, action should be done to lower the trend where it is high and to reinforce it where it is low.

The Ministry of Planning arranged a national symposium called "Iraq 2050: Economically Productive and Socially Protected," where Amjad Rabi (2022) prepared his paper for a presentation [21]. However, it should be emphasized that the data constraint is that Iraq census data spans decades. Nevertheless, it highlights significant aspects of the underlying population of Iraq using the best available data and nation comparisons [6]. In another study, Geraldine Chatelard (2021) [43] states that her research focuses on the politics of population movements from the beginning of the modern Iraqi state to the present and is organized as a research agenda. Primarily derived from secondary sources, it poses inquiries, proposes theories, and opens up several conceptual avenues, partially referencing Michel Foucault's concept of governmentality. It is suggested to take into account the ways in which the state and other political actors influenced population movements, especially throughout the nation-building process and in more recent conflicts for state authority. Within this perspective, measures that restrict people's mobility or force them to relocate could be interpreted as types of control that political actors have exercised over populations. Lastly, Sabah Hussein (2020) [44] discussed the goal of his research, which was to quantify the spatial correlation of the population distribution with residential neighborhoods on both sides of Mosul city by using a semi-variogram model and a geographical information system (GIS) for geostatistical analysis. A total of 268 sample sites covering 240 km² have been chosen. Data were entered into ArcGIS10.3 software after the population distribution by neighborhood was established.

3. METHODOLOGY

In order to discuss them separately, we examine the demographic and geographic overview of the cities in this section, focusing on the populations and socioeconomic standing of Mosul, Sulaymaniyah, Erbil, and Duhok, respectively.

3.1. Geographic and demographic overview with population and socioeconomic data of Mosul

Mosul's population has been altered by years of insecurity and ethnic and religious strife, which has also had a significant impact on how well the city's governmental institutions, local government, and business organizations operate. Armed organizations controlled the city and robbed it of a significant portion of its income in the ten years after the previous regime fell. The issue was made worse by widespread corruption, which also played a part in the city's resources being taken over. The situation deteriorated significantly when the city fell to ISIL; its infrastructure and services deteriorated, its public institutions were destroyed, its history and cultural heritage were sadly erased, and its economy nearly collapsed [45].

3.1.1. Demographics

Long before the current wave of displacements caused by ISIL, Mosul has already seen widespread relocation, particularly of its minority groups. Although there is a dearth of precise statistical data regarding the ethnoreligious makeup of the city, it is believed that the bulk of its residents—roughly 80%—have historically been Arab Sunnis, followed by Kurds, Christians, Turkomans, Shabaks, and Yazidis. Many of the city's surviving religious and ethnic minorities left after ISIL took over [46].

3.1.2. Economy

As a major commercial hub, Mosul's primary exports were mineral, industrial, and agricultural goods as well as oil. Years before ISIL took over, al-Qaeda and its affiliates took control of the city's government and economy.

ISIL terrorists seized the city in June 2014, destroyed businesses, plundered the central bank, and extorted money from farmers and business owners to fund their activities. As a result, the city's economy virtually fell apart.

Poverty and unemployment rates rose, and a large number of enterprises closed. ISIL took control of oil fields, refineries, gas factories, and gasoline stations, and they went on to dominate oil sales in their region.

ISIL seized agricultural output and equipment that the government had lent to local farmers and displaced minorities. Additionally, they made farmers sell their goods for less money. Many farmers stopped working in the fields as a result of an unpredictable security situation and declining financial rewards [20].

3.1.3. Living conditions

While Mosul city was a major business hub, Nineveh is one of the most impoverished governorates. Poverty and unemployment rates have risen sharply since ISIL seized over the city and destroyed the local economy. The following elements made the situation much worse:

- Salary transfers for government workers residing in ISIL-occupied areas were stopped by the Iraqi government in July 2015.
- The Public Distribution System that the city's impoverished families relied on for survival ceased to provide them with rations;
- The majority of city dwellers' vulnerability was made worse by heavy taxes, fines, and fees;
- Basic goods saw a sharp increase in price.

3.1.4. Education

All schools were shut down when ISIL took control of Mosul, although they were later reopened with the curriculum modified to fit its own beliefs. In addition, ISIL charged tuition, although public schooling was formerly free. Children born between 2008 and 2009 have enrolled in school at a very low rate during the two years that ISIL has been in power [47]. Mosul had two technical schools and three universities before ISIL. Following the city's occupation by ISIL, all universities were closed. ISIL restored Mosul University's medical departments, engineering schools, and educational institutions in July 2014, however it shut down the majority of the other universities, primarily those in the fields of law, the arts, politics, philosophy, archeology, and tourism.

3.1.5. Health

In the past, the Nineveh Governorate was renowned for providing high-quality healthcare, with the majority of its facilities located in Mosul. Between 2008 and 2014, a significant number of medical facilities underwent rehabilitation. Although hospitals have not been destroyed by airstrikes and are still accepting patients, the ISIL occupation has had a significant negative impact on health services for a number of reasons:

- Numerous medical personnel have escaped.
- No civilian is granted priority access to surgeries.
- The cost of medical services and procedures has gone up dramatically.

- Maternal health is being impacted by segregation.
- Hospitals with poor sanitation.
- The lack of maternity and obstetric care.

There are still a lot of pharmacies, but they don't have much inventory. When it is available, medicine is generally out of reach. Geographic and demographic overview with population data of Mosul is given in Table 3.1.

Table 3.1. Geographic and demographic overview with population data of Mosul.

Area of Nineveh, Iraq	39,065.1 km ²
Population	4.0 million
Male Population	2,012,635 (50.6%)
Female Population	1,961,072 (49.4%)
Population change from 1975 to 2015	+282.9%
Population change from 2000 to 2024	+63.9%
Median Age	19 years
Male Median Age	18.7 years
Female Median Age	19.4 years
Timezone	Arabian Standard Time

Thus, we can get an example of population data from 1975 to 2015 because the recent census of 2024 is still not documented in Iraqi statistical centers; for that purpose, we study the reliable data of the last 10 years. Figure 3.1 shows the population density of the city from 1975 to 2015.

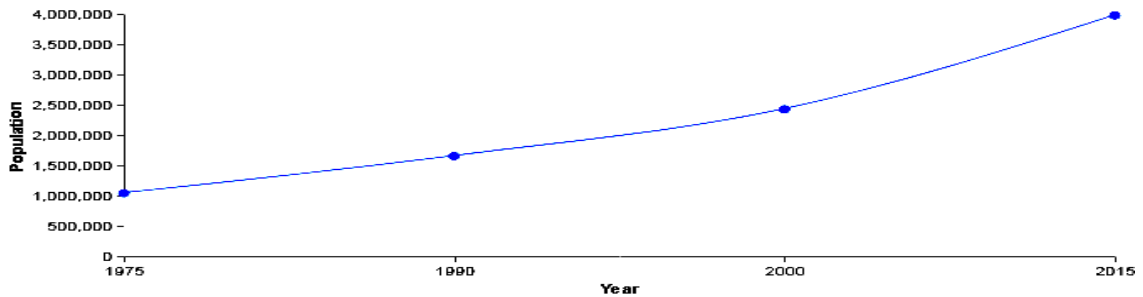


Figure 3. 1. The population density of Mosul from 1975 to 2015

Table 3.2. The population density of Mosul from 1975 to 2015.

Data	1975	1990	2000	2015
Population	1,037,881	1,651,923	2,423,991	3,973,699
Population Density	26.6 / km ²	42.3 / km ²	62.1 / km ²	101.7 / km ²

From another side, if we take population change from 2000 to 2015 and if we compare it with Iraq in general, we can see that the population increased by 63.9% from the years between 2000 and 2015 (Table 3.2).

Figure 3.2 and Table 3.3 show the population change percentage between Mosul or Nineveh and Iraq.

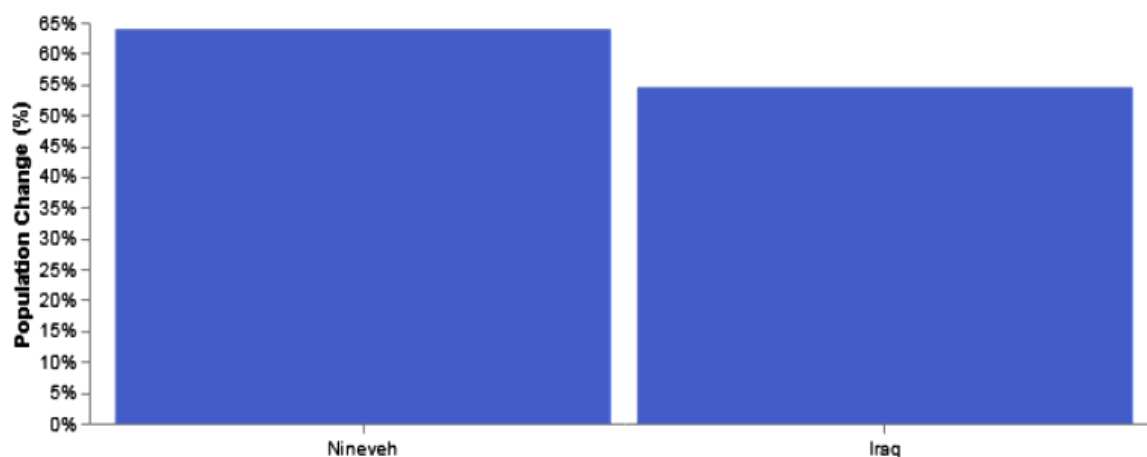


Figure 3.2. The population change percentage between Mosul or Nineveh and Iraq

Note: Increase of 63.9% from the year 2000 to 2015.

Table 3.3. Population change percentage between Mosul or Nineveh and Iraq.

Location	Change since 1975	Change since 1990	Change since 2000
Nineveh, Iraq	+282.9%	+140.5%	+63.9%
Iraq	+211.9%	+108.4%	+54.5%

By analyzing the population by age and gender, we can find the differences between those two ratios, and Figure 3.3 declares that contrast in ratios.

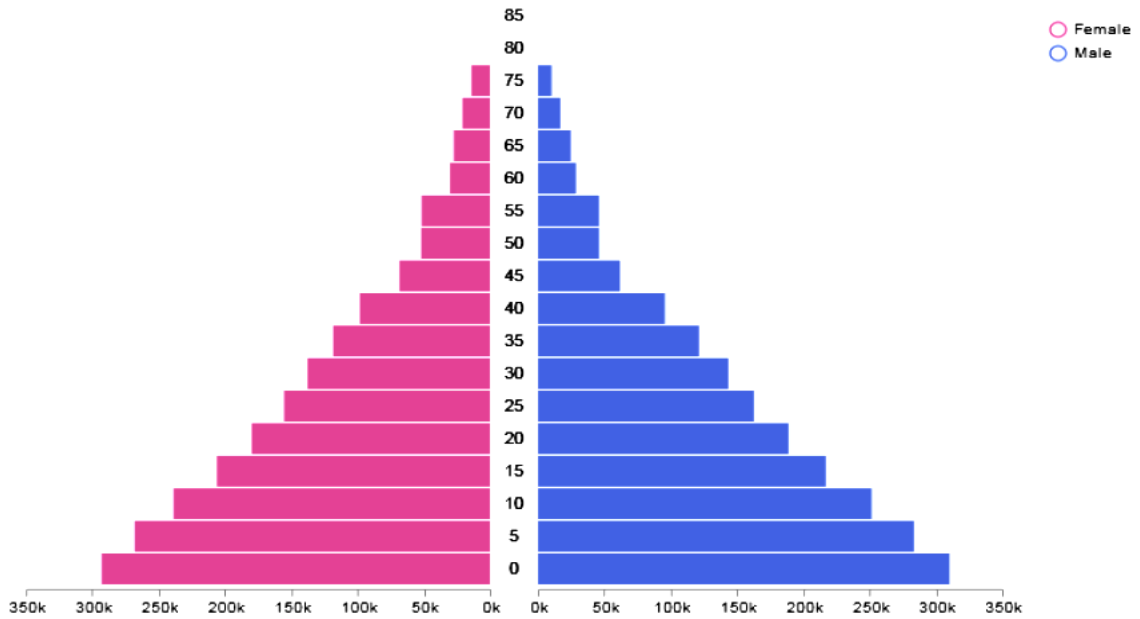


Figure 3.3. Analyzing the Population by Age and Gender

As we expect the population to more than 75 years and exactly to 2100, we can notice the huge increase in the estimation of the population till that year (2100). Figure 3.4 shows that estimation as follows:

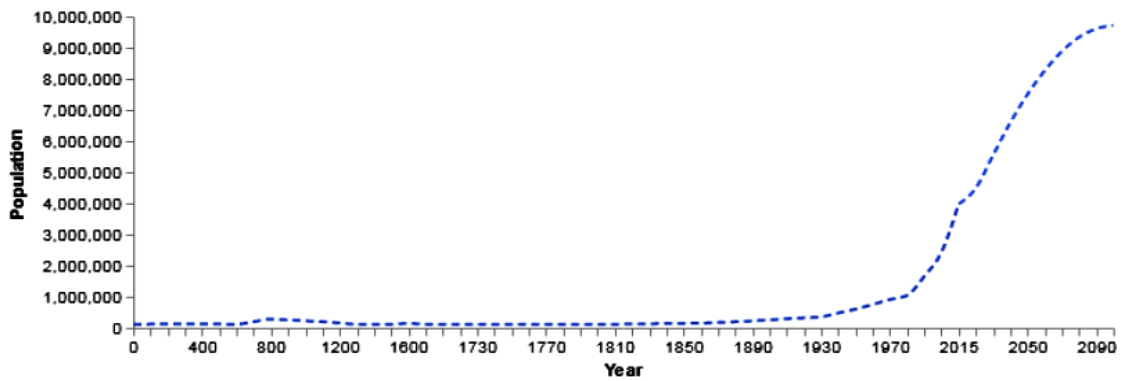


Figure 3.4. Estimated Ancient Population of Mosul until 2100

But if we discuss the Human Development Index (HDI) of the city, we can notice that from 1990 to 2015 there is a slow increase in population compared with the previous years, so Figure 3.5 shows the statistic composite index of life expectancy, education, and per capita income.

