

**PROMOTING URBAN SPATIAL PLANNING GUIDANCE FOR
ACHIEVING PHYSICAL SUSTAINABLE URBAN DEVELOPMENT IN
DUHOK CITY - KURDISTAN REGION / IRAQ**

A Dissertation Submitted

By:

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To the Faculty of Spatial Planning

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In fulfilment of the requirements of the degree of

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*Dissertation submitted in partial fulfilment of the requirements of the degree
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Declaration:

I, hereby declare that all information in this doctoral has been obtained and presented in accordance with academic rules and ethical conduct. I have fully cited and referenced all the materials that are indebted to the work of others.

Dortmund, Germany

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Ismail .I.S. Hajani

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Dedicated to:

My parents for their prayers

My wife (Shireen) for her patience

My daughters (Rondik, Bareek and Rezan) and

My sons (Rewan, Suliman and Keywan)

Ismail Hajani

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Abstract

City changes and grows over time at a different pace. May it grow or shrinkage, prosper or die, whatever is the matter, the city's urban form changes and transforms accordingly. The main force that affects the city's urban form is the process of urban growth. Kurdistan Region encounters great challenges characterised by high population growth and rapid expansion towards the surrounding rural region. The last five decades witnessed a serious of wars and other political conflicts which has made the whole Iraq unstable and affected the performance of planning institutions, patterns of physical development, and destruction of social and physical infrastructure. As a result, the cities in Kurdistan Region- also in whole Iraq- did not keep track of perceptive planning schedules which generated many conflicts in the form and the structure of the cities and hardly influenced land use pattern, provision of essential infrastructure and the quality of the built environment.

Kurdistan Region and the city of Duhok underwent rapid constructions and development phase during last fifteen years which was to some extent uncontrollable and improperly planned; therefore, this has created a type of urban form and structure that is a malfunction and is not user-friendly.

This research explores the way for the future urban development in Kurdistan to adopt the concept of sustainable urban growth. The notion of pursuing sustainable urban development is promoted through seeking better physical development that can uplift the quality of the urban built environment. Furthermore, the research explores the challenges facing the context and potentials needed for embracing sustainable development.

The methodology is developed to follow proper research strategy, select adequate data collection and analysis methods. The case of the city of Duhok has been analysed highlighting the context problems, driving forces, planning regulatory challenges facing cities in Kurdistan in general and Duhok in particular.

The objective and subjective approach have applied to evaluate the sustainability of the existing urban form and structure. As well as, the residents' opinions in the city of Duhok has used as a parameter to know the degree that residents' satisfaction with the built environment and the way they interact with the urban form, and how they perceive and recognise the deficiencies related to the physical development in the context.

The outcome of this research is depicted in the form of conceptual proposal suggesting compactness, density, mixed use, accessibility, diversity, enhancing greening and residents' satisfaction as criteria for sustainable physical development in the cities of Kurdistan. Moreover, this dissertation recommends general strategies as the fundamental basement for changing towards sustainability. The recommendations are related to; regulatory and institutional structure, spatial practices and current opportunities for early change.

Key Words: Rapid urban growth, sustainable urban development, physical urban development, urban form and structure, criteria, Duhok.

Zusammenfassung

Städte unterliegen ständigen Veränderungsprozessen und die Form einer Stadt wandelt sich stetig, egal ob eine Stadt wächst, schrumpft oder aufhört zu existieren. Besonders starken Einfluss auf die Form der Stadt hat der Prozess des Städtewachstums. Auch die Region Kurdistan steht aktuell vor Herausforderungen wie starkem Bevölkerungswachstum und rapider Expansion in das Umland. Zudem waren die letzten fünf Jahrzehnte durch politische Instabilität und Kriege bestimmt, was einen Einfluss auf die Arbeit von Planungsinstitutionen sowie auf die Stadtentwicklung in der Region hatte. Insbesondere hat dies in der kurdischen Region sowie im gesamten Irak die Infrastruktur zerstört und geordnete Stadtentwicklung verhindert. Somit hat die politische Instabilität im Irak zu einer Reihe von Konflikten u.a. in den Flächennutzungsmustern, Qualität der Infrastruktur und bebauten Umwelt geführt.

In den letzten 15 Jahren hat in der Region Kurdistan und insbesondere in der Stadt Duhok eine drastische und ungeplante Stadtentwicklung stattgefunden. Deswegen hat Duhok heute eine mangelhafte Morphologie und nicht optimale Zusammensetzung der funktionalen Einheiten der Flächennutzung.

Diese Forschungsvorhaben untersucht wie Stadtentwicklung in Kurdistan unter dem Stichwort "nachhaltige Stadtentwicklung" zukünftig gestaltet werden kann, um die Qualität der bebauten Umwelt durch optimale Städtebau zu fördern. Des Weiteren untersucht das Forschungsvorhaben die Herausforderung und Potentiale, die mit der Umsetzung des Konzepts nachhaltiger Entwicklung einhergehen.

Der methodische Ansatz zur Behandlung des Forschungsproblems kombiniert die empirische und theoretische Analyse. Durch eine Fallstudie, d.h. Stadt und Region Duhok wurden kontextuelle Problemen und Herausforderungen, die mit den Stadtplanungsinstrumenten verbunden sind, analysiert.

Um die Nachhaltigkeit der existierenden städtischen Form und Struktur zu evaluieren, wurde ein objektiver sowie ein subjektiver Ansatz angewendet. Zusätzlich wurden die Meinungen der Bewohnerinnen und Bewohner der Stadt Duhok als Parameter genutzt, um den Grad der Zufriedenheit mit der bebauten Umwelt zu bestimmen und um herauszufinden wie Defizite in der städtischen Form wahrgenommen werden.

Das Ergebnis dieser Forschung sind konzeptionelle Vorschläge für ein nachhaltiges Wachstum der Städte in der Region Kurdistan wie Kompaktheit, Dichte, Nutzungsmischung, Erreichbarkeit, Diversität, Verbesserung und Förderung von Begrünung. Außerdem werden in dieser Dissertation allgemeine Strategien für einen Wandel hin zu Nachhaltigkeit erarbeitet. Diese Vorschläge sind in die Kategorien behördliche und institutionelle Struktur, räumliche Praxis und aktuelle Herausforderungen für frühzeitige Veränderungen unterteilt.

Schlüsselwörter: Schnelles Stadtwachstum, Nachhaltige Stadtentwicklung, Physische Stadtentwicklung, Stadtform und Struktur, Kriterien, Duhok.

Abbreviations

BREEAM-Building Establishment Environment Assessment Method
CASBEE-Comprehensive Assessment System for Built Environment Efficiency
CSD- Commission on Sustainable Development
CSOs- Civil Society Organisations
EPIB-KRG-Environmental Protection and Improvement Board in Kurdistan
ICLEI- International Council for Local Environment Initiative
KRG – Kurdistan Regional Government
KRDP-Kurdistan Regional Development Plan
LEED- Leader in Energy and Environment Development
MoMT-KR-Ministry of Municipalities and Tourism in Kurdistan Region
MoP- Ministry of Planning
NDP-The National Development Plan
OECD-organisation for Economic and Co-operation and Development
SDGs- Sustainable Development Goals
UN- United Nations
UGBs- Urban Growth Boundaries
UNEP- United Nations Environmental Program
WHO-World Health Organisation

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Chapter One: Main Introduction

1.1. Introduction

This chapter tends to present the scope of the research, and expose the motivation behind undertaking this research. It also presents the problem statement, the significance of the research, aims and objectives of the research with the research key questions and research design. As well as a brief definition of the geographical features of the area as an important element in displaying the location of the conducted study area.

1.2. Scope of the research

This research focuses on the physical urban development since the urban form is affected directly by physical urban development initiatives. The transformation of the old urban form and establishing of the new districts and neighbourhoods in the city of Kurdistan Region/Iraq has associated with many deficiencies. The consequences of such changing and transformation are prominent through generating a series of impacts on social, economic and environmental aspects.

This research mainly focuses on the urban form and structure at the city level (macro) and neighbourhood level (micro), as an outcome under existing urban development practices and planning system in the city of Duhok. The research argues that urban form is a crucial element for promoting physical sustainable urban development in addition, formulates implementation strategy and guidelines, that can integrate urban form control into the existing urban planning framework for achieving more physical sustainable urban development in the city of Duhok.

1.3. Research Motivations and Justifications

The major concerns that motivated the researcher to carry out this study are associated with three main issues:

First, Duhok is the capital of the Duhok province and one of the main cities in the Kurdistan region/Iraq, which has witnessed diverse phases of urban development and experienced different periods of urban planning designs. This has provided its urban form with different characters and of variety of different patterns and traits that would be absent and different in other cities of the Kurdistan region. Furthermore, it is this city, which sets the pattern for other small cities of the province, and, therefore, its study would be assisting the study of other cities by showing how its urban form has evolved and changed.

Duhok clearly demonstrates all the indications of rapidly growing cities, encroaching fertile agriculture land and seemingly chaotic expansion of the city in terms of physical development and displays rapid population growth. These inefficiencies are also found in the other main cities; however, Duhok:

- Clearly demonstrates all the symptoms of rapid physical development.
- Interrupts by natural determinants from three sides which constrained the city growth to all directions.
- Expanded on nearby farmland and captured more than 13 villages due to rapid urban growth.
- Displays a clear rapid population growth rate.
- Has inefficient public transportation with high traffic congestion.

- Has received special attention by the local government of Duhok, yearly thousands of land parcels were granted freely to the public servants in the city.
- Is positioning the province's capital and has administrative and political importance.
- Is one of the major cities in the Kurdistan Region.

Duhok emerges as the main economic centre in the province, depends mainly on service sectors, public administrative services and trading. The existence of more than four universities and other educational centres, many private firms, non-governmental organizations (NGOs), national and international institutions in the city have created job opportunities and attracted more internal migration to the city of Duhok.

From a social point of view, fundamental changes have occurred in Iraq and Kurdistan Region. Since the beginning of the seventies, the increasing population has had distinctive impacts on the social structure and fabric in the entire Kurdistan Region. The evidence is very clear in the main cities like the city of Duhok. After the process of Safe Haven during the second gulf war in 1991, the Kurdistan Regional Government (KRG) has established in 1992. Many refugees from Iran and Turkey have started to return and settle in the city of Duhok, as well as the migration of many thousands of villagers and other people from small towns towards Duhok to seek job opportunities and a better life. This has produced minor social groups reflecting their original towns and tribal customs and led to alter the indigenous social fabric. From the cultural point of view, the city distinguished by its multi-ethnic and multi-religious diversity and its active and distinctive cultural performance.

Second, the scarcity of the scientific and academic studies dealing with spatial planning and development issues related to the city of Duhok, and the serious deficiencies in investigating its spatial characteristics in the academic studies. The availability of the related data comparing to the other cities in the province has encouraged to investigate the city of Duhok by the researcher, and

Third, there is also a personal reason for selecting this city as the area of study. The experience of living and working, participating as an architect in the municipality of Duhok, UN-Habitat programme and as an academic in the University of Duhok. These experiences have helped the researcher to develop and formulate his ideas about the city's urban development patterns in the general and urban form in particular. Furthermore, these experiences have made him familiar with Duhok more than any other city in Iraq.

1.4. Problem Statement

Developing countries are urbanising at incredibly fast paces - in many cases with extemporaneous planning – posing huge challenges. Iraq as one of the developing countries is experiencing rapidly growing cities. The process of urban development had not been associated with the provision of suitable urban planning legislation in form of land use plans, subdivision regulations, building codes, and other public policies in a way to guide proper physical urban development. Thus, the consequence is a more random city growth, low density, lack of mobility and accessibility, distances between daily services, the split of urban texture, the disorganisation of urban visage, traffic congestion, thoughtless urban constructions and haphazard developments, depletion of primary agriculture land and amongst

other social, economic and environmental problems which threatened urban environment and contributed to mould the form and the structure of the Iraqi cities.

There is an acute shortage of researches related to the context of Iraq in general, and the Kurdistan region in particular as a part of the federal state. The available studies which investigated the urban form of the city of Duhok are concerned with the geographical aspects of the city such as the areal expansion of the city of Duhok, the geography of Duhok, transportation in the city of Duhok, urban planning strategies, towards sustainable land use management in Duhok city and others, with other few pieces of research mostly conducted by bachelor and master students at the universities of Kurdistan. There is a scarcity of empirical research in investigating the urban form and structure characteristics of the city of Duhok and its impacts on the sustainability of the city.

In the context of the City of Duhok, features of urban form and structure have not been taken into account (e.g. density, accessibility and open spaces) in examinations and testing of sustainability of the urban built environment. There are practically no sound guidelines in urban development ordinance and strategy in Kurdistan to control urban form and structure and development process. This, in turn, has led to significant gaps in knowledge. There is no existing indication in Kurdistan that can explain whether features of sustainable cities are affected by, for example, the layout, density, accessibility, green space availability in an examination of the sustainability of the towns and cities. Similarly, there has been no examination of existing urban forms (e.g. sprawling the settlement spreading from the city centre) to show how they may negatively influence residents' access to facilities and services, which in turn influence the quality of the urban built environment, and the possibility of using indicators for evaluating existing urban forms and their validity to enhance the existing built environment and elevate future development initiatives.

Therefore, there is an urgent need to undertake this study in the city of Duhok and test findings from sustainable approaches for congruence in the Kurdistan context. The study also contributes towards understanding the urban development process and the impact of the workable regulations on urban form and structure. Willingly, the research looks towards fulfilling this gap.

1.5. Significance of the Research

The necessity of this research arises from the perspective of crucial transformation occurs in growing cities in developing countries. The physical changes and the spatial transformation that takes place normally accompanied by dramatic changes to the urban built form has drawn attention to the challenges that face the growing city. In particular, the way that the city grows and develops. Rapid urban growth of cities often creates patterns of urban development that are malfunctioning and are not anticipated. Therefore, urban form and structure supposed to be deliberately planned and designed, and the impacts of the development must be carefully examined and controlled.

There is a requisite to think more pro-actively on sustainable solutions to the cities' problems in Iraq and the Kurdistan Region. Promoting the concept of sustainable cities presents challenges that acquire to address social, environmental and economic sustainability concerns and the inter-linkages between these dimensions, whereas recognising these challenges is sluggishly building-up. The linkage of sustainability dimensions to urban form

and structure is missing, as a consequence of the lack of sustainable urban development and planning.

The elements of urban form and structure such as layout, block's type, open space, land use pattern and street pattern influence social and environmental sustainability. The social and environmental factors in the cities of Iraq and Kurdistan were not addressed early during the development phases unless their clear physical influences were observed on the form and structure of the city and become chronic urban problems.

The outcome of this research is depicted in the form of conceptual proposals suggesting guidelines for sustainable physical urban development. Thus, this research tries to give birth to a sound deal of new thinking and proposes an alternative approach based on the concept of sustainable development to guide urban form and structure in the cities.

1.6. Research Aims & Objectives

The main goal of this research is to determine the factors that affect urban form and structure and the extent of its effect on the sustainability for rapidly growing cities in Kurdistan. It looks at how the elements of urban form and structure influence social, economic and environmental sustainability; moreover, it establishes the correlation between urban form, city growth, and urban development planning and process. The study endeavours to identify the impact of sustainable urban development through analysing and investigating the urban form and structure of the case study at two scales; city-level (macro-level) and neighbourhood-level (micro-level). At the generic city-level the research investigates overall characteristics of the city including; city morphology, social structure, overall services and infrastructure availability, overall land use configurations, overall transportation facilities, demographic trends. At the neighbourhood level, the research investigates how the elements of urban form and structure influence the sustainability of a neighbourhood by using criteria of; compactness, density, mixed use, diversity, accessibility, open space and social satisfaction. Furthermore, the study attempts to recommend strategies of implementation and guidelines that can integrate the urban form into existing urban planning and development framework to create a sustainable built environment. The legitimacy and the importance of the research goal have recently been recognised and have become individual and public concerns. Enhancing the built environment is one of the most urgent requirements for many decision-makers at the local and regional levels in Kurdistan to attain urban sustainability.

The objectives of this research could be summarised, as follows:

- I. Identifying the effects of urban growth and urbanisation in changing and transforming physical urban development patterns.
- II. Exploring the role of sustainable development goals in enhancing and improving urban environment quality.
- III. Determining and defining the elements that characterize and shape urban form, and to manifest the relationship between urban form elements and sustainable criteria.
- IV. Investigating the role of institutional- setup on creation and transformation of urban form and structure.
- V. Perceiving the degree that the residents are satisfied with their built environment, and their recognition regarding urban form problems.

1.7. Key Research Questions

To fulfil the above aim and objectives of this research, the research tends to pose the main question and five derived key questions to orientate the built urban environment towards more physical sustainability in the context of growing cities. The main question is:

How can urban form and structure of a rapidly growing city be orientated towards more physical sustainability?

Based on the main question, the following key research questions are proposed:

Question I: What are the driving forces of rapid urban growth from a physical development point of view?

Question II: How can the concept of sustainable development interpreted in the urban context?

Question III: What are the elements that shape/define urban form? And how can the concept of sustainable urban forms be defined?

Question IV: How does the institutional set-up and regulations affect the creation and transformation of urban form?

Question V: What is the impact of urban form and structure elements on the residents' satisfaction?

The first question tries to explain different driving forces that affect rapid urban growth in the urban context and clarify the challenges that urban context faces, and potentials that control insane urban growth. Moreover, it investigates the effect of fast growth in terms of physical development and the impacts of urbanization and urban sprawl on the sustainability of the urban built environment.

The second question tries to understand the concept of sustainable development and its relation to urban development through defining the dimensions of urban sustainability and sustainable development goals (SDGs) and their effects on promoting physical development, in addition to, indicating the challenges that face sustainable urban development.

The third question tries to identify the spatial elements that shape and define the urban form and structure of the urban context and the claims of sustainable urban form in contributing to sustainable physical development. It analyses different elements of urban form in the city such as settlement layout, block's type, and green space, and the impacts of these elements on the sustainability of urban form and structure.

The fourth question tends to clarify the way that institutional set-up effect on the creation, transformation of urban forms and the role of regulations, legal framework and stakeholders in shaping and forming urban form and the development patterns in an urban context and their impacts and consequences, and

The fifth question investigates the residents' opinions and perceptions on the urban form and structure as well as the residents' recognitions regarding urban problems and the performance of the planning institutions.

1.8. Statement of Limitation

It is useful, from the beginning of the research to set some delineations and boundaries, especially under the limitation of the period of the study from one side and, the limited resources from the other side. The decision made to focus and concentrate on the physical aspects of the development, especially sustainable urban form concepts and its application to

the case study context at the city level (macro-level) and neighbourhood level (micro-level) through assessing the current urban form as a manifestation of physical development.

Access to different official documents encountered multiple constraints due to the distribution of related information between institutions of urban planning and lack of professionals and research centres that undertake urban issues, in addition to, the lack of detailed maps and information regarding planning and designing of newly developed areas. It is worth mentioning that some documents, information and statistics that have been used for this dissertation are considered as limited documents for public use by officials such as unpublished local government, bylaws and reports. Thus, the secrecy of such documents has been firmly secured.

This research is limited to understand the pattern of physical development through evaluating the urban form and structure of the city of Duhok at the city level and in more detail at neighbourhoods within the current jurisdiction boundary of the municipality of the city of Duhok.

1.9. Research Design

A research design is the preparation and arrangement of conditions that are needed for collecting and analysis of the data in a way to combine relevance to research purpose and aims with an economy in procedures (Selltiz et al, 1962, cited in Kumar, 2012, p.94). Kothari (2004, p.31) argues, that “*the research design is the conceptual structure within which research is conducted; it constitutes the blueprint for the collection, measurement and analysis of data*”. As such, the research design implies the logic sequences from writing the hypothesis, collecting and analysing data, and to research the final conclusions in relation to research questions (Yin, 2003; Kothari, 2004; Kumar, 2012).

Based on academic and practical experiences, the research design has been divided into four major phases and detailing the process in each phase -see Figure 1-1.

The first phase exposes the background of the research problem and the context in brief. The ideas in this phase have supported by academic and practical experiences and consolidated by the literature review. The main research questions are formulated and edited in view of the research problem and statement. The detailed research questions are derived based on variables identified within the conceptual framework. Moreover, in this phase, the conceptual framework developed based on an extensive literature review relevant to theories and approaches to sustainable urban development.

In the second phase, the research strategy is identified by selecting a case study strategy. Different methods are adopted to extract information which ranges from non-participants’ observation, measuring and calculation, resident interview, expert interview, photos and aerial images and using different computer software like ArcView 10, AutoCAD, Word and Excel. These sources of data collection are specified in relation to identify and measure variables related to the research and pave the way to catch the required information.

In the third phase, the empirical study examined by analysing the context which guided by the strategy and methods developed previously for this purposes, and in the last phase the theoretical reflection is outlined, findings are interpreted and depicted as a set of conceptual recommendations, then the area of further investigation identified.

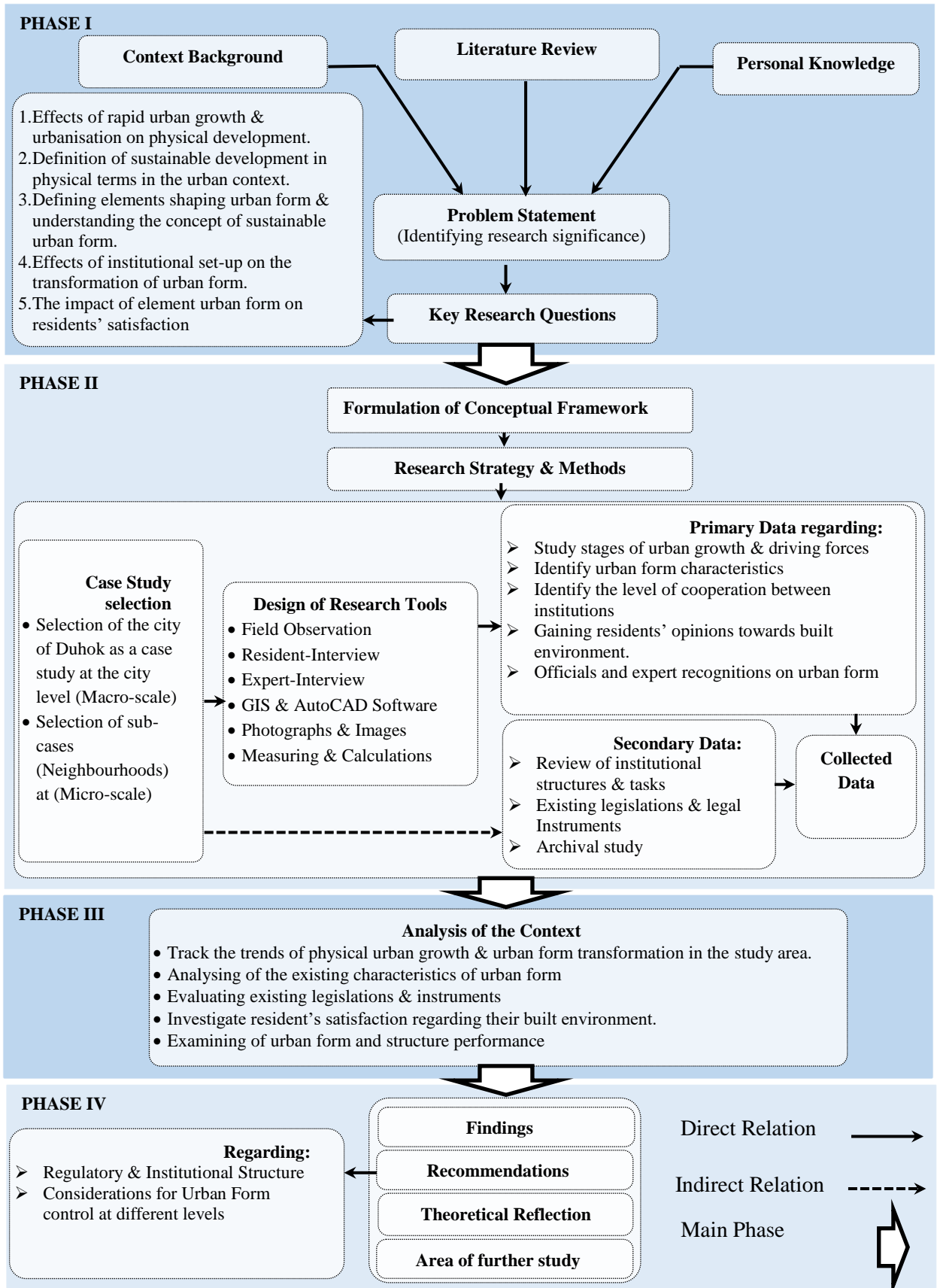


Figure 1-1: Research Design
Source: Own construct

1.10.2. Location of the city Duhok

The city of Duhok is located in the Kurdistan Region in the north of the Federal Republic of Iraq. Duhok is one of the three northern Iraq Provinces which is called the Kurdistan Region. The total area of the Province is about 8824 km² according to old Province boundary in 1970¹.