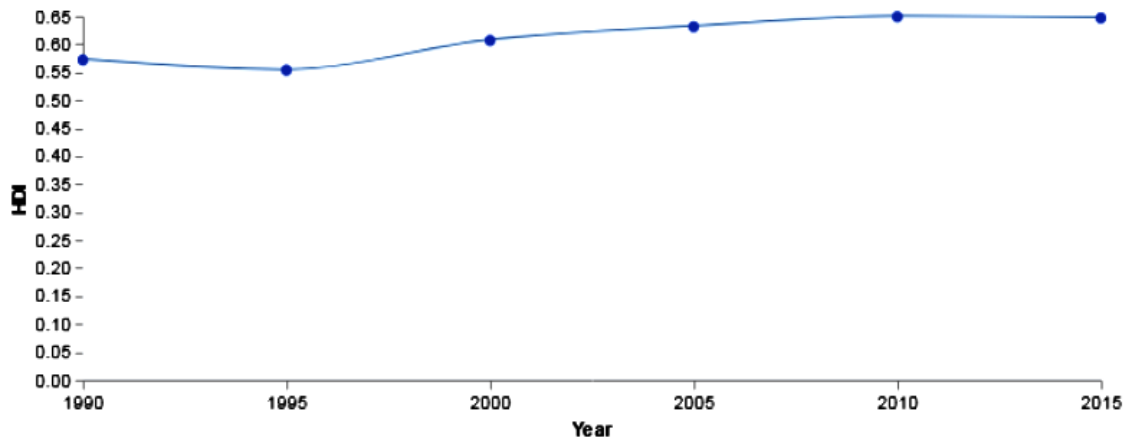


Figure 3.5. Statistical composite index of life expectancy, education, and per capita income

3.2. Geographic and demographic overview with population and socioeconomic data of Sulaymaniyah

The northeastern region of Iraq is home to the Sulaymaniyah Governorate. After Erbil and Mosul, it is the third-biggest city in the north. With a population of about 1.5 million, Sulaymaniyah is regarded as one of the most significant political, cultural, and economic hubs in Iraq.

3.2.1. Demographics

The city has a magnificent backdrop thanks to its location in a valley encircled by the breathtaking Zagros Mountains. With hot summers and moderate winters, the city has a semi-arid climate. Summer temperatures can get to as high as 40°C, while winter temperatures hover between 5 and 10°C.

Sulaymaniyah is renowned for having a long and rich history and cultural heritage. Throughout history, a number of civilizations have called the city home, including the Sumerians, Babylonians, Assyrians, and Persians. It has also had a big impact on modern Iraqi history, especially during the late 20th-century Kurdish uprising against Saddam Hussein's government.

Kurdish is the official language of the city, while Arabic is widely spoken, and its diverse population comprises Kurds, Arabs, Assyrians, and other ethnic groups. Furthermore, it is home to a wide variety of religious communities, such as Christians, Muslims, Yazidis, and Kaka'I (Yarsanism) [48].

3.2.2. Economy

One of the main economic hubs is Sulaymaniyah, which has a thriving industrial sector that produces food items, building materials, and textiles. Additionally, it is the location of numerous foreign businesses that have made their mark in the area. With a large airport and numerous highways linking it to other regions of Iraq and its neighbors, it is also a center for trade and transportation. During the last 19 years, Sulaymaniyah has accumulated 370 permitted investment projects, making it the leading investment destination in Iraq. Out of all the years, 2023 had the most projects, with 53 projects in total. Due to the notable development and expansion of the investment sector, Sulaymaniyah has become the most prominent city in Iraq. A total of 53 projects totaling \$21,280,437,064 were completed in 2023, the most projects during the previous 19 years. In 2023, there were 30 licensed housing projects overall, according to data and research by the Sulaymaniyah Investment Directorate and the researcher. The least licensed sectors were the tourism and agriculture sectors, with only one project licensed for both. 55 percent of the 53 projects totaling \$21,280,437,064 are housing projects, 15 percent are commercial projects, 9 percent are industry, 7 percent are health, 4 percent are services, 4 percent are education, 2 percent are agriculture, and another 2 percent are tourist [49].

3.2.3. Employment

The National Committee for Sustainable Development of the MoP reported in July 2021 that the economic activity rate of individuals aged 15 to 29 in the Sulaymaniyah governorate was 44.7%, which was higher than the national average of 36.8%. Nevertheless, the unemployment rate for this demographic was high, at 27.7%. Even prior to the COVID-19 outbreak, northern cities had notably high rates of youth (42%) and female (28%) unemployment as compared to the rest of Iraq. Prior to March 2020, the two industries with the highest employment rates in northern cities were construction and services. According to a May 2020 survey, 77% of job searchers said they would rather own their own company. Many young people found employment in one of three sweet factories in Sulaymaniyah's Khabat settlement, which is home to many IDPs and their host families. Young males also worked in the private commerce and service industries or with government police units. Breadmaking, hairdressing, and tailoring were among the occupations of female entrepreneurs and workers. Along with the service sector, trade was identified as the industry with the most employment potential, employing the greatest number of people in the city [50].

3.2.4. Education

In 1968, the University of Sulaymaniyah opened, offering courses in English, Arabic, and Kurdish. Engineering, agriculture, the arts, science, and medicine are among its faculties. After Mosul

University, it is the biggest university in the north. Sulaymaniyah Polytechnic institution, a second institution that offers courses in Arabic, English, and Kurdish, was founded in 2012.

One of the newest American universities in the Middle East was the American University of Iraq-Sulaymaniyah (AUI-S), which graduated its fifth class in 2013. A US-accredited program in English as a Second Language (ESL) is offered at this private, non-profit liberal arts university, which offers instruction only in English and there are several other private universities [51].

3.2.5. Health

The Ministry of Health's 2020 Annual Statistical Report states that there were 492 PHCs in the Sulaymaniyah governorate, comprising 377 health sub-centers and 115 primary health care centers. The governorate had the highest primary health facility density in the country, with approximately 21.6 health centers per 100,000 people. Physicians administered 13.2% of all PHCs, but other medical professionals administered the great majority (86.8%). The governorate also has 30 specialty health centers, including 24 with additional specializations, 1 for respiratory disorders, and 5 dentistry centers. There were 63 hospitals in Sulaymaniyah: 25 private and 38 public, including one that provided tertiary care. 3,080 general beds were among the 3,519 total beds available in public hospitals, while 3,847 general beds were available overall (3,080 public beds plus 767 beds in private hospitals). There was no information provided about the number of "emergency beds" available at private hospitals. The report listed 40 pharmaceutical offices and drugstores, along with 356 pharmacies, as other health-related infrastructure. Private laboratories were not included in the data [30]. Geographic and demographic overview with population data of Sulaymaniyah is given in Table 3.4.

Table 3.4. Geographic and demographic overview with population data of Sulaymaniyah

Area of Sulaymaniyah, Iraq	18,077.6 km ²
Population	1.9 million
Male Population	961,776 (50.6%)
Female Population	937,143 (49.4%)
Population change from 1975 to 2015	+151.8%
Population change from 2000 to 2015	+40.7%
Median Age	19 years
Male Median Age	18.7 years
Female Median Age	19.4 years
Timezone	Arabian Standard Time

Thus, we can get an example of population data from 1975 to 2015 because the recent census of 2024 is still not documented in Iraqi statistical centers; for that purpose, we study the reliable data of the last 10 years. Figure 3.6 and Table 3.5 show the population density of the city from 1975 to 2015.

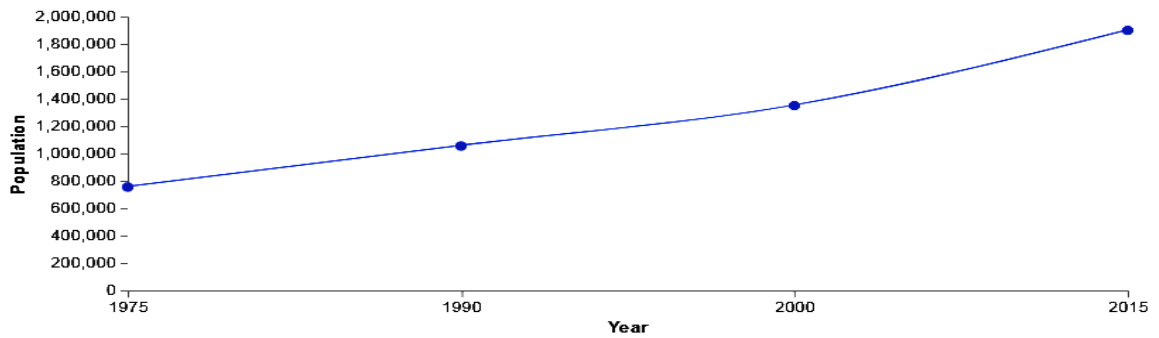


Figure 3.6. The population density of Sulaymaniyah from 1975 to 2015

Table 3.5. The population density of Sulaymaniyah from 1975 to 2015

Data	1975	1990	2000	2015
Population	754.234	1,054,434	1,349,337	1,898,919
Population Density	41.7 / km ²	58.3 / km ²	74.6 / km ²	105.0 / km ²

From another side, if we take population change from 2000 to 2015 and if we compare it with Iraq in general, we can see that the population increased by 40,7% from the years between 2000 and 2015. Figure 3.7 and Table 3.6 show the population change percentage between Sulaymaniyah and Iraq.



Figure 3.7. The population change percentage between Sulaymaniyah and Iraq

Note: Increase of 40,7% from year 2000 to 2015.

Table 3.6. Population change percentage between Sulaymaniyah and Iraq

Location	Change since 1975	Change since 1990	Change since 2000
Sulaymaniyah, Iraq	+151.8%	+80.1%	+40.7%
Iraq	+211.9%	+108.4%	+54.5%

By analyzing the population by age and gender, we can find the differences between those two ratios, and Figure 3.8 declares that contrast in ratios.