Duhok city situates at 585m above the sea-level and the latitude (36°51'43.56"N) and longitude (42°59'51.47"E) in the city centre. The city of Duhok is laid in between two ranges of opposing mountains, namely Bêxêr Mountain in the north and Zawa Mountain in the south directions. The two ranges of mountains join each other in the east and detach in the west forming the plain of Sêmêl as a flat agriculture plain. Therefore, Duhok takes the shape of an elongated east-west triangular having 27 km as height and 5.5 km as its base (Duhok Province, 2013) - see Figure 1-3. Beyond the Zawa Mountains in the south, the Sharîya plain is found, which is bordered also in the south by the Dakan Mountains which considered being the future extension of the city of Duhok.

At the administrative level, the Province of Duhok is divided into six districts (Nawçedarî) namely; Duhok, Sêmêl, Zakho, Amêdy, Shêkhan and Akrê, and each district has divided into sub-districts (Nahiya or Deverdari) which makes a total of 29 sub-districts (Ministry of Municipality & Tourism in Kurdistan, 2011; Duhok Province, 2013) - see Appendix 16. The sub-districts run by directors (Deverdar) and connected directly to the centres of Districts. The districts (Nawçedari) run by mayors (Qayimqam or Nawçedar) connected directly to the Duhok Governor (Parêzgar).

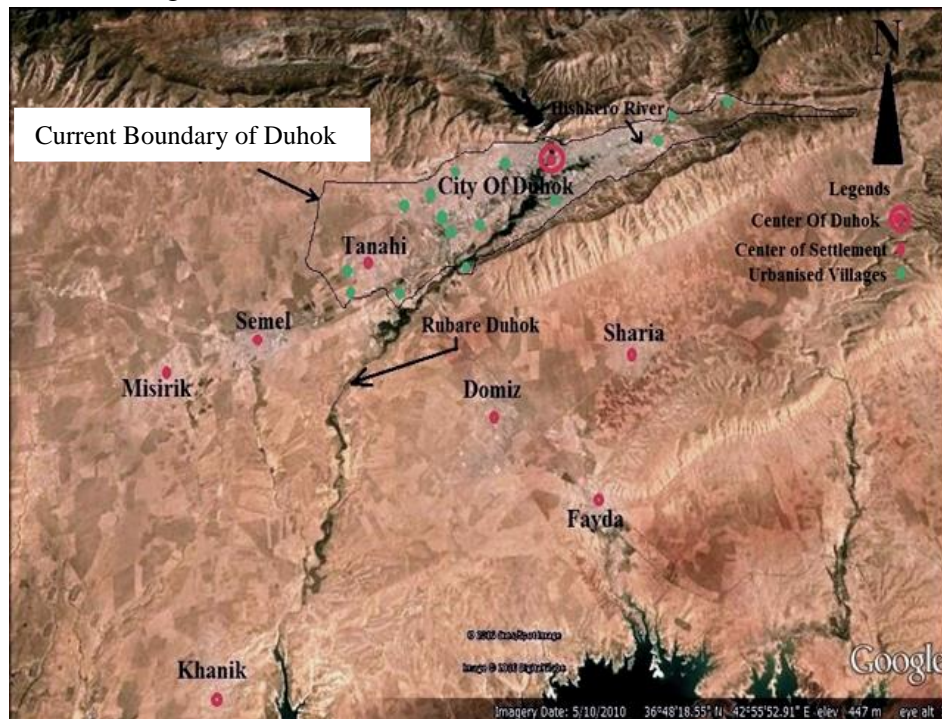


Figure 1-3: Aerial Image of the city of Duhok and the around Settlements
Source: Modified by GIMP software. Retrieved January 14, 2014, from <http://www.googleearth>

¹ The area of the Province increased to include all other districts which were delineated within old Province administrative border according to the 11th of March agreement in 1970.

1.10.3. Urban Development and Urban Growth of the city of Duhok

During the last decades, the city of Duhok developed in rapid and intensive paces. The process of rapid urbanisation can be clearly observed in the city of Duhok and might be perceived in other cities in Kurdistan and Iraq. The concentration of the national and political elites and the location of Local Government in Duhok have raised the stake of urban growth. Duhok represents the spatial locus of the political and economic power of the province.

The city of Duhok has grown from the small settlement with size 18.6 hectares in 1923 to medium size city with an area of 5763 hectares in 2014- see Table 1-1. The ensuing spatial structure of the city of Duhok is longitudinal with land development patterns concentrating along with the two ranges of the mountain. Undoubtedly, such fast growth has to put pressure on different infrastructures of the city and causing many problems such as; consuming land, sprawl, congestion, pollution and extemporaneous physical urban development.

The consecutive development stages and the spatial expansion of the city have encroached thousands of hectares of fertile agricultural land and converted it to new urban areas. The rapid urbanisation process has captured thirteen villages within Duhok's juridical municipality border that were the main suppliers for the primary agricultural products to the city before the urbanisation carrying on. These villages were Beruşkê, Malta Jorî, Malta Jêrî, Gaverkê, Şindoxa, Şaxekê, Nizarkê, Masîkê, Êtutê, Zirka, Bêsirê, Kêvilan and Qasara (Master plan of Duhok, 2009). All of these villages have remained as organic urban forms within the urban fabric of the city without effective complementary policies to upgrade and improve these villages, which become new neighbourhoods of the city – see Figure 1-4.

Duhok now consists of 48 neighbourhoods with different sizes ranges between eight hectares to 400 hectares. All the neighbourhoods are dominated by residential uses except four neighbourhoods which are dominated by other uses such as educational, light industrials, health and institutional.

It is evident that the city of Duhok has grown and developed rapidly since 1947. Many economic, social, institutional, spatial and political factors have affected the rate of urban growth and moulded its characteristics. Urban development in Duhok has not been at the same rate and scale, but it oscillated depending on different factors to fulfil the necessities of its inhabitants, dependently, the percentages of the land use dedicated to different patterns have changed- see Figure 1-5.

Table 1-1: Population, Area, population density and numbers of neighbourhoods in the city of Duhok since 1947

Years	Area of the city of Duhok in Hectares	No. of population	Population Density (per./hectare)	No. of Neighbourhoods
1947	28.6	5621	196.54	5
1957	41.00	7680	187.32	7
1977	260.6	40191	154.22	15
1987	581.65	114322	196.55	23
1998	1470	212469	144.54	26
2008	3973.92	298548	75.13	42
2014	5763	355193	70.86	59.25

Source: Own construct based on Al-Janabi, 1985; Hirori, 2009; Directorate of Statistics in Duhok, 2013



Figure 1-4: Spatial boundary of the city of Duhok indicating the location of neighbourhoods and urbanized villages

Source: Own construct based on Plans from Municipality of Duhok 2015

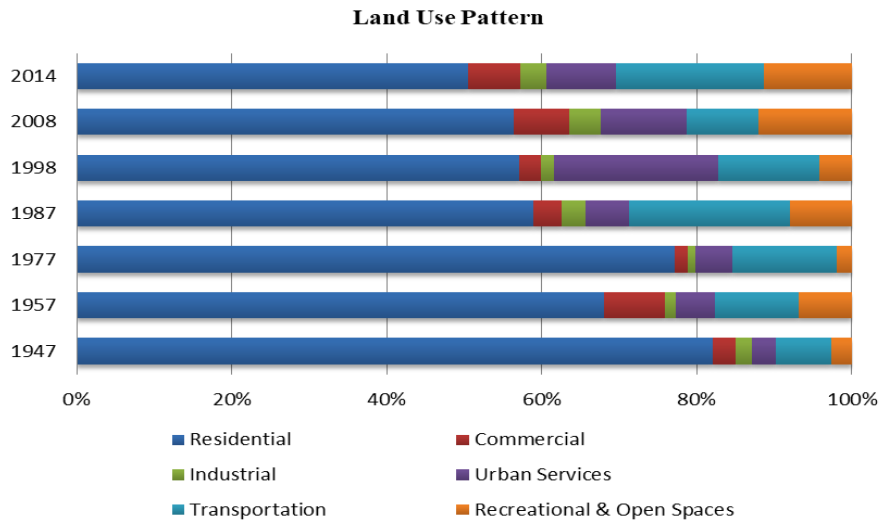


Figure 1-5: Percentages of land use devoted to different uses in the city of Duhok since 1947
 Source: Own construct based on Al-Janabi, 1985; Al-Feqeeh, 1999; Directorate of Statistics in Duhok, 2013; Municipality of Duhok, 2014

1.10.4. Population Growth

There is no clear idea about the exact number of inhabitants of Duhok in the nineteenth century. Henry Bender during his journey to Duhok in 1850 reported that the city of Duhok was a small settlement with 60 families (Bender, n.d), by using an average family size of 8.5 persons taking into consideration the big size of families at that time (Duhok Master Plan Report, 2009; Directorate of Statistics in Duhok, 2014). The population of Duhok then was approximately 450-500 inhabitants. Nevertheless, in 1923 a map for the city of Duhok was prepared. There were 414 houses by calculating the number of the residential plots on that map, which indicate that the population was around 3105-3500 persons using the same average of 8.5 persons/family (Al-Janabi, 1985; Al-Feqeeh, 1999). In 1947 the first official census was conducted in Iraq. The population of the city of Duhok was 5621 inhabitants according to the recordings of the (Ministry of Social Affairs, 1954). The statistics of the inhabitant growth show a continuously steady rise in population.

The population number in the province of Duhok is distributed between urban and rural areas. A large number of the population reside in urban areas and is estimated to be 1089877 inhabitants distributing between small towns and capitals of districts namely; Sêmêl, Zaxo, Amêdî, Şêxan, Akrê and Berdareş including the city of Duhok the capital of Province, while the number in rural areas is only 397158 inhabitants in the whole of the Province (Duhok Master Plan Report, 2009; Directorate of Statistics in Duhok, 2014) - see Figure 1-6. The city of Duhok is accommodating the big share of the population which makes 25.08% percentages of the total urban populations of the province. Population numbers in the Province and the city of Duhok is experiencing rapid growth since 1970 - see Table 1-2 and Figure 1-7.

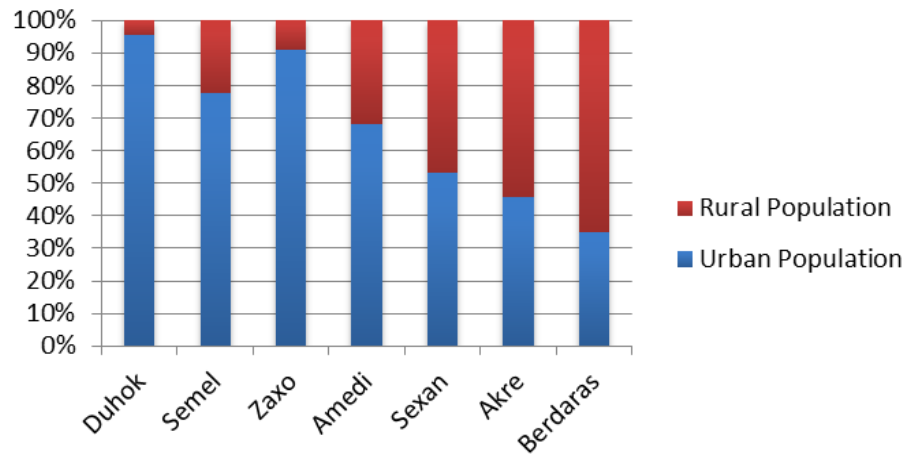


Figure 1-6: Rural and Urban Population in the Province of Duhok
 Source: On construct based on data from Directorate of Statistics of Duhok in 2015

Table 1-2: Population growth in Duhok Province in the last forty years

Year	Population of the Province (Inhabitants)	Population of the city of Duhok (Inhabitants)	Population of Duhok in % from total Inhabitants of the Province
1970	243113	18284	7.52
1977	240575	40191	16.70
1987	294304	114322	38.85
1998	714034	212469	29.76
2003	919431	249918	27.18
2010	1257098	295850	23.53
2014	1487035	355193	23.86