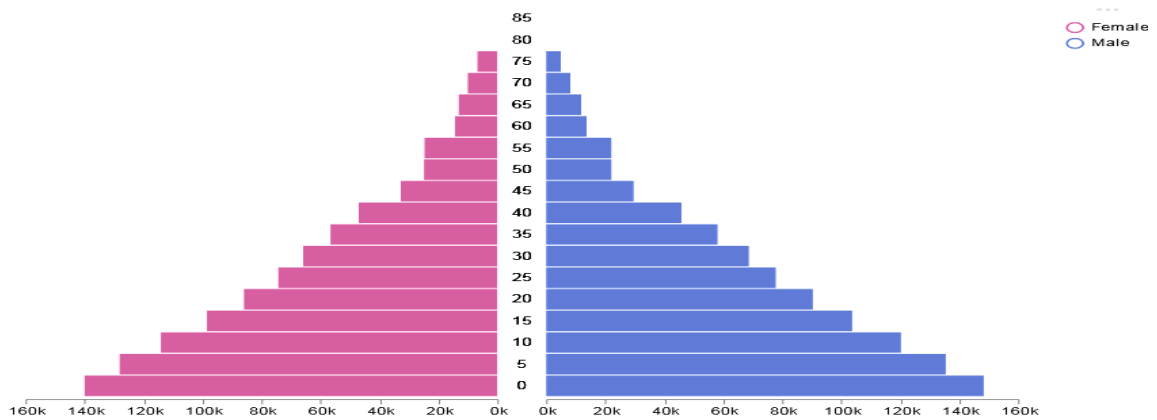


Figure 3.8. Analyzing the Population by Age and Gender

As we expect the population to more than 75 years and exactly to 2100, we can notice the huge increase in the estimation of the population till that year (2100). Figure 3.9 shows that estimation as follows:

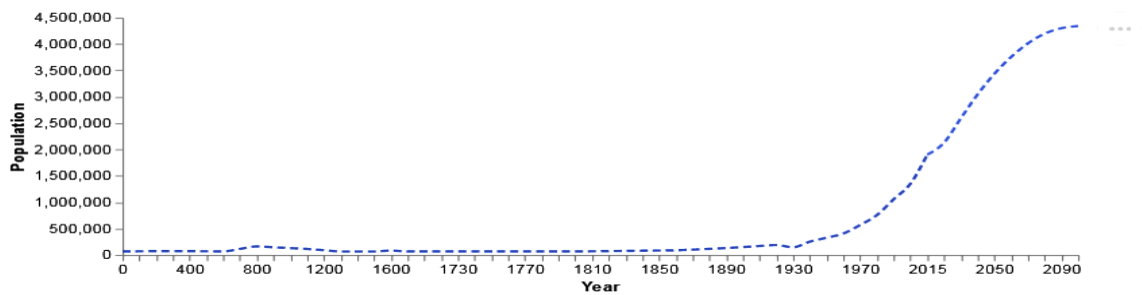


Figure 3.9. Estimated Ancient Population of Sulaymaniyah until 2100

But if we discuss the Human Development Index (HDI) of the city, we can notice that from 1990 to 2015 there is a slow increase in population compared with the previous years, so Figure 3.10 shows the statistic composite index of life expectancy, education, and per capita income.

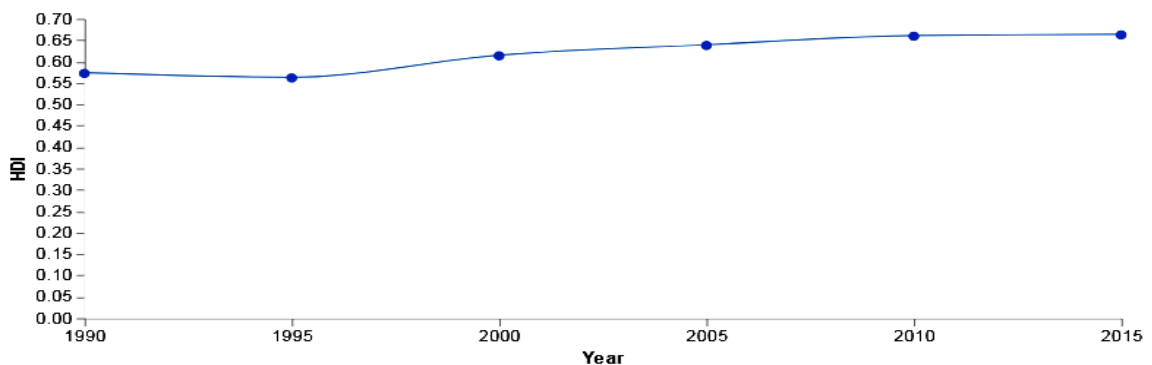


Figure 3.10. Statistical composite index of life expectancy, education, and per capita income

3.3. Geographic and demographic overview with population and socioeconomic data of Erbil

With a history spanning 6,000 years B.C., Erbil is among the world's oldest cities still inhabited. Over the ages, the Persians, Greeks, Romans, Mongols, and Ottoman Turks have all called it home. The Kurds are currently the dominant ethnic group in the city; between 1.5 and 2 million people live there, with 93% of them being Kurdish, according to estimations.

3.3.1. Demographics

In addition to a large population of Arabs, Turkmen, and Assyrians, the city is primarily Kurdish. There are an estimated 300,000 Turkmen living in Erbil. They mostly live around the citadel in the Taci, Mareke, and Three Tak areas in the heart of Erbil. They were residing in the Citadel's Tophane, Tekke, and Saray neighborhoods, which had almost 700 homes, until 2006. The Turkmen inside the citadel were moved to different communities when it was cleared out in 2006. Turkmen take part in this city's political institutions, which are significant areas. On November 17, 1993, Iraq inaugurated its first two Turkmen schools, one in Kifri and one in Erbil. The Turkmen Culture House is also located in Erbil's citadel. On the other hand, we may state that Christian Assyrians make up the majority of the population in Erbil's Ankawa district. There are over 40 churches in the district [37].

3.3.2. Economy

Agriculture, construction, wholesale and retail trade, and government jobs make up the majority of the Erbil economy. Its oil industry is expanding as well. According to a 2016 World Bank assessment, the economy of the northern cities is heavily dependent on the oil industry and is dominated by government employment, which accounts for over 50% of all jobs. A 2017 analysis by the Minority Rights Group International states that the oil and gas industry provides 90% of all Kurdish government funding. Northern Iraq's administrative and commercial hub is the governorate of Erbil. While the food supply is reliant on agriculture and food supplies imported from Turkey and Iran, it is abundant in natural resources, particularly oil and gas. The majority of imported goods that come into Iraq from overseas, especially from Turkey, pass through the city of Erbil, which is a trading hub in Iraq, according to IOM [45]. Due to its tourism appeal, Erbil receives two-thirds of all visitor arrivals in northern Iraq, making it the most visited city. According to a 2017 analysis by Mark A. DeWeaver, an economist at the American University of Iraq Sulaimani, tensions over oil revenue sharing between this city and the federal government in 2014 sparked the economic downturn that has now entered its third year in the northern cities. The recession began

in 2014 when world oil prices crashed, dropping by more than 50% in the second half of that year [12].

3.3.3. Employment

Erbil City's labor force participation rate was recorded at 14.8% for women and 65.9% for men, per the IOM 2018 demographic survey [52]. In terms of occupation, IOM data indicated that 43.7% of Erbil's city labor force had previously worked for the government, 13% for the private sector, 18.7% for themselves, and 19.2% for daily wages. In the Erbil Governorate, the vast majority of people work in the public sector, and 78% of those who do have a signed employment contract. In contrast, informal employment is more likely to occur in industries like wholesale and retail and construction. Only 30% of workers in these industries are legally employed and receive wages rather than salaries, according to UNHCR.

3.3.4. Education

According to a 2018 poll, between 20.1% and 25.0% of children in Erbil province were enrolled in primary school. According to a joint report by the Erbil Refugee Council, IOM, the Joint Crisis Coordination Centre, UNHCR, UN-HABITAT, OCHA, and UNFPA, public schools are the primary source of basic and high school education for the city's citizens, and they are free. Education funding has been steadily declining since 2012–2013 due to the economic crisis in northern cities. This has had a major effect on the Erbil governorate, where the implementation rate of the education budget fell from 45.9% in 2011–2013 to 3.7% in 2015–2016. Three universities, as well as other colleges and other educational institutes, are located inside the Erbil Governorate. IOM's 2018 demographic census found that the Erbil governorate had one of the highest literacy rates in northern cities, with about 80% of participants being literate. In the Erbil Governorate, 37% of students were enrolled in school, while 45.9% were not enrolled at the moment and 17.1% had never gone [53].

3.3.5. Health

The government hospital to population ratio in the three Kurdish city governorates was much greater, with one hospital for every 60,000–75,000 inhabitants. The WFP reports that the Erbil Governorate had a higher rate of 15.1-19 physicians per 10,000 people and a range of 27-49 public and private institutions. Furthermore, Erbil has 10.1–20% child mortality rates for children under five. Reuters also noted that there were 1.5 hospital beds for every 1,000 residents in this community. Based on statistics from the National Development Plan 2018–2022 [54] states that there was a surplus of 96 primary health care units in Erbil and a deficiency of 11 governmental

hospitals. Erbil offered a wide range of fundamental primary care services, albeit inconsistently. All Iraqis, including non-Kurdish people who are Iraqi nationals, are covered under the PHC [Primary Health Care] system. However, non-Kurdish inhabitants who are not Iraqi citizens are not entitled to the same health care and medication benefits as Kurdish citizens [55]. Geographic and demographic overview with population data of Erbil is given in Table 3.7.

Table 3.7. Geographic and demographic overview with population data of Erbil

Area of Erbil, Iraq	2,388.3 km ²
Population	1.5 million
Male Population	777,151 (50.6%)
Female Population	757,229 (49.4%)
Population change from 1975 to 2015	+290.3%
Population change from 2000 to 2015	+57.3%
Median Age	19 years
Male Median Age	18.7 years
Female Median Age	19.4 years
Timezone	Arabian Standard Time

Since the most recent census of 2024 is yet unrecorded in Iraqi statistical centers, we can obtain an example of population data from 1975 to 2015; in order to do so, we examine the trustworthy data from the previous ten years. The city's population density between 1975 and 2015 is depicted in Figure 3.11 and Table 3.8.

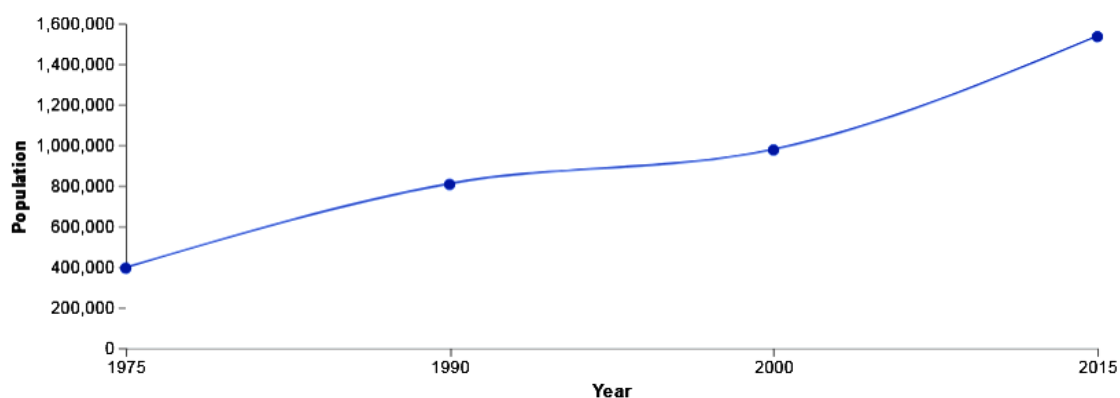


Figure 3.11. The population density of Erbil from 1975 to 2015

Table 3.8. The population density of Erbil from 1975 to 2015

Data	1975	1990	2000	2015
Population	393,128	806,007	975,683	1,534,380
Population Density	164.6 / km ²	337.5 / km ²	408.5 / km ²	642.4 / km ²

On the other hand, if we look at the population change between 2000 and 2015 and compare it to Iraq as a whole, we can find that the population grew by 57.3% over that time. The population change percentage between Iraq and Erbil is displayed in Figure 3.12 and Table 3.9.

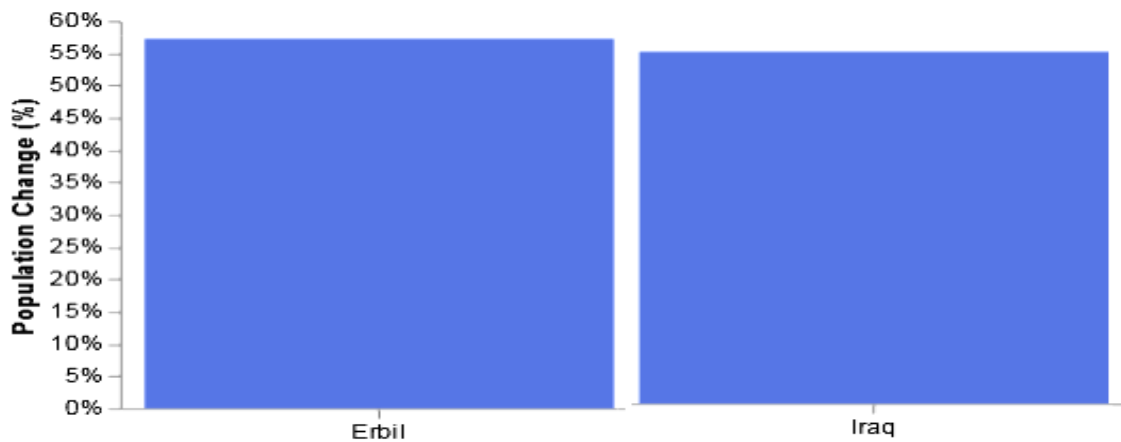


Figure 3.12. The population change percentage between Erbil and Iraq

Note: Increase of 57.3% from year 2000 to 2015.

Table 3.9. Population change percentage between Erbil and Iraq

Location	Change since 1975	Change since 1990	Change since 2000
Erbil, Iraq	+290.3%	+90.4%	+57.3%
Iraq	+211.9%	+108.4%	+54.5%

We may determine the differences between those two ratios by examining the population by gender and age. Figure 3.13 illustrates this ratio disparity.

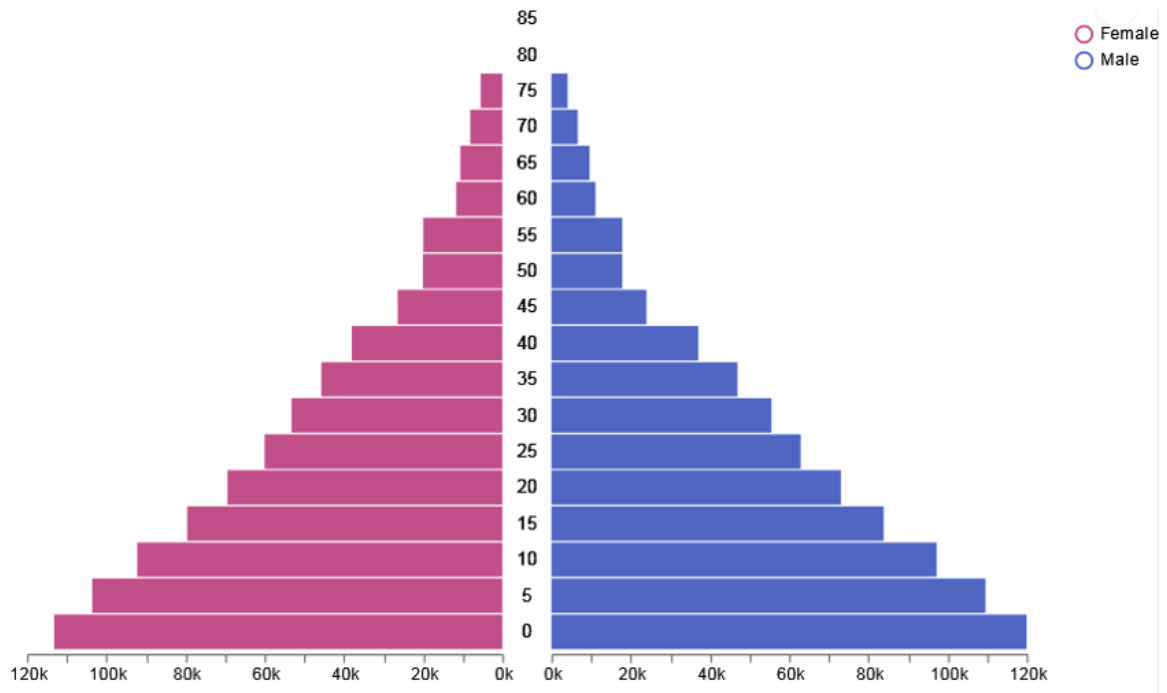


Figure 3.13. Analyzing the Population by Age and Gender

We can observe the significant increase in population estimates up until the year 2100, as we anticipate the population to be above 75 years old. The following estimation is depicted in Figure 3.14.

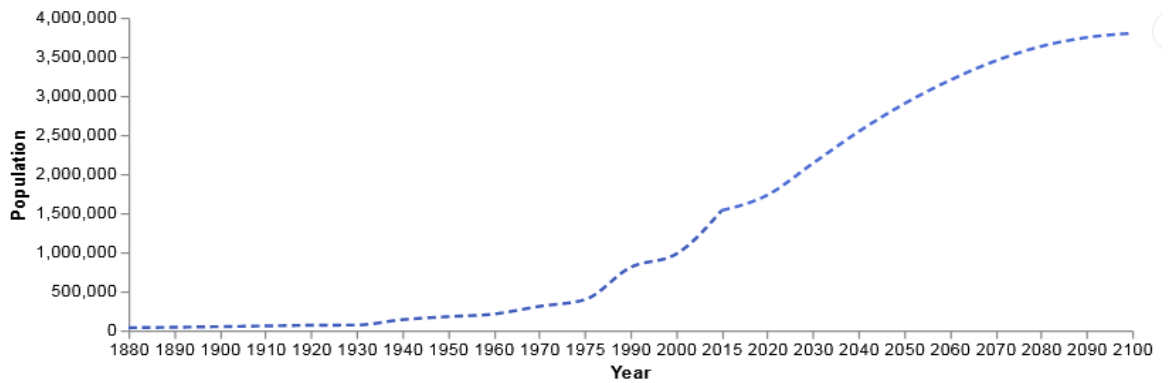


Figure 3.14. Estimated Ancient Population of Erbil until 2100

However, if we look at the city's Human Development Index (HDI), we can see that, in comparison to prior years, the population grew slowly between 1990 and 2015. Figure 3.15 displays the composite index of life expectancy, education, and per capita income.

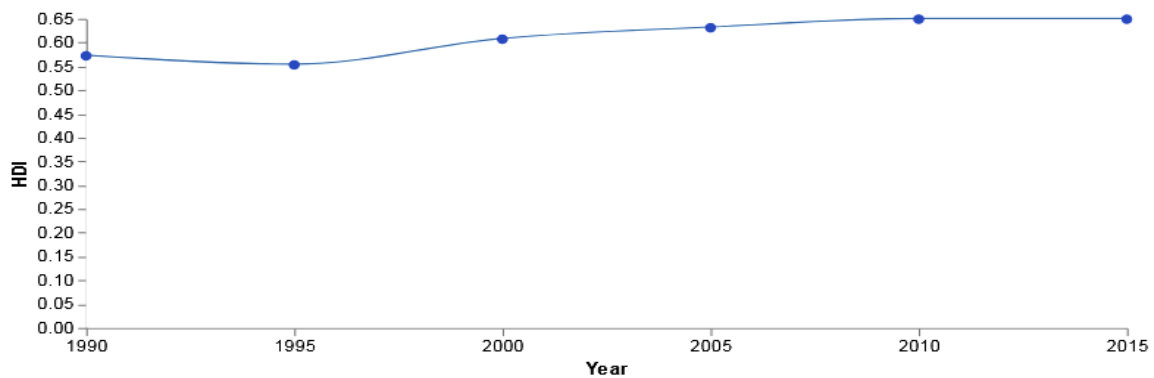


Figure 3.15. Statistic composite index of life expectancy, education, and per capita income

3.4. Geographic and demographic overview with population and socioeconomic data of Duhok

It was the main location of the Doski tribe, together with eighty other villages, and Rich characterized it as a sizable town of 300 homes in 1820. Jewish people lived in Duhok, according to missionary Henry Aaron Stern (1851), who also mentioned that the village's mayor, or Kiahya, was a Chaldean Catholic. Rabbi Yehiel discovered two Jewish minyans there in 1859. Approximately one hundred homes were made up of Christians and Muslims. About 3,500 people lived there permanently in 1929, the majority of whom were Kurds. Among the 550 houses, 30 were Jewish and 65 were Christian. A significant number of Chaldeans from the Turkish regions of Merga and Bothan, as well as Nestorian refugees from Tiyari, moved to Duhok in the wake of World War I. There were 29,858 people living in the qada of Duhok in 1929, primarily Muslim Kurds (18,307), Christians (5,784; 19.3%), Muslim Arabs (2,068), Yezidis (2,870), and Jews (829; 2.7%), according to the report [56].

3.4.1. Demographics

There are about 340,000 people living in the city, the most of whom are Kurds, while there is also a sizable Assyrian population. The Mar Marsi Cathedral, one of the biggest churches in the area, is owned by the Assyrians of Duhok and serves as the hub of an eparchy. Due to the ISIS invasion of Iraq in 2014, the subsequent fall of Mosul and the Nineveh Plains region after two more months of fighting, and the Siege of Sinjar, where 5,000 Yazidis were massacred in what has been called a genocide against them, tens of thousands of Yazidi and Assyrian Christian refugees also reside in the city. The bulk of the city's population is Kurdish, but there are also minorities like as Assyrians, Yazidis, and Arabs. Tens of thousands of internally displaced people (IDPs), primarily Yazidis and Assyrians, and Syrian refugees, primarily Syrian Kurds, are also residing in the city. They left when ISIS took over Mosul, Iraq [57].

3.4.2. Economy

Numerous businesses primarily involved in the oil industry have shut down as a result of the present economic crisis and the low price of oil, which has had a significant effect on other industries and businesses that depend on these oil corporations. For instance, there has been a significant impact on electricity generation, tourism, agriculture, and road and highway development. This has led to a decline in the unemployment rate and a sharp decline in the employability of recent college graduates. The large number of refugees, the expenses of setting up camps for them, the high cost of military operations to combat ISIS and other security concerns, and other factors are also problematic. Health, education, agriculture, water purification, dams, electricity generation and distribution, tourism (including vacation resorts and recreational centers, as well as the sightseeing of religious and historical sites), crude petroleum refineries for extraction, production, and distribution, building materials and construction companies, and refugee centers and camps are just a few of the sectors that the city's numerous public and private institutions are working to develop. The region's primary economy is based on the production of natural gas and crude oil, as well as the associated sectors. The region is also known for its tourism and agricultural products. There are three private universities, two state universities, and other private institutes offering a range of academic programs in Duhok. To connect different government and educational institutions, a strategic fiber optics network has been developed and finished [58].

3.4.3. Health

The clinical need for child mental health (CMH) care is substantial in spite of this fact. Behavioral issues that affected families and schools were the main complaints over the first few years. At first, there were no appropriate services for these individuals in the current healthcare system. Additionally, there were no institutions, social assistance programs, or other options. In addition, the CMH's master's students required clinical cases for training. Additionally, the CMH was not permitted to receive clinical visits because it was an academic institution used primarily for instruction. In the end, the Psycho-Social Education and Training Center (PSETC) in Duhok was independently founded by the Swedish non-governmental organization (NGO) "Diakonia" to offer mental health services in the area. The attempt to supply these services by bringing in foreign expertise was unsuccessful. An agreement was reached between the PSETC and CMH following an initial dispute brought on by disparate profiles. As a result, the CMH supplied clinical administration, education, research, and supervision, while the Diakonia supplied logistics and salaries. The Directorate General of Health in Duhok assumed responsibility for the PSETC as a competent body in northern Iraq when the Diakonia stopped providing financial assistance for it.

The academic capabilities and funding for child mental health services in Duhok were reduced by the closing of the academic unit CMH and the transfer of the PSETC from the NGO to the state system. However, the need for child mental health treatments, especially for traumatized and other special needs children, skyrocketed. Other child mental health care providers made an effort to raise the caliber of services they offered as a result of this demand and other circumstances. As a pilot project for the prevention and treatment of mental health issues in children in Duhok, the private facility Metin Health House (MHH) was established in 2008 [49].

3.4.4. Education

Of the 280,602 pupils enrolled in primary school, 44.5% were girls and 59.5% were males, according to a 2004 report. That figure rose to 501,053 pupils in 2019, with 52.8% of them being male. In 2019, there were 77 private elementary schools in the city, with 1408 students, of whom around one-third (64%) were male. In 2019, only 7.3% of primary schools were private, while 92.6% were public, according to the Central Statistical Organization. In comparison to public primary schools, which grew by about 22% between 2015 and 2019, private schools have grown by 56% since 2016 [59].

Intermediate and preparatory education makes up secondary education, and they typically share school premises. Every school separates the sexes, such as intermediate schools that are exclusively for girls and boys. The duration of intermediate education is three years. English, Arabic, math, science, and social studies are among the subjects taught; some schools offer additional courses. Students must pass a standardized national exam at the conclusion of year three, much like in primary school, in order to be eligible to enroll in preparatory school. The three years of preparatory school are comparable to those of intermediate education. Based on their score on the standardized national exam, students must select the route that best fits their needs from the three options offered: the scientific route, Literary Track, and Vocational Track. A student must pass a thorough, nationally recognized exam in order to acquire a baccalaureate, the preparatory school diploma that grants admission to a university [60].

Table 3.10. Geographic and demographic overview with population data of Duhok

Area of Duhok Governorate	6,689.4 km ²
Population	1.5 million
Male Population	773,583 (50.7%)
Female Population	753,672 (49.3%)
Population change from 1975 to 2015	+1,808.1%
Population change from 2000 to 2015	+203.2%
Median Age	19 years
Male Median Age	18.7 years
Female Median Age	19.4 years
Timezone	Arabian Standard Time

Geographic and demographic overview with population data of Duhok is given in Table 3.10. Since the most recent census of 2024 is yet unrecorded in Iraqi statistical centers, we can obtain an example of population data from 1975 to 2015; in order to do so, we examine the trustworthy data from the previous ten years. The city's population density between 1975 and 2015 is depicted in Figure 3.16 and Table 3.11.