Source: Own construct based on Al-Janabi, 1985; Al-Feqeeh, 1999; Directorate of Statistics in Duhok, 2013; Municipality of Duhok, 2015

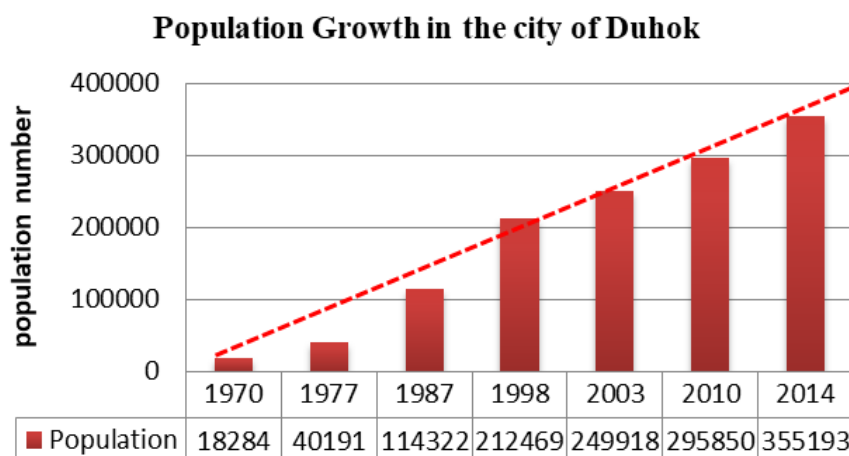


Figure 1-7: Exponential Population Growth of the City of Duhok in the last forty years
 Source: Own construct based on document analysis from the Directorate of Statistics in Duhok, 2015

1.10.5. Socio-Economic Settings

Ethnically, the majority of the populations in the Province and the city of Duhok are 95% Kurds, with minority groups of Assyrians, Chaldeans, Arabs and Armenians. The dominant religion is 90% Islam and the remaining is Christian and Iyzids who live in peace and brotherhood (Al-Janabi, 1985; Duhok Province, 1986; Directorate of Statistics, 2014). According to the Directorate of Statistics of Duhok, the total population of Duhok Province in 2014 was 1487035 inhabitants. This population has divided between three major age classes, from 0-14, 15-64 and more than 64 years- see Figure 1-8.

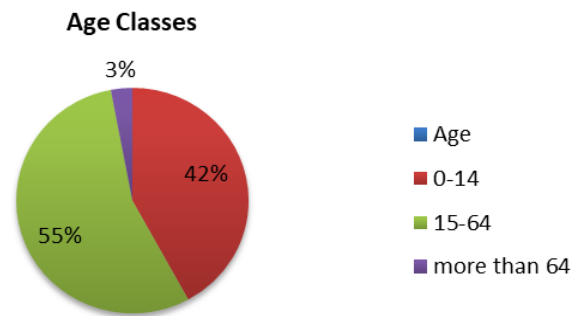


Figure 1-8: Percentage of Population of Age groups in the Province of Duhok
Source: On construct based on data from Directorate of Statistics of Duhok in 2015

Duhok society is characterised as a youthful society with 42 percent of the total population in 2014m below 15 years of age and 55 percent above 15 years. The average family size is 6.8 persons. The transformation process of the society in Kurdistan in general and Duhok, in both rural and urban have drawn its social character form and has accompanied by the development of civil society. In general, the society suffers from a lack of political stability, high population growth rate and high level of poverty through the unfair distribution of the resources, high rate of unemployment and difficulties in access to different services.

The economy of Duhok depends on oil revenues from the Kurdistan Region Government, while the local revenues are directly transferred to the Central Bank of Kurdistan. The dominant local economy in the first rank is services followed by trading, agriculture, and tourism. The agricultural sector mainly was a victim of the serial numbers of the continued wars waged against the region through destroying and evacuating the villages by pervious regimes of Iraq. The ability of the local government to meet the needs of the residents depending on the available resources that they have, and how they use these resources and to what extent it is planned and managed. Deficiencies and weaknesses in any of the mentioned areas can undermine the viability of the local government and its ability to build a strong local economy.

Before the collapsing of the Baath regime, in 1998 the Kurdistan Regional Government (KRG) received from the UN about 14% of the revenue from Iraq's Oil-for-Food programme and, Duhok Province's share was 24% from mentioned percentage. In 2006, the (KRG) started to invest in the oil industry (Kurdistan Regional Government, 2008). The stability of the Kurdistan Region during the last years has encouraged achieving a high level of development than the other parts of Iraq. In 2004, the per capita income in the Kurdistan region was one time higher than the other part of Iraq, while four years after 2008 it was two

times higher. The growth rate between the years 2010-2012 was about 11.55%. Since 2012 the growth rate has oscillated between 7-8%, due to the instability in the region (KRG-MoP, 2014).

The monthly average income rate in the city of Duhok for 39% of the families are between 250 -450 \$ USD, 28% of the families ranges from 450-670 \$ USD, 18% of the families have income from 670-1250 \$ USD, 10% of the family’s income range between 1250-2500 \$ USD while the rest is more than 2500 \$ USD (Directorate of Statistics of Duhok, 2014).

The investment has been mostly targeted towards housing, industry, trades and tourism. Duhok’s economy is highly connected to the economy of the Kurdistan region as a whole. The city of Duhok comparing to the capital of the region (Erbil) is still hampered by limited infrastructure and spreading of corruption in most of the public segments- see Figure 1-9 and Figure 1-10. One of the strategic projects is Duhok international airport which has been under construction since 2013 in Sêmêl plain; this will have its effect on flourishing the economy of the Province and offer many job opportunities (Duhok Province, 2014).

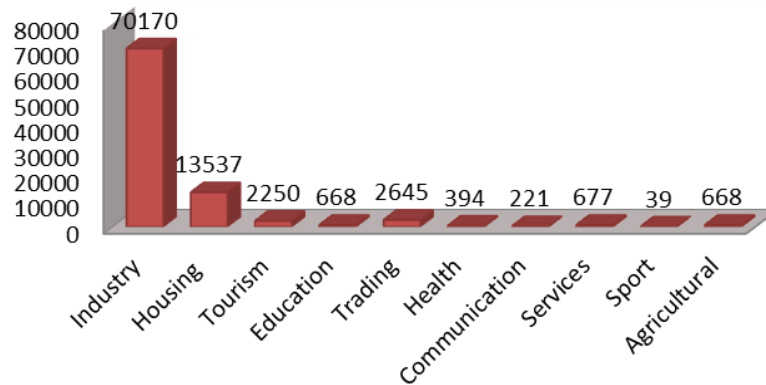


Figure 1-9: Kurdistan Licensed Projects in May 2013 approved by KRG in Kurdistan region
Source: Kurdistan Board of Investment, 2014

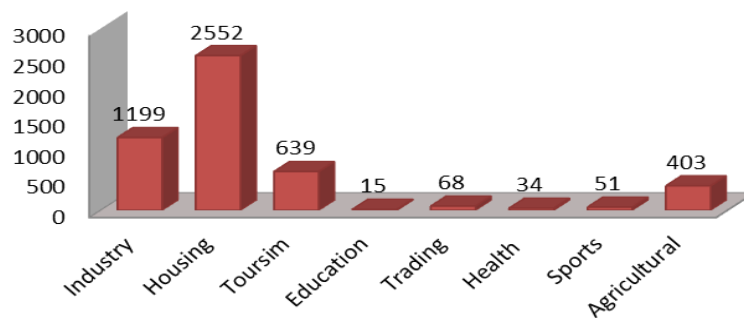


Figure 1-10: Duhok Licensed Projects in May 2013
Source: Kurdistan Board of Investment, 2014

During the last decades, the region was not able to build a strong economy by depending on local potentials and resources, because of the sequential wars against the region and the racial politics of the Ba’ath regime. Between the years 1991-2014 of self-autonomy the Kurdistan Regional Government was also not able to build the sound economy and dependent

on oil revenues, this type of economy is sensitive to shocks and not stable which adversely affects the community.

1.10.6. Environmental Settings

The environmental condition is disastrous in the Kurdistan region and continuous detonation and pollution. During the last four decades, there was a lack of serious attention to environmental issues because of the sequential wars waged against neighbour countries and Kurdistan Region by the previous regime of Iraq, and the absence of an effective body which was responsible for environmental affairs. Moreover, rapid population growth and the low perception and lack of awareness by the people and the decision-makers towards the environment, which is reflected through the behaviour of people and the way that the planning and development initiatives taking place has extreme pressure on the environment. The main sources of environmental deterioration emerge from different sources, such as air pollution which resulting from the fuel through extensive use of cars and heating, shortage of water, solid waste and sewage, lack of open green spaces in urban areas and lack of regulations relating to zoning and buildings. These are the main challenges to the urban environment in Duhok city context.

Environmental Improvements and Protection Board in Kurdistan Region (EIPB_KRG, 2014) has classified the priorities into themes, depletion of water resources, deterioration of water quality, land degradation, depletion of natural resources, air and noise pollution, depletion of biodiversity, landscape degradation and threats to cultural heritage.

1.10.7. Transportation

Streets in the city of Duhok lack of sound design and planning. In general, the arterial street network has not been able to carry the flow of the increased traffic volume. Main streets are narrow comparing to the population density and the high rate of owning cars by individuals. Streets in Duhok face big challenges of high congestion rate during the daytime, especially in the city centre and other main arterial roads -see Figure 1-11 and 1-12.



Figure 1-11: Traffic congestion and high numbers of Taxis in Kawa Street in Duhok City

Source: Photo by the researcher, 2015

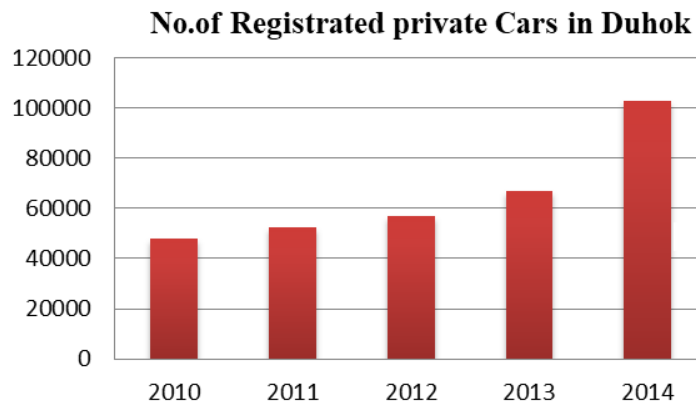


Figure 1-12: Registered numbers of private cars in the Province of Duhok.

Source: Own Construct based on data from Directorate of Traffic in Duhok in 2014

1.10.8. Brief Review of Urban Planning System and Policies in Iraq

The country had a legacy of urban planning before establishing the new Iraqi state in 1921. Most of this legacy was inherent from the Islamic creed, Ottoman Empire and colonial period of British colonialism. The planning system in Iraq was very influenced by this legacy. By declaring Iraq as a republic in 1958 a new urban planning system and policies were adopted, the government had started to put master plans for most of the larger Iraqi cities.

In Iraq, planning was centralised with the Ministry of Planning playing as the main partner in both co-ordinating of the planning process and in consultations and cooperation with the Ministry of Finance to allocate the resources in countrywide. The related ministries and other responsible departments in the capital prepared development plans (e.g. physical plans, sector plans). These plans were made based on information and data provided by the respective departments and institutions at the national level. Normally, all five-year sector plans were prepared for the whole country. The fund for implementing the plans was provided by the Ministry of Finance through an annual budget process (UN-Habitat, 2003; Municipality of Duhok, 2013).

The main instrument for the area of urban planning was the master-plan as conventional and traditional way, which was addressing only zoning and physical plan for the given city or town, with limited inclusion of socio-economic aspects. Strategic urban plan or modern spatial planning tools and methods were absent and not existed (UN-Habitat, 2003). The highly centralised urban planning process meant to offer a limited involvement at regional and local levels, which give no space to stakeholders' participation at all levels.

In 1991 by declaring UN no-fly zone resolution, under this umbrella Kurdistan Region Government established with many ministries including the Ministry of Municipality and Tourism according to the law no.15 of 1992 by the first cabinet of Kurdistan Regional Government (KRG) followed by the Law no. 6 of 1993 for identifying the directorates of the ministry. The Ministry was responsible for planning, managing and implementing all urban development initiatives in the Kurdistan Region of Iraq. The Ministry of Municipalities and Tourism also deployed Law no. 3 for land separation and transformation in 1998, and Law no.4 of 2006 for Investment projects. Moreover, they later stipulated by the Law no.2 of 2007 and legislation no. 12 of 2010 which identifies the duties and responsibility of the Ministry of Municipalities and Tourism to administrate public and civil municipal services. The Ministry

of Municipality and Tourism took responsibility for urban planning through the General Directorate of Constructive Planning in Erbil. The urban planning in Kurdistan remained centralised with very limited intervention from the side of residents and civil society. Except during the advertising the master plan, the residents and public have the right to comment on the master plan within the duration of only two months (UN-Habitat, 2006; Municipality of Duhok, 2013).

Iraq has virtually had limited experience in the field of urban planning and preparing plans at both central, regional or local levels which constrained the country to pursue sustainable development in cities and towns (UN-Habitat, 2003).

After the operation of the Freedom for Iraq by USA and alliances in 2003 the previous regime of Iraq collapsed and ended. In 2004 the Republic of Iraq declared as a federal system consisted of federal-level authority, the federal region of Kurdistan with its three Provinces (Duhok, Erbil and Sulaimaniya) and 15 other Provinces which include Baghdad. The constitution of the Republic of Iraq however, provides a model of decentralised political and administrative government with authority transformation to the Provinces. The limits of provinces' authorities remain obvious concerning decentralised finance and delivery of services (UN-Habitat, 2009).

In Kurdistan Regional, the Government has stepped towards decentralisation through the first Article of Act (1) of the year 2005 of the Iraqi Kurdistan Presidential Order, the order known as the mandate of the Ministry of Planning (MoP) for creating the framework for the planning system in Kurdistan Region (Mandate of the Ministry of Planning-KRG, 2005). The new planning system has eliminated all the previous legislation which opposite to nation, public and private interests and issued during the Baath regime of Iraq.

Changes of the law and other regulations since 1991 have vastly boosted the importance of a strategic plan for the Kurdistan Region land use decision-making. The Ministry of Planning (KRG), has prepared three Regional Development Strategies; each was prepared for five years' period (2010-2014, 2012-2016 and 2013-2017) as a development plan for the entire region of Kurdistan. These strategies have been updated twice with the co-operation of public, local and international agencies. These strategies addressed many of the issues related to urban planning and sustainable development (Regional Development Strategies 2012-2016; Regional Development Strategies 2013-2017). Unfortunately, these plans have not been implemented due to the financial crises and political circumstances that raged the Kurdistan Region after the year of 2014.

1.10.9. Land Use and Land Ownership

In the Kurdistan Region, during the last decades, land use has been affected by the political situation of the country. The absence of an influential planning system has led to random and extemporaneous developments, without taking into consideration the preservation of natural resources, consuming fertile agricultural lands and availability of land for future development.

The land use structure in the city of Duhok reflects the way that the land has been claimed for different uses. The city of Duhok encompasses the area of about 65 square kilometres. More than 70 percent of useable land for development has been executed, while 20 percent is rocky land and constrained by the topographical features of the land.

Residential land is the dominated pattern of land use and occupies 50.48 percentages of the available land, followed by; Transportation 19.08, public services 9.00 percentages, industrial 3.41 percentages, commercial 3.23 percentages and recreation and open spaces 11.33 percentages including orchards in Duhok valley.

The land ownership law in Iraq is inherited from the Ottoman Impair and British Colonial. Land law had divided into: privately owned land, which the individuals has the full swing right, Amiri land which is owned by the government and divided into two types; discretion land granted to individuals as users of the land, in this case, the development officer must approve the use of the land, here the users don't have the right on possessing the land or to change the use of the land without government authorisation, and the other type is fully governmental property, which nobody has the right to use it (Directorate of Land Registration in Duhok, 2014).

The land is privately owned in the rural areas, while in the urban areas the municipality owns the land by the process of land acquisition which is based on the law, and then the municipality can sell or grant the land to individuals as private property.

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Chapter Two: Urban Development and Urban Growth

2.1. Introduction

Within the continuous dynamic and evolution and growing of the cities and urban areas, there are evident impacts on the urban environment and human well-being. To underline these impacts, their roots and consequences, it is necessary to understand the development process of a particular urban context, the pace of urbanization and urban growth, and the driving forces that affect urban environment.

2.2. Urban Development

For a wide range of people, development is looked at as a 'well-being', which often related to economic prosperity and seen as an outcome and process, in which wealth and economic growth improve living conditions and protect the environment. It can be experienced in different scales, from the individual, to the local community, the regional, the national and the global level (Willis, 2005). Development is a multi-dimensional process aims to achieve specified goals. According to Philips & Pittman (2009) development outcome can be understood and described as;

- In physical terms such as new homes, office buildings, retail shop, infrastructure, roads, schools and so on
- In socio-Economic terms such as an increase in per capita income, new jobs, enhanced quality of life, or reduction in poverty ...etc.

Urban development is defined by Clark (1982 cited in Bhatta, 2010, p.2) as “...*the process of emergence of the world dominated by cities and by urban values*”. Development in the urban context responds to complex forces. Modernisation and tradition play a great part in the process, and exerts huge pressure on the local urban environment and surrounding area and their natural resources. These, in turn, create many growing problems (e.g. housing demand, pollution, water supply, solid waste) (UNEP, 2002).

2.3. City Growth

Fast and uncontrolled urban growth often result in urban sprawl and poorly planned areas. Usually, such urban growth is driven by the growth of informal settlement or non-well planned growth. The unsustainable chosen land for new development initiatives, lack of service infrastructure, insufficient planning policies and regulation resulting in improperly built environments and unhealthy living conditions.

The following sections try to focus on the main concepts relating to; increasing the size of a city through the process of urban growth, sprawling and urbanisation in an urban context.

2.3.1. Urban Growth and Urban Sprawl

2.3.1.1. *Urban Growth*

There is a lack of consensual universal definition of 'urban settlement' which leads to an unclear definition of urban growth, because what constitutes urban varies from country to another. The criteria that used for defining urban areas depend on several characteristics, such as; administrative or political boundary (e.g. settlement with municipality), functional

characteristics (e.g. settlements with a certain level of administrative, population density, proportion employed in non-agricultural sectors, the presence of infrastructures like paved roads, electricity and water pipes, or can be described according to its population sizes, or the extent of the built-up area that the population occupies (Cohen, 2006; EC,2011). Rapid physical growth of cities happens in the case of integration of the surrounding pre-urban settlements with cities and towns, as the consequence, the built-up expands and administrative boundaries of cities getting enlargement (UN-Habitat & Cities Alliance, 2014).

Urban development occurs through two processes; urban growth and urbanisation. It is useful to make a clear distinction between the two processes. According to Clark (1982, cited in Bhatta, 2010, p.3) and Saraswati and Bandyopadhyay (2009, cited in Thapa & Murayama, 2010, p.70), while urban growth is a spatial and demographic process which refers to the concentrations of population and increasing the importance of cities within a particular economy and society; urbanisation is a social process which refers to the changes of behaviour and social relations that occur in social dimensions as a result of people living in urban areas (Clark, 1982 cited in Bhatta, 2010).

According to (Cheng, 2003) urban growth is a broad and unclear concept. It may refer to the spatial growth, population growth, and economic growth or environmental change. There is a strong correlation between urban growth and population growth, urban growth can be defined as “*the absolute increase in the size of the urban population*” (Clark, 2003, cited in Oktay & Conteh, 2007, p.5). When a population growth rate exceeds the death rate or an increase in net, urban in-migration exists (Oktay & Conteh, 2007). Migration from rural to urban is considered the main cause of urban growth (UN-DEAS, 2001). The consequence of the population growth leads urban area to expand spatially in order to compel with additional needs to housing, infrastructures and facilities. This requires that cities have to expand and grow in terms of land size to accommodate new development initiatives (Oktay & Conteh, 2007). The growth of the settlement is in the form of a dual process of external as spatial expansion and internal as physical growth. External expansion appears in the form of an increase in the city limits, while internal growth emerges in the form of an increase in the inner urban population and built-up area (Rahnama, 2006 cited in Mobaraki, Mohammadi & Zarabi, 2012).

The world has been experiencing unprecedented and dramatic rapid urban growth since the middle of last century until now as a result of the world’s economic transformation, and there are no indicators that this rapid growth will go slowly especially in developing countries (UN-Habitat, 2002a; Cohen, 2006; UN-Habitat, 2011). By the year 2020, there will be six people out of ten living in an urban area. Presently, more than half of the world’s urban dwellers live in cities with a population of fewer than 500,000 inhabitants, and more than 10 percentages of urban dwellers live in megacities (UN-Habitat, 2011). Angle et al (2011 cited in Blanco, 2014, p.278) investigate growth rates of 160 cities around the world between the years 1990-2000 they have found that; the spatial growth rate of urban land cover is more than double of the rate of urban population growth rate.

Urban growth in spatial point of view has categorised by Wilson et al (2003 cited in Abiodun & Bayode, 2014) and Forman (1995 cited in Shi, Sun, Zhu, Li & Mei, 2012) into three types; infill, expansion and outlying, outlying urban growth further divided into branches; isolated, linear and clustered growth. Rapid and uncoordinated urban growth is

mainly a result of an urgent responsiveness to curb increasing informal settlements and supplying necessary housing due to a constant influx of new migrants (Ranhagen & Groth, 2012). Moreover, such growth produces leapfrog development. The rapid development is blamed for having no enough time for planning and coordination between government agencies, developers and proponents (Bhatta, 2010).

Should urban growth be planned in a sustainable way to meet the requirements of their inhabitants, or it should proceed in a *laissez fair* state of affairs? Arguably, there is some sort of near consensus on which urban growth is positive and which one is negative. The apparent features of fast growing-cities that they occupy a large area of land associated with many problems including; low residential density, high car dependency, inefficient land use, segregation and remoteness of services, which coupled with land use speculation (Blanco, 2014), as a result, creating models of fragmented city growth and the concept of the city is lost (UN-Habitat, 2013a). The continuous growth rates of urban areas threaten the natural potentials of rural areas. This has led researchers to investigate other models of urban growth such as the compact form of urban growth which refers to a planned, controlled and orderly growth, in contrast to urban sprawl which refers to an uncontrolled, chaotic, scattered and incoherent growth (Jenks & Burgess, 2004). Undoubtedly, the excessive and rapid spatial urban growth results in many urban forms and patterns of development, and it has resulted in dramatic changes in socio-economic and environmental aspects, because of unsustainable urban development patterns, especially in developing countries as a result of the fast-growing economy (Besussi, Chin, Batty & Longley, 2010; Yeh & Li, 2000, cited in Deka, Tripathi & Khan, 2012, p.1062).

Urban growth pattern influences on urban development processes at the city and neighbourhood levels on one hand, on the other hand, urban growth pattern is affected by land and housing policy, current built-up area, availability of developable area, changes in the household count, population, economy and other factors (Bhatta, 2009; Besussi, Chin, Batty & Longley, 2010; Yeh & Li, 2000 cited in Deka, Tripathi & Khan, 2012, p.1062).

Measuring of urban growth provides a significant tool for planning and decision-makers, and as an accurate explanation of the type of spatial development patterns, thus, helps in identifying and analysing the social, economic and environmental impacts that resulted by the development process. Also, it helps to understand the nature and the direction of urban growth, to depict and envisage the likely scenario for the future development (Frenkel & Ashkenazi, 2001 cited in Abiodun & Bayode, 2014, p.65). Researchers have been carried out to measure the spatial extent of urban growth using various methods and techniques such as Shannon entropy model, patchiness and density by using remote sensing (Bhatta, 2009; Shi, Sun, Zhu, Li & Mei, 2012).

Urban growth is an inevitable process which cannot be stopped; rather it can be mitigated and orientated in the right direction. Managing forms of urban growth is extremely a difficult task (Sorensen, 2011). The benefit of slowing and controlling urban growth is to provide time and opportunities to improve the community. The consolidation of urban facilities and the efficient use of existing land use, provide more sustainable urban form, protect the rural production area and other sensitive ecological areas, improve access to services, and offer job opportunity for a majority of residents.

2.3.1.2. *Urban Sprawl*

Urban sprawl is highly related and dependent on the context and socio-political background, and it is assigned to the time and the context (Besussi, Chin, Batty & Longley, 2010), it is not restricted and limited to any context. Urban sprawl is the result of rapid urban growth because the governments are not capable to offer controlled and managed locations for inhabitants.