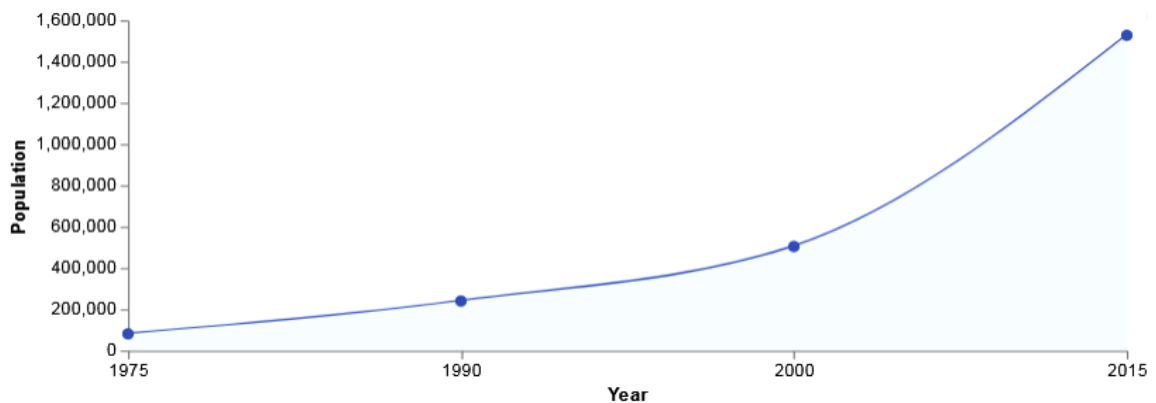


Figure 3.16. The population density of Duhok from 1975 to 2015

Table 3.11. The population density of Duhok from 1975 to 2015

Data	1975	1990	2000	2015
Population	80,041	239,180	503,695	1,527,254
Population Density	12.0 / km ²	35.8 / km ²	75.3 / km ²	228.3 / km ²

On the other hand, if we look at the population change between 2000 and 2015 and compare it to Iraq as a whole, we can observe that the population grew by 54.5% over that time. The population change percentage between Iraq and Duhok is displayed in Figure 3.17 and Table 3.12.

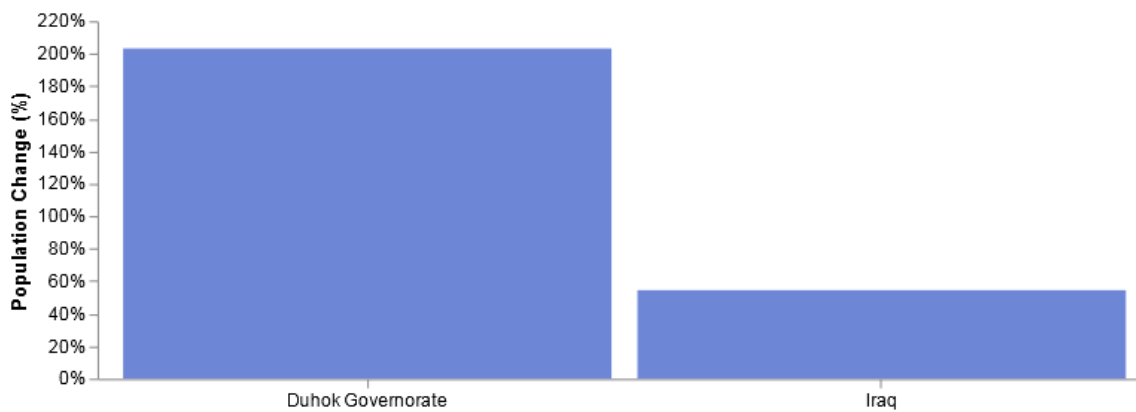


Figure 3.17. The population change percentage between Duhok and Iraq

Note: Increase of 203.2% from year 2000 to 2015.

Table 3.12. Population change percentage between Duhok and Iraq

Location	Change since 1975	Change since 1990	Change since 2000
Duhok Governorate	+1,808.1%	+538.5%	+203.2%
Iraq	+211.9%	+108.4%	+54.5%

By analyzing the population by age and gender, we can find the differences between those two ratios, and Figure 3.18 declares that contrast in ratios.

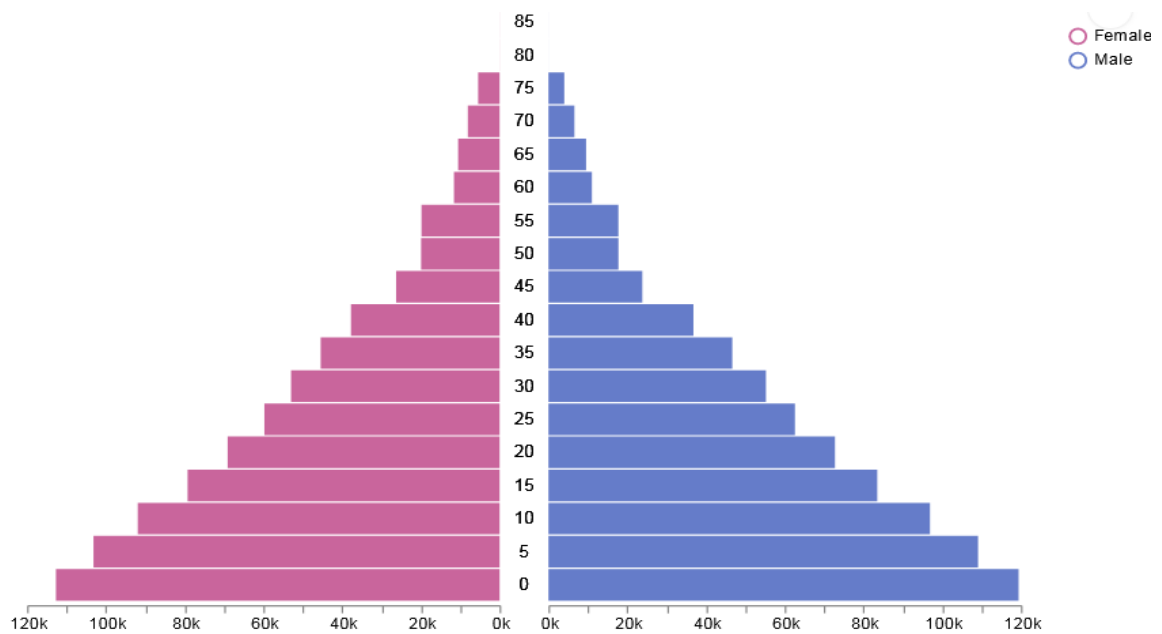


Figure 3.18. Analyzing the Population by Age and Gender

As we expect the population to more than 75 years and exactly to 2100, we can notice the huge increase in the estimation of the population till that year (2100). Figure 3.19 shows that estimation as follows.

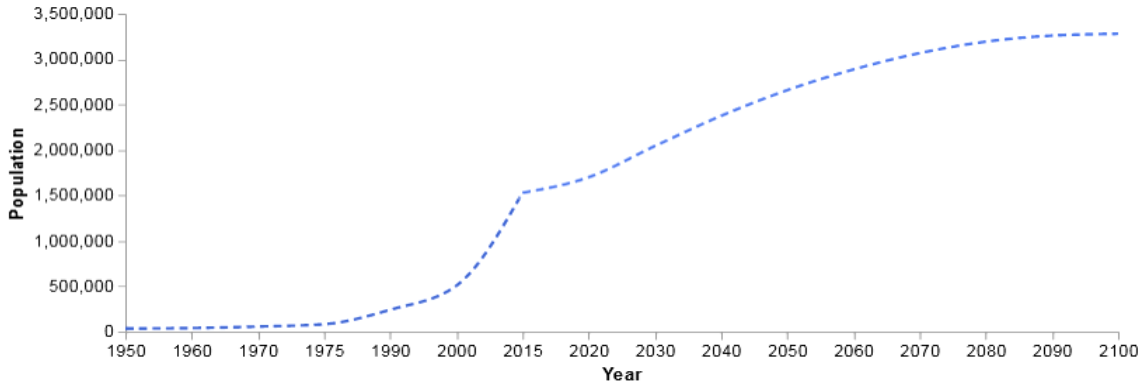


Figure 3.19. Estimated Ancient Population of Duhok until 2100

However, if we look at the city's Human Development Index (HDI), we can see that, in comparison to prior years, the population grew slowly between 1990 and 2015. Figure 3.20 displays the composite index of life expectancy, education, and per capita income.

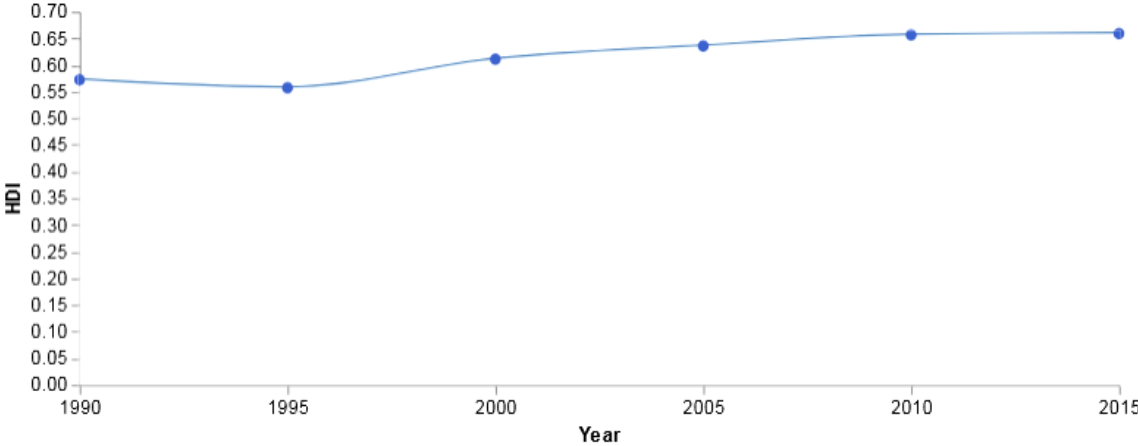


Figure 3.20. A statistical composite measure of per capita income, education, and life expectancy

4. RESULTS AND DISCUSSION

In this chapter we discuss the population distribution patterns with the spatial analysis of population density and growth trends in rural and urban areas of Mosul, Sulaymaniyah, Erbil, and Duhok governorates. Although we discuss Socioeconomic Development Levels with a comparison of cities based on selected indicators. In another section we try to discuss Multivariate Analysis Findings Identification of factors influencing development. The final important point for discussing is the Implications for Urban Development Recommendations for balanced regional development [61].

4.1. Population Distribution Patterns Spatial analyses of population density and growth trends

One of the subjects covered in population studies is population pattern because all population societies are dynamic due to numerical population growth or decline, which is reflected in the vital activities of the populace, such as migration, which is one of the factors that significantly influences population size fluctuations, and births, which represent the positive factor contributing to population growth and deaths representing the negative factor contributing to population decline. According to the economic, political, and social circumstances of the nation where the population resides, as well as the population policy, it differs from one location and time period to the next and has a negative impact on living conditions, health, and population increase [62]. As such, the size of the population throughout the study period must be known, followed by data and information on the factors influencing population growth, such as migration, births, and deaths. Determining the problem (question) is essential for researchers in the human sciences, including geographers. One of the most recent developments in the field of geography is the study of the problem. Table 4.1 shows the area and percentage of Mosul, Sulaymaniyah, Erbil, and Duhok cities.

Table 4.1. Area and percentage of Mosul, Sulaymaniyah, Erbil, and Duhok cities

Area Rate / Iraq	Area Km ²	Governorate
8.6	37323	Mosul
3.9	17023	Sulaymaniyah
3.5	15074	Erbil
1.5	6553	Duhok

The pattern of population distribution on the earth's surface is a collection of interconnected aspects, and it is one of the key topics where the interaction between the population and the land and their position emerges.

The distribution process is constantly changing, and we currently observe a serious lack of focus due to the fact that a significant amount of the population is concentrated in cities with relatively small areas, and that these distributional disparities are also a result of population growth rates. The population's relationship to the resources available in each region is represented by its numerical distribution, which is the distribution of the population in the area where they live. Since resources, whether natural or man-made, vary in quantity and quality, the population's numerical distribution also varies over time and space. Because it serves as a mirror reflecting all geographical features, the population distribution map is among the most significant maps in geographical research. In light of this, the majority of studies incorporate a thorough analysis of population distribution in order to support development plans in a manner that is consistent with science and to improve the lives of all population members [63]. The population distribution in Mosul, Sulaymaniyah, Erbil, and Duhok Governorates by environment is displayed numerically in Table 4.2 for the years 2010–2020 AD.

Table 4.2. Population distribution by environment during the years 2010–2020 AD in the cities of Mosul, Sulaymaniyah, Erbil, and Duhok.