Some types of urban growth are remedies to urban sprawl (e.g. infill development) (Roca et al. 2004 cited in Abiodun & Bayode, 2014, p.65). Indeed, not all kind of urban growth is considered as urban sprawl, appointing the type of urban sprawl is disputable and is not solved by the researchers (ibid.), because there is an ambiguity as well as a disagreement in defining of urban sprawl; it means different things to different people (Banai & DePriest, 2014). Some view sprawl as an unintended consequence of modern lifestyle, others consider it a waste of resources especially land, it is *“inimical to civic life if not the economy and society”* (Kunstler 1993, Duany et al. 2000 cited in Banai & DePriest, 2014, p.3).

Urban sprawl is broadly defined as the spreading of new development initiatives on isolated plots, separated by vacant area, and described as a specific form of urban development with low-density, dispersed, auto-dependent and environmentally and socially-impacting characteristics (Ewing, 1997; Downs, 1998; Burchell & Shad, 1999 cited in Hasse & Lathrop, 2003, p. 160). Also, urban sprawl has been described as a leapfrog development (Lata et al, 2001; Torrens & Albert, 2000 cited in Patel, 2014, p.670), and as excessive spatial urban growth of cities (Patel, 2014). In general, urban sprawl is characterised by single-use zoning and scale of development (Nallathiga, 2008), inefficient land use and service inefficiency (Bhatta, 2010), and has become one of the crucial issues facing most of the cities around the world especially in developing countries. Therefore, urban sprawl must be studied with relation to space-time and not simply as increasing in urban land *“but the rate of increase relative to population growth”* (Barnes, Morgan III, Roberge & Lowe, 2001, p.4). The working definition of urban sprawl has been drawn by Barnes, Morgan III, Roberge and Lowe (2001, p.4) as *“a pattern of land use/land cover conversion in which the growth rate of urbanized land [...] significantly exceeds the rate of population growth over a specified time period with a dominance of low-density impervious surfaces”*.

Urban sprawl can be analysed according to:

- *Form:* urban sprawl is not a specified urban form; rather it refers to many types such as the linear pattern of compact development to scattered pattern of development (Maier, Franz & Schrock, 2006; Chin, 2002).
- *Land use layout:* urban sprawl has been associated with low-density housing, single-family houses and dispersed urban blocks. This approach of urban sprawl is defined as low-density urban development (Chin, 2002; Maier & Franz & Schrock, 2006; Nallathiga, 2008; Bhatta, 2010).
- *Impacts:* According to Ewing (1994) urban sprawl should be defined by its costs and negative impacts; therefore, the negative impacts of urban form could be understood as urban sprawl.
- *Density:* In general, urban sprawl understood as low-density development regardless of its impacts. Density plays a crucial role in defining urban sprawl and works as an indicator of land intensity representing the ratio between the

- population of an urban area and a given land area (Chin, 2002; Maier, Franz & Schrock, 2006; Barnes, Morgan III, Roberge & Lowe, 2001).

Normally, urban sprawl generates remote developable areas that need massive infrastructure to interconnect them due to low density; therefore, it is evident to become not sustainable at an affordable level (Nallathiga, 2008; Ranhagen & Groth, 2012). Therefore, this form of urban development is regarded as an inefficient pattern of urban growth with the number of social, economic and environmental disadvantages (Hasse & Lathrop, 2003; Peiser, 1989; Thompson & Prokopy, 2009 cited in Shi, Sun, Zhu, Li & Mei, 2012), and imposes many costs on residents such as economic, emotional, aesthetic and physical costs (Barnes, Morgan III, Roberge & Lowe, 2001). Urban sprawl has many traits - see Box 2-1.

- Unlimited outward extension of development,
- Low-density residential and commercial settlements, Leapfrog development,
- Fragmentation of powers over land use among many small localities,
- Dominance of transportation by private automotive vehicles,
- Lack of centralised planning or control of land uses,
- Widespread strip commercial development,
- Great fiscal disparities among localities,
- Segregation of types of land use in different zones, and

Box 2-1: Traits of Urban Sprawl

Source: Own construct based on Downs, 1999; Barnes, Morgan, Roberge & Lowe, 2001

Because of those traits, urban sprawl is considered to represent a threaten for sustainable urban development. The environmental impacts of urban sprawl have attracted the attention of planners and have stimulated other models such as compact city, smart growth, transit-orientated development, urban containment and eco-city.

According to Galster et al (2001), urban sprawl can be observed and investigated in different circumstances and conditions; perhaps different types can identify which consist of combinations of various variables. Density is one of the land use dimensions that have been identified among others to measure values that designated to signify urban sprawl. The most known methods between scholars to measure urban sprawl are based on density measurements and land consumption (Abiodun & Bayode, 2014).

2.3.2. Urbanisation

Perhaps the most important changes in patterns of urbanisation happened during the last century was the excessive spreading of urban development over the huge area with lower density. Sorensen (2011) states that this phenomenon is not only related to certain countries but includes countries from developed worlds and developing countries. According to Bhatta (2010), the term of urbanisation has given a broad sense in meaning and it can be defined from the social perspective and the spatial perspective as “...it refers to the physical growth of urban area from rural areas as a result of population immigration to an existing urban area” (p.3). Urbanisation refers to the shifting of population from the rural area that spatially is dispersed and dominated by agricultural activities as a main economic income resource towards an area that population is more concentrated in a large and dense urban area, which dominated by industrial and service activities as main economic resources (Montgomery,

Stren, Cohen & Reed, 2003). Physically the predominated rural areas alter to urban areas, and demographically the people who live in these altered areas accounts as citizens of cities or suburban area, and they depend on non-agricultural resources for their incomes (Afify, 2009).

Natural population growth and migration from the rural area to urban area are fundamental components for occurring urbanisation (UN-ESA, 2001). People move to cities in search of better life and availability of varied opportunities for education and employment (Ranhagen & Groth, 2012). Rapid urban growth contributes to high rates of urbanisation (Bhatta, 2010). According to (Cohen, 2006; Soletsz, 2008; Satterwhaite, Saleemul Huq, Reid & Lankao, 2009) there are numbers of different factors causing urbanisation and urban growth including; natural population increase, rural-urban migration and annexation. In term of spatial expansion, the process results from annexation, transformation and reclassification of rural areas into new urban settlements. The rate of natural growth of population in an urban area is lower than in rural areas, as a result, urbanisation levels rise because of rural-urban migration. Eventually, the rate of land and population in rural areas declines, while the rate of land and population in urban areas increases.

Urbanisation trends between developed and developing countries contrast sharply mainly at the pace of urbanisation. Urban areas in the industrial countries indicate slowly change during a long period, and within the national framework, while in developing countries indicates fast changes and without any sound national framework to encompasses it (Soletsz, 2008). UN-Habitat confirms that each year, in developing countries about 50 million people move from rural area to urban area, and mostly they live in bad conditions (2011).

Trends in urbanisation raise dreadful challenges to governance, environmental sustainability and social equity (UN-DESA, 2001). Afify (2009) proclaims that urbanisation causes conflicts between competing groups in the region, and spatially destroys the traditional urban forms, cultural resources and exposes the local environment to high risks. Changes in the landscape fragment land use and reducing the amount and size of remaining patches of habitat and the degree of connectedness are the consequences of rapid urbanisation (Barnes, Morgan, Roberge & Lowe, 2001).

The influences of spatially growing cities lead to the emergence of spatial forms and urban patterns in expense to the predominantly rural patterns by dominating urban lifestyle and values instead of traditional customs and values, not only in the urbanising area but even in the rural area as well (Afify, 2009; Bhatta, 2010). This may be clear especially at a local scale through disappearing of many local traditional features of built form, emerging of gated-communities, distortion of spatial continuity and encouraging of urban sprawl, this on one hand. On the other hand, urbanisation brings many social-economic and environmental benefits. The urbanisation offers a great opportunity for development (UN-DESA, 2015). According to (Afify, 2009) urbanisation may increase richness and diversity of the population, and urbanisation produces new residential areas and urban spaces. Cities through the process of urbanisation experience growth of population, which demands more housing, employment, services, and extra infrastructure (Ranhagen & Groth, 2012). Moreover, rapid urbanisation presents big challenges to the governments and requires integrated planning and development solution to technical, financial and social aspects. It is impossible to slow down because cities offer a better chance for education, improved social facilities and economic opportunity and services, and cities are the centres of political, cultural and economic development.

2.4. Driving Forces of Urban Growth

The main causes of urban growth and urban sprawl cannot be distinguished from each other and they are intertwined. Urban growth can be observed as sprawl or compact, knowing that urban sprawl cannot happen without inducing urban growth in a certain area. Some of the causes like population growth can occur in controlled urban growth or uncontrolled growth. Whether the growth is compacted or sprawled depend mainly on the process, pattern and consequences. Uncontrolled urban growth results from inefficient policies, private sectors usually take advantage of weak controls, low prices of land and informal and illegal settlements (Chin, 2002; Jenks & Burgess, 2004). There are other causes responsible for one pattern of the growth- see Table 2-1.

Table 2-1: Causes of urban growth which may result in controlled and/or uncontrolled growth

Driving Forces of urban growth	Causes of Urban Growth	Compact Growth	Sprawled Growth
Economic Forces	Economic growth	● ²	●
	Industrialisation	●	●
	Development and property tax		●
	Living and property cost		●
	Credit and capital market		
	Housing investment		●
	Speculation		●
	The expectation of land appreciation		●
	Legal disputes		●
	Land hunger attitude		●
Demographic Forces	Population growth	●	●
	Migration		●
Spatial Forces	Physical geography		●
	Transportation	●	●
	Road width		●
	Large lot size		●
	The demand for more living space	●	●
Social Forces	Lack of affordable housing		●
	Single-family home		●
	Nucleus family	●	●
	Country-living desire		●
Legal-Institutional Forces	Independence in Decision		●
	Legal Disputes		●
	Public regulation		●
	Government developmental policies		●
	Lack of proper planning polices		●
	Failure to enforce planning policies		●

Source: Own construct based on Bhatta, 2010, p.18

² - (●) Refers to the causes

2.4.1. Economic Forces

2.4.1.1. Economic Growth

The word “Growth” from an economic perspective implies wealth creation, measured by gross domestic product (GDP) or other metrics to gauge changes in the level of economic prosperity in a region over a certain time (Hammer, Kamal-Chaoui, Robert & Plouin, 2011). Annez and Buckley (2009) report that urbanisation and growth occur simultaneously. Countries experience urbanisation by reaching at least middle-income status and shifting population into cities. Rapidly urbanisation has historically associated with economic expansion and a shift in employment pattern from agricultural activities in the rural area to industrial, service-orientated and knowledge-based activities in an urban area.

The urban transition was stimulated in Europe and Northern America by the economic growth and industrial revolution in late-nineteenth and twentieth centuries. Similarly, in some developing countries (e.g. Eastern Asia, parts of Latin American) there is a linkage between urbanisation and economic development, but in weak form. In general, urbanisation is stimulated by urban transition and economic growth of a context. Economic prosperity (e.g. increasing in per capita income, number of working persons) implies demanding for extra housing or more space for individuals. In turn, this encourages developers for constructing new houses and other public spaces (Bhatta, 2010). People move towards the urban area in search of job opportunities which is less physically labour-intensive, higher salary and better quality of life offered in cities. Globally rapid urban growth has emphasised the importance of urbanisation and density for growth and prosperity. Urban areas are seen as engines of economic growth contribute to knowledge generation; improve living conditions and poverty reduction (Hoornweg & Freire, 2013). Urbanisation influences the process of economic growth both the efficiency and the extent of income quality. In turn, economic growth influences the urbanisation process by driving the spatial promotion of production and population agglomeration (Black & Henderson 1999). Notably, there is a link between urbanisation and socio-economic. The countries (e.g. developed countries) that are highly urbanised enjoy a high rate of incomes, more stable economies, sound institutions and withstanding to any economic volatility comparing to less urbanised countries (UN-Habitat, 2012).

2.4.1.2. Industrialisation

Establishment of industries in city’s vicinity encroach impervious surfaces. Industries tend to build housing for its worker near to their locations to afford transportation fees because the land is cheap in suburban areas. Mostly, the land which devotes to housing and parking exceeds the size of the factory many times, in turn causing rapid growing and sprawl (Bhatta, 2010).