2010			2020			Governorate
Population	Rural population	Urban Population	Population	Rural population	Urban Population	
3187945	1249778	1938167	3928215	1546083	2382132	Mosul
1831560	275982	1555578	2277170	347707	1929463	Sulaymaniyah
1572154	264536	1307618	1953341	327201	1626140	Erbil
1100187	293008	807178	1361211	353214	1007997	Duhok

4.2. Socioeconomic Development Levels

According to historical development patterns, development is a continual structural process that frequently results in changes in patterns of production, distribution, and consumption. It also likely has a significant impact on the social and individual behaviors of the populace. Such a shift affects the distribution, composition, and growth of the population directly as well as indirectly. However, no definitive historical data nor proof have ever resolved the theoretical dispute over the relationship between population expansion and progress. Given that rising birth rates are a direct effect of economic expansion, population growth is more often the product of development than its

cause. When decreasing death rates are the driving force behind population expansion, the population may be viewed as an external element in the development process [64]. As a result, in the early phases, there is a positive and direct proportionality between the rates of population expansion and development. Accordingly, population studies assume a demographic change pattern that aligns with economic and social change patterns and emphasize the significance of identifying the relative importance of various economic and social factors that are unique to or linked to particular fertility patterns. Thus, in this section, we talk about the chosen city indicators [65].

4.2.1. Demographics

The demographic transition theory is based on the historical experience of developed nations in the 19th and 20th centuries, when communities in Mosul, Sulaymaniyah, Erbil, and Duhok gradually moved from slow and low population growth rates because of high mortality and reproduction rates to low and slow population growth rates because of lower fertility and reproduction. Since the transition process in developed countries has progressed slowly over the past 200 years due to steadily improving living conditions, housing, access to medical care, and increased food supplies, historical evidence suggests that all communities may test the transition process with differences in operation speed and sequence for developing countries. It took several decades for the emerging cities of Mosul, Sulaymaniyah, Erbil, and Duhok to benefit from medical and technological advancements brought about by contact with the West [39]. The shift in fertility and mortality rates from high to low levels as a result of social, economic, and health variables is known as the demographic transition. Changes in conceptions of reproduction, family, and intergenerational relationships are linked to demographic transition. The demographic transition is also linked to the change of societies from traditional lifestyles and low-income economies to more developed ones. There are four interconnected stages of demographic transformation.

4.2.2. Economy

A population's economic activity represents the distribution of the labor force by economic activity and is correlated with the economy's structure. As a result, it shows the disparity in the relative distribution across different economic sectors, the degree of reliance of the community on particular economic activities, and the activity that is now taking place in terms of the workforce. Since the expansion of employment prospects is dependent upon economic growth, which is dependent upon the rise in productivity, the relationship between economic growth and employment is causal. One of the primary barriers to development is low productivity, which limits the economy's ability to

accumulate capital [15]. Low productivity rates can be caused by both mental and physical incapacity in the workforce.

Because economic growth depends on rising oil revenues rather than productivity, and because employment opportunities depend on the pattern of use, policies, and management of oil revenues mandated by the state's populace, this indicator is not appropriate to explain the phenomenon in Mosul, Sulaymaniyah, Erbil, and Duhok cities.

The production and export of crude oil is recognized to be the main driver of the Iraqi economy, which has caused it to divide into two independent and distinct economies. A significant portion of the GDP, exports, and public revenues that fund governmental operations are produced by the oil industry. The lack of front and rear links between it and other sectors, however, means that it is only intimately connected to the extent that it provides electricity. An failure to meet the increasing domestic demand for a variety of goods and services, particularly some that the domestic sector cannot provide, and a lack of output diversification are two ways that the economy reflects this phenomenon.

Under these conditions, the real sector continues to face numerous challenges, such as declining productivity, which demonstrates glaring inadequacies in the entire demand activities of essential sectors and commodities in the economy. Specifically, while accounting for 9% of GDP in prior years, the transformative industrial sector, which makes up around 2% of GDP, has numerous challenges. Although it was roughly 22% fifty years ago, the agriculture sector's contribution has now dropped to 5% [7].

4.2.3. Education

The governorates of Duhok, Erbil, Sulaymaniyah, and Mosul have achieved remarkable achievement in giving their citizens access to education. The percentage of children between the ages of 6 and 11 who are enrolled in primary school or have already started secondary school is known as the net primary school enrollment rate. Mosul, Sulaymaniyah, Erbil, and Duhok cities had net primary school attendance rates of 95.9%, which is 4.5 percentage points higher than the national average for Iraq. Universal primary enrollment is almost attained in all governorates, but especially in Sulaimaniyah [59].

The number of children of any age enrolled in the final grade of primary education as a percentage of the population of primary school completion age is known as the gross primary school completion rate. Given that many children may enter in primary school but not finish the level, it is typically crucial to distinguish between primary enrollment and completion. However, primary completion rates are extremely high in those four cities (Mosul, Sulaymaniyah, Erbil, and Duhok); in fact, the gross primary completion rate exceeds 100% because there are more children enrolled

in the final year of primary school than there are 11-year-olds overall (presumably due to some children repeating the final grade).

In comparison, the number of children in their last grade of primary education who are of formal primary school completion age (not any age) as a percentage of the entire population of that age is known as the net primary school completion rate. In theory, all of these kids ought to be finishing elementary school.

The fact that many students do not finish primary education in their eleventh year is reflected in this statistic, which is significantly lower than gross primary completion at 64.9%. The percentage of people who reach the final year of primary school is higher in Mosul, Sulaymaniyah, Erbil, and Duhok than in the rest of Iraq, despite the fact that both this and the gross primary completion rates are noticeably higher in these cities than in Iraq overall: the gross primary school completion rate in Mosul, Sulaymaniyah, Erbil, and Duhok is 20.7 percentage points higher, and the net primary school completion rate is 20.5 percentage points higher, than in Iraq overall [62].

4.2.4. Health

Mosul, Sulaymaniyah, Erbil, and Duhok have a variety of health indicators, many of which were obtained from the 2011 Fourth Iraq Multiple Indicator Cluster Survey (MICS4). The number of prenatal deaths per 1,000 live births is known as the Infant Mortality Rate (IMR), which calculates the likelihood of dying before turning one year old. Mosul, Sulaymaniyah, Erbil, and Duhok all have infant mortality rates of 28 per 1000 live births. Compared to the overall infant mortality rate for Iraq, this is 4 percentage points lower. However, when compared to other Iraqi cities, Mosul, Sulaymaniyah, Erbil, and Duhok do not compare well [14].

Since health is a natural and essential aspect of people's lives, it is one of the primary foundations of development. Even while numerous health indicators in Mosul, Sulaymaniyah, Erbil, and Duhok cities showed notable gains compared to the 1990s, the Iraqi health system has not yet guaranteed fair access to services for all citizens.

There was comparatively tangible progress in the primary health care services for both mother and child. It refers to the medical treatment that the mother receives prior to, during, and following delivery. However, in order to lower maternal mortality during pregnancy, childbirth, and the postpartum period—three of the fundamental health indicators in the Millennium Development Goals—further efforts are urgently needed to promote this element of health care. Without a doubt, the danger of difficulties, illness, and infection for both mother and child is decreased when health conditions and medical aid are provided at the right moment of birth. By guaranteeing safe births, the primary goal of safe delivery services is to safeguard the lives and health of both mothers and children. As more babies are born under expert supervision, healthy surroundings can frequently play a significant role in lowering unforeseen health risks to both the mother and the kid. According

to data from the Family Health Survey conducted in those four locations, 9.7 pregnancies end within the first six months, and 89.1 pregnancies conclude with a live newborn out of 100. Additionally, there is a 0.8 chance of fetal death in utero for every 100 pregnancies. Pregnancy loss rates are significantly greater in urban than rural areas, according to the data, and they are also higher in the central and southern governorates than in the cities of Mosul, Sulaymaniyah, Erbil, and Duhok. All things considered, this is mostly caused by variations in the birth rates of the so-called "stillborn." Additionally, it is shown that as educational levels increase, so do the loss rates. Women with no education lose 9.2 pregnancies out of every 100, but those with at least a high school diploma lose 14.4 and 14.7 conceptions out of every 100. One possible explanation for this is because educated women are more likely to marry later, increasing their exposure to the complications of pregnancy [11].

4.3. Determining Factors Affecting Development Using Statistical Findings

According to the study's findings, the province of Baghdad has the lowest size in Iraq, making up only 1.0% of the country's total area, while the cities of Mosul, Sulaymaniyah, Erbil, and Duhok have the biggest areas, making up a substantial 31.7% of the country's total area. With a population dispersion of 21.2%, those cities have the largest percentage of residents. Interestingly, the population of Iraq grew at a pace of 2.1% between 2010 and 2020 AD, with urban regions growing at a faster rate of 2.3% than rural areas, which grew at a rate of 1.8%. The study also estimated that by 2030, there will be about 49,675,379 people living in Iraq, with 35,214,703 living in urban areas and 14,460,676 in rural areas. The cities of Mosul, Sulaymaniyah, Erbil, and Duhok did not appear to grow and develop quickly; rather, they went through numerous stages. The natural features of the location have an impact on the city's operations, population, and connections with its surroundings. The roles and areas of expertise of those four cities have evolved through several phases. As a result, based on their functions and activities, these cities have changed in a certain percentage at different points in time. The morphological evolution of cities is the modern term for these phenomena. A city's movement from one functional structure to another without losing its prior functional descriptions is known as the morphological stage. As one of the morphological aspects (plans, land uses, buildings), each stage is characterized by a certain pattern of structures [53]. Urban renewal policies, such as development, conservation, or rehabilitation, are causing some functions to advance while delaying others. In Iraqi cities, particularly Mosul, Sulaymaniyah, Erbil, and Duhok, buildings and their uses are referred to as cultural heritage, and they are frequently gathered in the heart of the city to form its traditional core.

Changes in the environment, urban planning, economy, society, and politics all influenced the expansion and development of the cities of Mosul, Sulaymaniyah, Erbil, and Duhok. The

development, land uses, and construction characteristics of those four cities were historically shaped and guided by a number of factors [31].

In addition to difficult political circumstances, Iraq experienced waves of colonial invasion in a variety of forms, including military, cultural, economic, and urban. These elements have had a significant impact on the composition and development of Iraqi cities. The following are the key elements that influenced the development of contemporary Iraqi cities.

4.3.1. Population growth

Because a city's extent and distinctiveness are correlated with its population density, size, and economic activity, population change affects how cities are formed. One human component that sets apart the interaction between individuals and their distribution and places of existence is the study of populations. Additionally, one of the most important topics for developing development policies is the research of population growth.

Iraq's population density is determined by the area's human stability requirements, particularly its water supply. The population of any human community, whether it be rural or urban, expresses the significance of that settlement.

As a result, some villages acquire their metropolitan location and play the role of its focal point. The high rates of population increase in Mosul, Sulaymaniyah, Erbil, and Duhok are caused by social, political, economic, and cultural factors. Because of both natural population growth and migration, some Iraqi cities have had higher rates of population expansion. In addition to the impact of the government's population program from 1977 to 1990, migration has also been caused by foreign migration as a result of colonial control for various periods.

In order to meet labor market demands during the Iran-Iraq War, particularly following the exodus of Egyptian laborers from Iraq in 1989 and 1990, the government's strategy promoted population growth and prioritized numbers over kind.

One of the factors contributing to population expansion is migration, which also has an impact on how urban patterns are transferred between locations and societies. For instance, migrants from rural areas are progressively relocating to the city's center. As a result, the urban landscape of the Iraqi metropolis has remained inextricably linked to rural patterns that are appropriate for the rural population's environment [56].

4.3.2. The emergence of European urban style

The distinctive morphology of Mosul, Sulaymaniyah, Erbil, and Duhok sets them apart from other cities. When examining the morphology of any Iraqi city, the streets are the most noticeable feature.

Buildings come in second, and the purpose that those four cities have served for more than a decade in Iraq comes in third [66].

Following Germany's defeat in World War I (1914–1918), the map of the world was redone. Britain and France split the Middle East in 1916 with the Sykes-Picot Agreement. After Iraq was ruled by the Ottomans, it became part of Britain. Alongside the European presence in the Arab world, there has been a drastic and unprecedented reversal of the conditions and features of urban space. Existing traditional systems and shapes have been merged with a new European-urban-style layout [60].

4.3.3. Area extending and variety of land uses

The multitude and diversity of activities carried out inside the city's geographical space was a result of the growing population of Mosul, Sulaymaniyah, Erbil, and Duhok. The size and land use of those four Iraqi cities have increased in tandem with their population. Older cities have experienced urban and economic challenges as a result of their modern construction and transportation developments. The old city's land use changed as a result of these forces, creating a complicated issue. Cities like Mosul, Sulaymaniyah, Erbil, and Duhok grow as their populations rise in tandem with advancements in transportation, which leads to an increase in human activity. This growth is renewable, adaptable to human needs, and fluctuating in both quantity and quality. For instance, Baghdad's land uses in 1997 were 900 km², although in 1956 it had an area of 101 km². As the population grew, the city gradually grew four times larger than it was in 1956. This was also the case in other Iraqi cities, including Mosul, Sulaymaniyah, Erbil, and Duhok. By highlighting the housing patterns of Mosul, Sulaymaniyah, Erbil, and Duhok cities from their founding and throughout their lengthy histories, it was possible to determine that these patterns were the outcome of the cities' development during different historical periods [67].

4.3.4. Technological evolution and car emergence

Every level of civilization has benefited from technological advancement. Clusters of people grew in size inside the cities of Sulaymaniyah, Erbil, and Duhok over the 20th century. Developments in science and technology have also improved the urban fabric's distinctiveness in the cities of Duhok, Erbil, Sulaymaniyah, and Mosul. The Western character of a society dominated by the machine (the car) and the material economic law in terms of utilizing the land area has dominated differentiation. More profits from the economic, cultural, and educational uses of property in major places is an advantage, to put it another way. The layout and design of the homes in Mosul, Sulaymaniyah, Erbil, and Duhok were different prior to the car's discovery as a mode of

transportation. Narrow, twisting roads and haphazard expansion are no longer appropriate for contemporary traffic.

Dependent on contemporary traffic and communication systems, a new urban pattern developed. The morphology of the four cities' original urban fabric was altered by the building of roadways, tunnels, suspension bridges, and parking lots [68].

4.4. Implications for urban development recommendations for balanced regional development

In Mosul, Sulaymaniyah, Erbil, and Duhok, planning laws are thought to be useful for structuring the urban areas and granting executive authority to the master plans. The city-region's development in the present and its future are shaped by urban plans, master plans, and structural plans.

The presence of laws entails the establishment of specialized organizations, organizations that operate in accordance with them, and others that strive to implement them. Because of the various variables that have shaped Iraqi cities over time, the country has been characterized by civilized qualities that are conducive to the establishment and development of cities and civilizations. Plans to control the use of urban land have been developed by government agencies. The planning methods used in the cities of Mosul, Sulaymaniyah, Erbil, and Duhok are not new; rather, they are an outgrowth of the laws of earlier civilizations. Natural conditions, religion, customs, and traditions all influenced its formulation, and as it was the most appropriate at the time, it was made into law [42].

Before establishing its borders in the early 1900s, the four Iraqi cities were under the sovereignty of numerous empires, and they were subject to the laws, rules, and regulations of the ruling state. The historical study concentrated on the laws enacted in the newly established Iraqi state in the early 1920s. The planning and administration of the cities of Mosul, Sulaymaniyah, Erbil, and Duhok are specifically the responsibility of the institutions and legislative system. In contemporary Iraq, municipal services have existed since the Ottoman era. All cities and villages, regardless of size, had their own municipal departments. Health, cleaning, security, lighting, fee collection, and employee salary payments were their only responsibilities. Its imports and results were small, but after the Ottoman ruler (Midhat Pasha) assumed control of the state of Iraq, things improved.

The stage improved following the British occupation. Following its independence from Great Britain, Iraq joined the League of Nations in 1932, marking the start of contemporary Iraqi architectural design and construction. There were no more than 80 municipalities when the previous ones were eliminated and replaced. Its only responsibilities were to roof markets, patch potholes, enlarge certain streets, and provide certain small and public gardens. At this point, the July 1958 revolution led to the creation of the Ministry of Municipalities. The task of developing the cities of

Mosul, Sulaymaniyah, Erbil, and Duhok was given to the newly established Directorate of developing.

Beginning in the early 1970s of the previous century, the golden age period began. At this point, the Polish Paul Service Foundation created the overall housing plan for Iraq. After the city of Erbil was designed and its legislation was passed, the Capital Municipality and the Ministry of Municipalities were separated. Additionally, the English Foundation (Lewin Davis) created the master plan for Sulaymaniyah City, while the French Set International created the plan for Mosul and the Greek Doxyades Foundation created the plan for Duhok [58].

The urgent need for planners (local, urban, and regional) as well as the appropriation of princely lands within municipal boundaries by Law No. 80 of 1970 and the fundamental designs for local units (municipalities) were demonstrated at the scientific seminar organized by the Ministry of Planning in collaboration with the United Nations Development Program (UNDP) in 1970. The law has significantly boosted municipal imports and facilitated master plan implementation. A number of engineers and scholars have been dispatched by the Iraqi government to pursue graduate degrees in architecture, urban planning, and design. These scholars contributed to the growth, organization, and expansion of those four Iraqi cities.

5. CONCLUSION AND RECOMMENDATIONS

The appearance, morphology, and architectural style of the northern Iraqi cities of Mosul, Sulaymaniyah, Erbil, and Duhok have changed significantly. Numerous elements that shaped the city's shape contributed to the transfer of northern architectural and urban ideas to the contemporary Iraqi city. The study's authors determined that the following four major factors—demographics, economy, health, and education—had a greater influence on the morphological changes in those four Iraqi cities. Due to a variety of factors, the administrative systems of Mosul, Sulaymaniyah, Erbil, and Duhok underwent numerous stages of transformation in tandem with their structural modifications. The cities of Mosul, Sulaymaniyah, Erbil, and Duhok had changes in shape due to a variety of circumstances, and an administrative structure was established to try to coordinate these changes. The study highlighted the involvement of foreign corporations in developing some Iraqi cities and implementing these designs in other cities by examining the influencing elements and the administrative system's development side by side. The growth of the planning institution has been greatly impacted by political and economic circumstances and their effects, both positively and negatively, according to studies. The failure of urban development in Iraq has also been attributed to the lack of administrative and planning skills in using contemporary technologies [69].

Summary of Key Findings

Because all population societies are dynamic due to numerical increases or decreases in the population, population growth is one of the topics covered in population studies. These changes are reflected in the vital activities of the population, such as births, which represent the positive factor that increases the size of the population, and deaths, which represent the negative factor that decreases it. Among the elements that significantly influence population growth and decline are the size of the population and the migratory factor. This is detrimental to population growth, health, and living conditions and it changes from place to place and from time to time depending on the economic, political, and social circumstances of the nation where the population resides as well as population policy. Therefore, in order to study population growth, one must first determine the size of the population during the study period, followed by data and information on the elements that affect population growth, such as migration, births, and deaths.

Since it illustrates the proportion of the population that suffers from the governorate compared to the overall population, the most popular and widely used approach is the analysis of the relative distribution of the population of any region by governorate. Since the population varies throughout the many administrative entities, the proportional distribution is helpful in determining each region's respective population weight [64]. Iraq's rapid population expansion is a challenge to urban

development in particular, but to development in general. The population of the nation was ten times more in 2007 than it was in 1927. According to the Arab League-endorsed Arab Strategy for Housing and Urban Development, there were almost 35 million people living in Iraq in 2014, with Mosul, Sulaymaniyah, Erbil, and Duhok accounting for around one-third of this total. The proportion of young people, which was 28 percent of the population in 2014, has also significantly increased. The economy's capacity to offer good work prospects will be constrained by this percentage, which is predicted to keep rising over the next 20 years. This expanding workforce in the private sector has not yet been absorbed by the Iraqi economy. Unstructured and inadequate juvenile services have resulted from prior youth-focused policies that were neither comprehensive nor capable of bringing about long-lasting change. Along with the lack of technical skills that the nation's youth have gained, this has put them in a dangerous position that makes it difficult for them to participate in public and political life. The degree of urbanization is directly related to the quality of life in the cities of Mosul, Sulaymaniyah, Erbil, and Duhok. Because of the differences in the quality and accessibility of infrastructure, health care, education, and security for various socioeconomic strata, poverty rates are generally higher in rural areas [37]. Poverty is at its lowest in larger cities because poverty decreases as urban agglomeration increases. This served as a primary driving force behind Iraqi internal migration to bigger cities, particularly in the 1950s and 1960s. Additionally, villages and rural areas have deteriorated as a result of coercive actions. For example, a sudden shortage of water, which they relied on for their livelihood, forced many people to flee their settlements. Using the standard of life index, it was discovered in 2012 that rural areas, where poverty rates reached 58%, suffered significantly more than cities and urban areas of those four northern cities, where poverty rates were just 17%. There are also differences in the remaining fundamental domains, which clearly show how much better urban areas are than rural ones. Iraq's road and rail system runs longitudinally, paralleling the paths of the Euphrates and Tigris rivers. This has historically resulted in the concentration of activities and human settlements along these two pathways. Due to the dearth of major transportation hubs in other parts of Iraq, these traditional routes had heavy traffic, which put more strain on the nation's key roads [65]. The high expenses of travel delays and their detrimental effects on other economic sectors that are impacted by transportation were indicative of this situation. In order to address the rising rates of traffic accidents, it is imperative that more money be spent on road maintenance. Therefore, it is necessary to build a network of radial highways to link small and medium-sized cities and form new development hubs in northern Iraqi cities. Additionally, this would reinforce the long-term expansion of the Iraqi transportation system that connects various commercial and industrial sectors. Expanding basic health services and focusing on reproductive health, including family planning services and safe motherhood and childhood strategies, as well as protecting adolescents from infectious diseases, including sexually transmitted diseases (STDs), including HIV/AIDS,

should be the main focus of the upcoming population and other pertinent development policies. Improving maternal health and lowering maternal death rates should be the top priorities of population policy. Since the nation began to develop in the middle of the last century, the political and economic structures of the cities of Mosul, Sulaymaniyah, Erbil, and Duhok have changed multiple times. For instance, the creation of the Construction Council in 1952, which allowed the state to take on the responsibility of constructing the nation's infrastructure, resulted in an extension of the state's role and development plans, which in turn increased public spending on social services. As a result, the general public's health, education, and living conditions have significantly improved, and it has also had a direct impact on the population's distribution and mobility in terms of geography, employment, the environment, and profession [69].

Policy Recommendations Strategies For Addressing Socioeconomic Disparities

General Recommendation

Establishing a broad strategic framework is essential to ensuring that everyone has a respectable standard of living and to advancing the household's economic, social, health, and cultural standing. In addition to increasing the current collaboration across pertinent national, regional, and international agencies, such a framework should create the right conditions for garnering significant official and public support for those policies and initiatives.

In order to attain the welfare of both individuals and the population, a population policy must be established as a realistic and scientific instrument that is considerate of the concerns of the populace as well as the decisions made by families and individuals. Additionally, it must be more receptive to the implementation and exercise of their equal and lawful rights. As soon as feasible, components that facilitate the inclusion of people's concerns and decisions in all phases of sustainable development should be developed [48].

Detailed recommendation

First: Population and Development

By taking concrete steps to include population issues in their plans and national or fashion strategies, it is necessary to push the complementary relationship between population and development to the intellectual and practical levels and turn those into national policies and programs. Of course, the national development plan and sectoral strategies—particularly those pertaining to housing, water, energy, health, and education—are referred to here. Furthermore, it should be emphasized that the National Development Plan 2010-2014 makes reference to the demographic dimension when discussing employment strategies.

Second: Gender

More resources must be raised and allocated, and policymakers and strategies must pay greater attention to the issues of gender equality, justice, and women's empowerment. It serves as a tool to accomplish sustainable development objectives in addition to being a crucial objective in and of itself due to the cultural heritage that has mostly excluded women from meaningful discussions about women's issues and their basic rights. All elements of population policy and development plans should be strongly committed to incorporating these rights.

Third: Reproductive Health and Reproductive Rights

The International Conference on Population and Development's program of action urges all governments and states to offer HIV-related and other reproductive health care to all people of the appropriate age as soon as feasible, but no later than 2015. Protecting and upholding the health and educational rights of children and adolescents, as well as integrating reproductive health components into the primary health system, are crucial state priorities.

Fourth: Youth and Adolescents

Sexually transmitted illnesses, declining reproductive health, abnormalities in economic and social development, environmental degradation, and the adverse effects of globalization are all more likely to affect young people and adolescents. On the basis of this fact, the goals of the International Conference on Population and Development's program of action, as well as national and regional policies and programs, began urging governments to adopt more objective and tangible attitudes in order to protect the lives of youth and adolescents from dangers and to incorporate their creativity.

Fifth: Changing Behavioral Patterns

Using traditional and contemporary media, the Cairo Conference 1994 on Population and Development places particular emphasis on information, education, and communication efforts to raise awareness and modify behavior regarding reproductive health and reproductive rights, including HIV/AIDS, for all populations, including adolescents [57].

Limitations of the Study

Four northern Iraqi cities—Mosul, Sulaymaniyah, Erbil, and Duhok—are included in the study's limitations. Iran, Turkey, and Syria encircle northern Iraq, which stretches north from Baghdad. Sulaymaniyah, Erbil, Dahuk, and Mosul are its constituent provinces. The northern region, comprising Sulaymaniyah, Arbil, and Dahuk, is home to Iraqi Kurds. A variety of ethnic and sectarian groupings make up the rest of the area. Most of the cities along the Tigris River Valley,

which stretches north from Baghdad, are Sunni. Additionally, there are sizable Sunni Arabs in Erbil and a sizable Turkoman population in Mosul.