2.4.1.3. Development and Property Tax

The cost of supplying and maintaining infrastructure and other public services in the countryside and other remote areas is higher than downtown. Accordingly, the property tax should be higher than downtown (Bhatta, 2010). The taxes are mostly independent of location; in the real-life taxes in periphery areas are lower than the core city, which makes development seem to be less expensive and encourages developer and resulting in rapid spatial growth of cities and other urban areas (Brueckner & Kim, 2003).

2.4.1.4. Living and Property Cost

In general, the living cost and property cost is cheaper in the countryside than the main city, in turn, encourage countryside development. The opportunity of getting a house at an affordable price in the countryside is much higher than the other areas that attracting people to live in the countryside (Bhatta, 2010).

2.4.1.5. Credit and Capital Market

Subsidies, credit, loans and low-interest rate facilities encourage people to settle in the countryside and buying homes or plots before achieving financial capability (Bhatta, 2010). Resulting growth before actually supposed to be in reality and leading to rapid urban growth in advance.

2.4.1.6. Housing Investment

During the process of spatial urban growth, urbanites tend to purchase plots or second homes with cheap price in the suburbs or countryside as future investments (Barnes, Morgan, Roberg & Lowe, 2001). In turn, this encourages and attracts developers to invest in constructing new houses in suburbs and countryside; especially when there is still a low-interest rate from most people and high rate of demanding houses (Bhatta, 2010). This will enforce the government to supply these areas with new infrastructures and other facilities in low- density area leading to urban sprawl.

Sustainable urbanisation needs to invest land intensively for housing development to accommodate a fast-growing urban population and at the same time curb urban sprawl. Therefore, “*Spatial agglomeration and high intensity of housing development become some notable features of urbanism*” (Tang & Yiu, 2010, p.172).

2.4.1.7. Speculation

Often government policies and extending facilities such as roads cause premature urban growth without proper planning. Political election manifestos play a role in encouraging people speculating the future direction of urban growth. In general, speculation produces withholding of land causing discontinuous development (Chin, 2002; Bhatta, 2010). The governments have to reduce land speculation by managing land markets, creating and guiding a market for development right (UN-Habitat, 2016).

2.4.1.8. Expectation of Land Appreciation

The expectation of land appreciation in cities or at urban fringe pushes some landowner to withhold land from the market for future speculation and causing discontinuous development (Chin, 2002; Bhatta, 2010). This depends on the rate of urban growth and the suitability of land for any future development initiatives.

2.4.1.9. Land Hunger Attitude

Trends of desiring land ownership leave these lands undeveloped within the city and causing infill policies unable to exploit all the available lands. The consequence is cities grow outward by leaving these lands undeveloped and causing urban sprawl (Wasserman, 2008, Bhatta, 2010).

2.4.2. Demographic Forces

Population growth is one of the factors which define the morphology and evolution of urban areas (UN-DESA, 2014), and results from two different demographic processes; one is from the rural area to urban area while the other is from natural growth (birth minus deaths). The relative importance of these two processes varies greatly between cities and countries (UN-DESA, 2012). A change in the rate of the distribution of the population from rural to urban area prevail most countries and considered as a dominant feature of demographic transition (UN-DESA, 2001).

The serious challenges face the world in the 21st century is a high rate of global population growth and its effects on urban expansion, especially in developing countries. In the middle of the last century, the world has experienced rapid unprecedented growth in urban population. Currently, half of the world population lives in cities, and it is projected that by the year 2050 it will reach about 70 percentages. Consequently, urban settlements are growing and will continue to grow to accommodate such a huge number of population (UN-Habitat & Cities Alliance, 2014). Moreover, rapid population growth represents a great challenge for governments in terms of fiscal capacity to fund additional public infrastructures needed and finding job opportunity especially when unemployment rate exceeds the absorptive capacity of the labour economy at the local and national level (UN-Habitat, 2002a; Nallathiga, 2008; UN-Habitat & Cities Alliance, 2014).

Managing of population growth is threatening governments to resolve conflict requirements for scarce of urban land, which demands a fair and transparent system of planning and regulations, to avoid any arbitrary decisions and ensuring that proper balancing between aspects of the economic, social and environment is achieved, based on local knowledge and appropriate judgments (UN-Habitat & Cities Alliance, 2014). In developing countries, growth of population and their spatial concentration presents opportunities as well as major challenges (ibid). The positive point of high concentration of people in an urban area contributes to many opportunities such as economy of scale and synergies based on collaboration and proximity (Ranhagen & Groth, 2012), and high population density helps to minimise the effects of human beings on the local ecosystem. As this implies, more people living within a certain area that in turn, reduces the costs of infrastructure and other services (Cohen, 2006). Also, the concentration of people in cities facilitates communication, knowledge and information sharing, encouraging enterprises and stimulating innovation. Cities nestle different segments of people and diverse classes of labours with a range of qualifications that businesses need to grow and flourish (UN-DESA, 2015).

At the same time, growing cities with a high concentration of population might expose countries to many risks like social dislocation and threatening environment. In both cases, the form and nature of urban growth affect the well-being and life chances of people, global migration flows, international stability, resilience of ecosystems and increasing resources scarcity (UN-Habitat & Cities Alliance, 2014). UN-Habitat (2009) confirms that cities and towns experience demographic growth, the consequence of this process tends to expand spatially and merging of adjoining settlements resulting 'Metropolitanisation' or uncontrolled peri-urbanisation resulting chaotic and urban sprawl (UN-Habitat, 2009).

2.4.3. Spatial Forces

2.4.3.1. Physical Geography

Physical terrains (such as rugged terrain, wetland or water bodies...etc.) are considered constraints in the face of continuous development (Barnes, Morgan, Roberge & Lowe, 2001). This causes leapfrog development as undesired development creating sprawl and expanding the size of the city. This problem cannot be overcome but should be overlooked and deal with it in a specific way (Wasserman, 2008; Bhatta, 2010).

2.4.3.2. Transportation

Transportation routes facilitate moving within and between city and countryside and often responsible for a linear development that occurring along the roads (Bhatta, 2010). Roads are major elements in forecasting and modelling urban expansion and also a major catalyst of occurring sprawling (Cheng & Masser, 2003). Transportation expansion allowed workers to commute between residence and their working stations. This encouraged business and industries to settle or resettle in suburban locations to provide good transportation accesses and reducing taxes on their operations (Barnes, Morgan, Roberge & Lowe, 2001). One of the motivations behind promoting compact development is to reduce urban sprawl, which minimises transportation externalities, by reducing travel distance through the encouragement of alternative modes of transportation (Holcombe & Williams, 2010). Transportation facilities play an essential role in developing urban economy and mobility in cities and can never be suppressed; rather should be controlled through government policies and regulations.

2.4.3.3. Road Width

Most of the municipalities around the world do not allow the constructing of high-rise buildings in the narrow access road, in turn, this results in the waste of the vertical space. Often this wasted space compensates with horizontal space in newly developed areas to accommodate population growth and causing urban sprawl. Commonly this happens to many relatively modern cities in developing countries because municipalities failed to visualise the future needs of the cities. Recent roads' widening policies in developing and developed countries creates a spatial expansion of the cities and spreading it over a large area (Wasserman, 2008; Bhatta, 2010).

2.4.3.4. Large Plot Size

Choosing of large plot size for housing is another reason for low density and rapid urban growth. The large plot divisions put extra financial loads on municipalities to supply these areas with trunk infrastructures. This trend seems to be common in developing countries and in developed countries. Residents who live in the countryside prefer big size plots (Bhatta, 2010).

2.4.4. Social Forces

2.4.4.1. Lack of Affordable Housing

This “*is similar to the living and property cost and another reason for urban sprawl*” (Bhatta, 2010, p.23). Lack of affordable housing and instability are of major causes behind

increasing of informal settlements and settling in the countryside due to high prices of residential plots and construction costs.

2.4.4.2. Demand for More Living Space

According to Liu, Daily, Ehrlich and Luck (2003) demand for more living space is responsible for urban land consumption and being identified as a driving force for urban growth. Moreover, they have demonstrated that population decline is not necessarily reducing land consumption under the condition of more growth in household numbers. Furthermore, Haase, Kabisch & Haase (2013) assume that decline in household number should cause a declining demand for new living space and as a result to reduce in urban land consumption as a solution for on-going urban growth. Demanding more living space encourages countryside development, and people can buy more living space at an affordable price than in the inner city. However, acquiring more living space is not always cause rapid growth or urban sprawl, and population density considered as a major concern in this issue (Bhatta, 2010). Increasing per capita living space is related to positive income development (Liu, Daily, Ehrlich & Luck, 2003). Higher per capita consumption of built-up area in some cases (e.g. high dense area) is preferable to indicate better living standards. However, demanding more living space in rapid low-density areas is an indication of urban sprawl (Bhatta, 2010).

2.4.4.3. Single Family Home

Liu, Daily, Ehrlich and Luck (2003) investigate 188 cities in Europe they find that the global growth in population exhibited growth in demanding more household between 1990 – 2000 and 2000-2006. Conversely, in some cases the population growth was declining, demanding for a household was substantially increasing. In general, in Europe, the growth rate of urban land consumption is increasing regardless of declining in population or household in separate or both of them. Thus, cities will expand spatially in future, due to trends of demanding small households and a single-family home in some cities in Europe (Liu, Daily, Ehrlich & Luck, 2003; Haase, Kabisch & Haase 2013). Individuals prefer mostly single-family home rather than multi-family high-rise buildings (Bhatta, 2010). Consequently, consuming more land and cities grow horizontally rather than vertically in developed and developing countries.

2.4.4.4. Nucleus family

Basically, per capita occupation of built areas by split family, is higher than the joint family. The transition from joint family to a split family requires new housing for individuals (Bhatta, 2010). Mainly, nucleus families increase due to the natural increase in population.

2.4.4.5. Country Living Desire

Living in the countryside and suburbs is a wish for many people who perceive the quality of life as better in these places, despite traffic congestion and a lengthy daily commute between home and working places. Sprawl development will continue as escaping from the city crowded environment to a more tranquil area (Barnes, Morgan, Roberge & Lowe, 2001; Bhatta, 2010).

2.4.5. Institutional Forces

2.4.5.1. Independence in Decision

Some of the main stakeholders may possess many expectations about the future development direction and a variety of development demands. In absence of good decision-making system and lacks of city master plan, these competitors can decide in their favour (EC, 2011). Consequently, generate uncoordinated, uncontrolled and unplanned development initiatives (Bhatta, 2010).

2.4.5.2. Legal Disputes

According to (Bhatta, 2010) the legal disputes (e.g. land acquisitions, subdivision problem, ownership problems) often causes to direct future development, leads to outgrowth development and leaving the undeveloped area within the cities.

2.4.5.3. Public regulations

Mainly the countryside and suburbs are lesser controlled and strict in enforcing regulations, which attract developers and individuals for new constructions. At the same time, municipalities' regulations fail to control these constructions in a sustainable fashion because of municipality fragmentation (Bhatta, 2010; Chin, 2002).

2.4.5.4. Government development Policies

Barnes, Morgan, Roberge and Lowe (2001) denote that “*restrictive land use policies in one political jurisdiction may lead development to “jump” to one that is favourably disposed toward development or is less able to prevent or control it*” (p.5). Sometimes differences and dissimilarities in development regulations, land use policies and inefficient coordination between neighbouring municipalities (or local governments) cause un-regulated and discontinuous development (Bhatta, 2010).

2.4.5.5. Inefficient Planning Policies

Inefficient and lack of consistent planning policies lead to uncontrolled development and urban sprawl. Planning cities with exclusive zoning policies by separating different land uses (e.g. residential, commercial, industrial, institutional and others) from each other (Wasserman (2008). This type of zoning creates more islands that are isolated, traffic congestion and automobile dependency. Mixed land use and compactness policies are being adopted to curb excessive urban growth.

2.4.5.6. Failure to Enforce Planning Policies

Efficient Planning policies in the absence of enforcement are worthless and can't change anything. Incapability to enforce land use plans and related regulations considered to be one of the main reasons in generating urban sprawl in developing countries (Bhatta, 2010).

2.5. Urban Growth Management

Urban growth management is a set of techniques used by governments to control urban growth and ensuring that the services such as; housing affordability, delivery of sufficient utilities, preservation of historical buildings and places and protection of natural resources are

available to meet their demands. Godschalk et al. (1977 cited in Lee, 2005, p.49) define urban growth management as “*a conscious government program intended to influence the rate, amount, type, location, and/ or quality of future development within a local jurisdiction*”. Rapid urban growth is usually associated with many challenges of management, especially for the public sector. The main challenge stems from the need for services and other infrastructures for newly developed areas to accommodate increasing population growth.