Suggestions for Future Research

Using systematic election criteria, we intend to finish a thorough analysis of a number of cities with sizable student populations. This will employ data from several Offices for National Statistics (ONS) sources, including administrative ones, and integrate pertinent, recently finished work. We will study the consequences for mid-year population estimates and projections for cities with sizable student populations using Census 2024 data when it becomes available. As much as feasible, we will base our rebasing effort on the Higher Education Leavers Methodology. In addition to reviewing how current research utilizing administrative sources can provide light on student population migration into and out of localities, we will investigate how student populations vary across our population estimates and predictions. In this exercise, we will draw on local knowledge bases and exchange perspectives with professionals to get feedback and think of more areas for improvement. More methodological study on the people of Mosul, Sulaymaniyah, Erbil, and Duhok is required in order to accurately capture the effects and results of public participation in studies. Qualitatively documenting the experiences and viewpoints of research partners who have had conflicting or unfavorable experiences may also be beneficial, since they could be less inclined than enthusiasts to volunteer for studies of involvement in research like ours. Likewise, future studies could investigate the (very uncommon) experiences of underrepresented and rarely heard study participants [63].

KAYNAKLAR

- [1] Birdsall, N., Kelley, A. C., & Sinding, S. (Eds.). (2001). *Population matters: demographic change, economic growth, and poverty in the developing world*. OUP Oxford.
- [2] Sachs, J. D. (2002). Rapid population growth saps development.
- [3] Keyfitz, N. (1991). Population and development within the ecosphere: one view of the literature. *Population Index*, 5-22.
- [4] The consequences of rapid population growth. *Population change and development*. Washington DC, World Development Report, World Bank, 2008, 3: 39–65.
- [5] Preston, S. H. (1986). Population growth and economic development. *Environment: Science and Policy for Sustainable Development*, 28(2), 6-10.
- [6] Cleland, J., Bernstein, S., Ezeh, A., Faundes, A., Glasier, A., & Innis, J. (2006). Family planning: the unfinished agenda. *The lancet*, 368(9549), 1810-1827.
- [7] Population statistics. Erbil, Ministry of Planning, Iraq, 2018 [Online] (<http://www.mop-krq.org/default.aspx?page=articles&c=StatisticsbySubjects&id=20>, accessed 15 November 2008).
- [8] O'Neill, B. C., MacKellar, F. L., & Lutz, W. (2001). Population and climate change. *Environmental Change & Security Project Report*, 137(9), 137-139.
- [9] Boserup, E. (2014). *The conditions of agricultural growth: The economics of agrarian change under population pressure*. Routledge.
- [10] Toth, A. B. (2006). Last battles of the bedouin and the rise of Modern States in Northern Arabia: 1850-1950. In *Nomadic Societies in the Middle East and North Africa* (pp. 49-77). Brill.
- [11] Bloom, D., Canning, D., & Sevilla, J. (2003). *The demographic dividend: A new perspective on the economic consequences of population change*. Rand Corporation.
- [12] Oshima, H. T. (1983). The industrial and demographic transitions in East Asia. *Population and Development Review*, 583-607.
- [13] Fayad, H. N. (2022). Urban Population Growth in Iraq and its Social and Economic Impact. *Omran*, 11(41), 63-100.
- [14] Oshima, H. T. (1983). The industrial and demographic transitions in East Asia. *Population and Development Review*, 583-607.
- [15] All Party Parliamentary Group on Population, Development, and Reproductive Health. (2007). *Return of the population growth factor: its impact upon the Millennium Development Goals*.
- [16] Alfred Marshall, Parker Weber (2017). The Relationship Between Economic Development and Socio-Cultural Values, January, *Journal of Ibn Haldun Studies Ibn Haldun University*, 7(1):17-25.
- [17] Paul Krugman, . 2003a. "demographic challenges and urban mobility." *Problèmes Économiques* 2366: 25–29. 6th ed. Cambridge, MA: MIT Press.
- [18] Basher Faisal (2024). *Analysis of Population and Demographic Changes in Iraq*, University of Baghdad / National Center for Population and Demographic Studies.
- [19] Zeki Fattah (2021). Is there a population growth problem in Iraq? Iraqi Economists network, May, IEN Policy Papers.

- [20] Agha, S. Y., & Rasheed, B. O. (2007). Family planning and unmet need among Iraqi Kurds. *Eastern Mediterranean Health Journal*, 13(6).
- [21] Amjad Rabi, *The Politics of Population Movements in Contemporary Iraq*, HAL SHS sciences humaines et sociales, Book Sections of 2022, World Scientific Publishers/Imperial College Press, pp.359-378.
- [22] Long, A., & Ascent, D. (2020). *World economic outlook*. International Monetary Fund, 177.
- [23] Saad Mahdi (2016). Factors that influenced on population movements inside Iraq, *Journal of the Babylon Center for Civilizational Studies*, University of Babylon, Al Hillah, Iraq.
- [24] Sabah Hussein (2020). The spatial correlation of the population distribution evaluation of Mosul city, *institute of development studies, the word of knowledge magazine*, Baghdad, Iraq, No.226, June.
- [25] Liao and Li (2009). Increasing of urban competitiveness and population growth in Iraq, *An Empirical Study of Iraqi Population*, *Journal of Environmental Protection*, Vol.7 No.11, October 27.
- [26] Alsabbagh, H. (2025). Toward a Sustainable Mobility System in Middle East Cities: the case of Erbil city, Iraq. *Sustainable Futures*, 100763.
- [27] Alsabbagh, H. (2025). Eastern paradigm of urban mobility: the case of Erbil city, Iraq. *Transportation*, 52(4), 1513-1541.
- [28] Jambally Mohammed (2013). Land use and cover change assessment using Remote Sensing and GIS: Dohuk City, Kurdistan, Iraq (1998-2011), *International Journal Of Geomatics And Geosciences*, Volume 3, No 3.
- [29] *Iraq living conditions survey, 2004*. Baghdad, Central Organization for Statistics and Information Technology, Ministry of Planning and Development Cooperation/United Nations Development Programme, 2005.
- [30] Barkey, H. J., & Laipson, E. (2005). Iraqi Kurds and Iraq's future. *Middle East Policy*, 12(4).
- [31] Crenshaw, E. M., Ameen, A. Z., & Christenson, M. (1997). Population dynamics and economic development: Age-specific population growth rates and economic growth in developing countries, 1965 to 1990. *American Sociological Review*, 974-984.
- [32] The Iraqi Ministry of Planning, the National Report on the Population of Iraq, *Population Situation Analysis*, 2022.
- [33] Abdul Ali Al-Khafaf, Abdul Mahmoud Al-Rihani, *Population Geography*, University of Basra, 2018.
- [34] The Ministry of Health's 2020 Annual Statistical Report, *Barriers to the Utilization of Primary Health Centers (PHCs) in Iraq*, PMID: 37092458.
- [35] Mark A. DeWeaver, *Making Ends Meet: Economic Reforms in the North of Iraq*, American University of Iraq, Sulaimani, IRIS Iraq Report, 2017.
- [36] Bassem Abdul Aziz Al-Othman (2023). Methods of using quantitative methods in measuring the age structure of the population, an applied study of population censuses, *Iraqi Geographical Journal*, No. 44.
- [37] Yassin Muhammad Bida al-Muhammadi and Qasim Ahmad Raml al-Dulaimi (2019). The human workforce in Anbar Governorate and strategies for its development, research published in the *Journal of the College of Education, Al-Mustansiriya University*, Volume 6.
- [38] *Duhok Municipality Master Plan Report, (2008)*: Slide share, a scribd company, prepared by: Paiman Bahjat, Ramiah Moqbal, Zanab Mohamad, supervised by: MRS. Rana Fathi.

- [39] Zaki, R. (1997). The Political Economy of Unemployment. *World of Knowledge Magazine*, 33.
- [40] Caldwell, J. C. (1976). Toward a restatement of demographic transition theory. *Population and development review*, 321-366.
- [41] Prskawetz, A., Fent, T., Barthel, W., Crespo-Cuaresma, J., Lindh, T., Malmberg, B., & Halvarsson, M. (2007). The relationship between demographic change and economic growth in the EU. Report for Tender VT/2005/035.
- [42] Bloom, D. E., Canning, D., & Sevilla, J. P. (2001). Economic growth and the demographic transition.
- [43] Geraldine Chatelard, Social anthropologist and historian of the contemporary Middle East - particularly Jordan, Iraq and Iraqi diaspora - with research interests in the politics of cultural and natural heritage, forced migration, and social (religious and tribal) identities and distinction. Aix-Marseille University, IREMAM - Institute for Research and Studies on the Arab and Muslim World, Associate Researcher, 2010.
- [44] Sabah Hussein, Evaluation of the Population Distribution Using GIS-Based Geostatistical Analysis in Mosul City, *Korean Journal of remote sensing*, 2020; 36(1): 83-92, February 2020.
- [45] Alborzi, M. R. (2006). Evaluating the effectiveness of international refugee law. Martinus Nijhoff.
- [46] Al-Rasheed, M. (1998). Iraqi Assyrian Christians in London: the construction of ethnicity (No. 21). Edward Mellen Press.
- [47] Al-Rachid, L., & Méténier, É. (2008). À propos de la violence «irakienne». Quelques éléments de réflexion sur un lieu commun. *A contrario*, 5(1), 114-133.
- [48] Batatu, H. (1978). The old social classes and the revolutionary movements of Iraq (Vol. 13). Princeton, NJ: Princeton University Press.
- [49] Bozarslan, H. (2003). Pouvoir et violence dans l'Irak de Saddam Hussein. *La société irakienne. Communautés, pouvoirs et violence*. Paris: Karthala, 31-46.
- [50] Caplan, J., & Torpey, J. (Eds.). (2002). Documenting individual identity: The development of state practices in the modern world. Princeton University Press.
- [51] Chatty, D. (2010). Displacement and dispossession in the modern Middle East (Vol. 5). Cambridge University Press.
- [52] The IOM 2018 demographic survey, International Organization for Migration, July 2018.
- [53] Goovaerts, P. (2006). Geostatistical analysis of disease data: accounting for spatial support and population density in the isopleth mapping of cancer mortality risk using area-to-point Poisson kriging. *International Journal of Health Geographics*, 5, 1-31.
- [54] National Development Plan 2018 - 2022, issued by The Ministry of Planning, Republic of Iraq.
- [55] Davis, E. (2005). *Memories of state: Politics, history, and collective identity in modern Iraq*. Univ of California Press.
- [56] Dowty, A. (1988). The assault on freedom of emigration. *World Affs.*, 151, 85.
- [57] Farouk-Sluglett, M., & Sluglett, P. (1983). The transformation of land tenure and rural social structure in central and Southern Iraq, c. 1870–1958. *International Journal of Middle East Studies*, 15(4), 491-505.

- [58] Hiltermann, J. R. (2007). *A poisonous affair: America, Iraq, and the gassing of Halabja*. Cambridge University Press.
- [59] International Crisis Group. (2022). *Failed Responsibility: Iraqi Refugees In Syria, Jordan And Lebanon*. International Crisis Group.
- [60] Ishow, H. (1996). *L'Irak: paysanneries, politiques agraires et industrielles au XXe siècle: contribution à la réflexion sur le développement*. Publisud.
- [61] Leenders, R. (2008). Iraqi Refugees in Syria: causing a spillover of the Iraqi conflict?. *Third World Quarterly*, 29(8), 1563-1584.
- [62] Leezenberg, M. (1997). Between assimilation and deportation: the Shabak and the Kakais in northern Iraq. In *Syncretistic religious communities in the Near East* (pp. 155-174). Brill.
- [63] Marfleet, P. (2007). Iraq's refugees: exit from the state. *International Journal of Contemporary Iraqi Studies*, 1(3), 397-419.
- [64] Romano, D. (2005). Whose house is this anyway? IDP and refugee return in post-Saddam Iraq. *Journal of Refugee Studies*, 18(4), 430-453.
- [65] Sassoon, J. (2008). *The Iraqi refugees: The new crisis in the Middle East*. Bloomsbury Publishing.
- [66] Shami, S. (1996). Transnationalism and refugee studies: Rethinking forced migration and identity in the Middle East. *Journal of refugee studies*, 9(1), 3-26.
- [67] Shiblak, A. (1986). *The Lure of Zion: The Case of the Iraqi Jews*. Al Saqi Books.
- [68] Shoeb, M., Weinstein, H. M., & Halpern, J. (2007). Living in religious time and space: Iraqi refugees in Dearborn, Michigan. *Journal of Refugee Studies*, 20(3), 441-460.
- [69] Torpey, J. (1998). Coming and going: On the state monopolization of the legitimate "means of movement". *Sociological theory*, 16(3), 239-259.

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[REDACTED]	[REDACTED]
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