Urban growth boundary (UGB) is one of the important tools of urban growth management that have been used as early approaches of urban growth management, which represent the boundary between urbanised land and undeveloped land. By this, urban growth will be accommodated within a certain area for a specific period (Pallagst, 2007). In a wide range, urban growth boundary becomes strong policy tools that mitigate and control urban sprawl in cities, and indicates boundary for future developments, beyond which development cannot pass over (Breucker, 2007). Urban growth boundary is balancing between the conservation area and area which is proper for future development. Urban growth boundaries (UGBs) have been used by the state, regional, or local planning agencies in different countries. Establishment of urban growth boundary paves the way to more compact and effective urban development, thus enhance sustainable urban development (Ding et al, 1999 cited in Pallagst, 2007, p.75).

Not always urban growth boundary has advantages on land values, Hiramatsu (2014) argues that expansive urban growth boundary has advantages, restricting urban growth boundary has a negative impact on land value because land values become more centralised. Urban growth then can be managed according to fundamental criteria and decisions through ‘where to grow’ and ‘where not to grow’ which are unlike to the conventional land use regulations dealing only with the utilisation of land use (Freilich, 1999; Fulton et al 2002 cited in Lee, 2005, p.49). San Diego Association of Governments (2001) distinguishes between two types of policies; urban growth policies focus on allocating, channelling or shaping the growth to reduce negative impacts and enhance the quality of life, while urban growth slowing policies focus on policies that influence the rate of urban growth.

According to Bengston Fletcher & Nelson (2003), there are lacks of studies regarding the evaluation of the effectiveness of urban growth management policies. Most of the studies tend to focus on describing the policies rather than evaluating their impacts. Many issues have been addressed that urban growth policies offer (Lee, 2005; Bengston Fletcher & Nelson, 2003) such as:

- Controlling urban sprawl
- Protecting taxpayer money & Expediting economic development
- Shaping efficient urban form
- Improving the quality of life
- Open space and farmland preservation

Nevertheless, urban growth policies have advantages and implications for various aspects of urban development as stated above.

2.6. Conclusions

Urban development is the process of changing urban area purposefully. As a result of rapid urban growth and emerging of big cities and its implications and consequences, there was a necessity and urgent needs to respond to the spatial, social and environmental problems that associated with this phenomenon.

The world is witnessing unprecedented urban growth and urbanisation since the second half of the last century accompanied by the high rate of populations' growth, especially in developing countries. This phenomenon has led to the depletion of natural resources, environmental pollutions, increasing of poverty, unemployment and degradation of an urban environment in cities. There are many driving forces stimulating rapid urban growth such as; social, demographic, economic, legal- institutional and spatial forces. Urban growth is a phenomenon that could not be avoided, inevitably, it occurs with different forces. It cannot be stopped, rather needs collaboration between different institutions in the country, as well as elaborating policies, laws and regulations to create sustainable urban growth.

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Chapter Three: Sustainability and Urban Development

3.1. Introduction

The chapter in hand tries to discuss the concept, principles and goals of sustainable development, further investigating the relationship between urban development and sustainable development. Also tries to clarify the different dimensions, criteria, requirements that lead to sustainable urban development. Furthermore, it discusses the main approaches to sustainable urban development and how the concept of sustainable urban development is operated and assessed.

3.2. Sustainable Development

3.2.1. Concepts and Principles

The term of sustainable development caught more attention by researchers from different fields when sustainable development was brought up in the 'Earth Summit' which took place in 1992 in Rio de Janeiro in Brazil. The outcome of the summit was Agenda 21 and its modifications (e.g. Agenda 2030), through this declaration, countries have patronized to create an awareness of environmental issues and to cooperate locally and globally (Fien & Tilbury, 2002; Curwell, Deakin & Lombardi, 2005).

The most common definition of the sustainable development is the one which presented in Brundtland's report as a; "*Development that meets the needs of the present without compromising the ability of future generations to meet their needs*" (WCED, 1987). Also, the term of sustainable development has defined as a dynamic process that let private and public to better their conditions of life in a way to protect and enhance the life on earth (Tippett, Handley & Ravetz, 2007; Allen, 2009).

The definition of sustainable development exposes different interpretations because the term '*development*' and '*needs*' both imply vagueness in themselves (Blowers, 1993). Thus, perspectives regarding interpretations of the concept of sustainable development, in general, can be categorised into four groups of researchers; Environmentalists, economists, equity advocates and spiritually and ethically orientated researchers (Wheeler, 2004). Mazmanian and Kraft (2009) argue that it is not important to come upon one certain definition of sustainable development. Most discussions of sustainability are reflecting interpretations of commissions' definitions and rarely presenting any sort of specifications (Vojnovic, 1998). However, all the definitions can come upon a consensus agreement by respecting the future of the planet and protecting the earth and at the same time satisfying the needs of its different inhabitants (Boyoko, Cooper, Davey & Wootton, 2006). According to Hoornweg and Freire (2013), there are two main trends in defining sustainable development, one considers the flow of materials and the impact of human consumption and production on the local and global environment, this trend is more directed towards engineering- orientated formulation, while the second proposes a wider set of characteristics, such social, institutional and fiscal sustainability, this trend describes sustainability as having three dimensions namely; economic, environment and social.

Therefore, the definition of sustainable development has subsequently been interpreted and adopted many times and used to embody different aspects of economic, society and environment relationships. According to Keiner, Zegras, Schmid and Salmeron (2004) "*These*

terms sustainability and sustainable development are arbitrary and user-defined and have lost their clear meaning” (p.13). And there is that; “Doubts on whether anything good can ever be accepted and agreed as a sustainable” (Mawhinney, 2002, p.1), or as Zegras (2005) asks; “is sustainability really a new concept, or simply new language for various interpretations of a good society that have existed throughout time?” (p. 14).

The term sustainability embodies three conflicted and contradicted pillars or systems, namely social, economic and environmental sustainability (Koglin, 2009). These three pillars which Campbell (1996) calls economic development, environmental protection and equity and social justice are conflicting each other; however, sustainability brings all the conflicts and discrepancies together on the same ground and urban planners are obliged to work with. Thus, sustainable development is depicted as a concept that is not homogenous, but rather three incongruous dimensions; it embodies a variety of issues and conflicted objectives. The challenging step is to create a balance between conflicting objectives and interests (ISDC, 2012). However, these conflicting objectives must be addressed and resolved at local and international levels.

The three main pillars of sustainable development have addressed as key principles to achieve the main goal and objectives of sustainable development. These principles have to be followed and respected, which lead further to the path of sustainability -see Table 3-1. The relationships and connections between the three pillars act as a shared ground for any argument regarding sustainability (Manning, Boons, Hagen & Reinecke, 2012).

Table 3-1: Key principles of Sustainable Development

Dimension	Key Principles	Descriptions
Environment Protection	<ul style="list-style-type: none"> • Protection of natural environment • Maintenance and restoration of the ecological integrity of ecosystems. • Minimal use of non-renewable resources and reduction of waste output. 	<ul style="list-style-type: none"> ➤ Preserving the dynamic diversity of nature, in terms of the health of ecosystems and species, and genetic diversity. ➤ Maintaining or restoring viable populations of indigenous species. ➤ Natural resources should be used only at the rate at which they can be regenerated
Economic Growth	<ul style="list-style-type: none"> • Economic system meets the needs of society. • Maintenance of infrastructure • Place-based economic vitality <p>Table 3-1: Key principles of Sustainable Development and diversity.</p>	<ul style="list-style-type: none"> ➤ Ensuring economic activity that meets the needs of individuals and society effectively. ➤ Ensuring infrastructure is maintained at an acceptable level. ➤ Instead of excessive and huge development, the development should meet basic human needs, such as appropriate home size, security, safety and a healthy social environment.
Social Cohesion	<ul style="list-style-type: none"> • Social equity (intra-generational and intergenerational equity). 	<ul style="list-style-type: none"> ➤ Consideration for the low-income population and not deprive them of basic property rights. ➤ Consideration for future generations’ rights to use natural resources and land.

Source: Own construct based on Park, 2001; Statistics New Zealand, 2008; Al-Shihri, 2013

3.2.2. Objectives and Goals

Generally speaking, sustainable development is understood as an approach to decision-making and planning that searches to minimize and limit economic and social disparities, and at the same time protecting the environment (EEA, 2006), which can be achieved through an interactive process between its main dimensions by considering patterns of development and their impacts (Pugh, 2000). The critical objectives and necessary conditions for achieving sustainable development identified by the World Commission on Environment and Development (WCED, 1987) could be summarised - see Box 3-1.

Critical Objectives of the Sustainable development

- Growth resurgence
- Mutating growth quality
- Providing essential needs for jobs, foods, energy etc.
- Conserving of sustainable level of population
- Preserving and consolidating the base of non-renewable resources
- Redirecting of the modern technology and managing the risks
- Embodiment of environmental and economic issues at decision-making level

Box 3-1: Critical objectives of sustainable development.

Source: Own construct based on UN, 2002, p.5-12

The world Environment Conference in Rio de Janeiro further elaborated the goal of sustainable development with Agenda 21. Agenda 21 is a non-binding action plan and was the product of Earth Summit which held in *Rio de Janeiro* in 1992. Different organisations and individual governments around the world can execute the agenda at local, regional and global levels. Agenda 21 refers to the 21st century and had modifications at subsequent UN conferences which aimed to achieve global sustainable development (United Nation, 2015). One of the main objectives of Agenda 21 is every local government should draw its own local agenda 21. Since 2015 sustainable development goals are included in the Agenda 2030 as a universal agenda. The 17 sustainable development goals and 169 targets demonstrate the scale and the ambition of this agenda- see Table 3-2.

Table 3-2: Sustainable development goals of agenda 2030

Goal No.	Sustainable Development Goals of Agenda 2030
Goal 1.	End poverty in all its forms everywhere
Goal 2.	End hunger, achieve food security and improved nutrition and promote sustainable agriculture
Goal 3.	Ensure healthy lives and promote well-being for all at all ages
Goal 4.	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
Goal 5.	Achieve gender equality and empower all women and girls
Goal 6.	Ensure availability and sustainable management of water and sanitation for all
Goal 7.	Ensure access to affordable, reliable, sustainable and modern energy for all
Goal 8.	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
Goal 9.	Build resilient infrastructure, promote inclusive and sustainable

	industrialization and foster innovation
Goal 10.	Reduce inequality within and among countries
Goal 11.	Make cities and human settlements inclusive, safe, resilient and sustainable
Goal 12.	Ensure sustainable consumption and production patterns
Goal 13.	Take urgent action to combat climate change and its impact
Goal 14.	Conserve and sustainably use the oceans, seas and marine resources for sustainable development
Goal 15.	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
Goal 16.	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
Goal 17.	Strengthen the means of implementation and revitalize the global partnership for sustainable development

Source: Own construct based on United Nation, 2015, p.14

Nevertheless, achieving the goals and the objectives of sustainable development in real life is associated with difficulties and complexity (Tippet, Handley & Ravetz, 2007). Maximisation of the goals across all three dimensions is the main objectives of sustainable development (Elliot, 2006). However, this cannot be done reactively, rather through strategic planning and management. All nations are obliged to practice sustainable development in view of objectives and requirements to preserve the local and global environment and demanding affluent life for human beings everywhere (UN, 2002).

The above discussion reveals that sustainable development is an approach that should be considered by decision-makers at the local and global level. Sustainable development lies in the heart of national policy, and has become *"a kind of conceptual touchstone, one of the defining idea of contemporary society* (Strange & Bayley, 2008, p.23), and *"despite its ambiguities, sustainable development is a compelling indicator that helps focus the debate on the realities of where and how we now live"* (Hald, 2009, p.41).

3.3. Sustainable Urban Development

Sustainable development is first announced as a sound answer to environmental problems associated with the rapidly urbanising world. The concept has been understood by a huge number of researchers that; it embodies *"the development of the built environment and its associated resources can both be achieved without jeopardising the natural environment"* (Teriman, Yigitcanlar & Mayer, 2009, p.3). In the urban context, the concept of sustainable development is promoted as sustainable urban development aiming balance exploitation of natural resources for urbanisation process in a way that can give the coming generations to have their opportunity to repeat the process (ibid.). Therefore, sustainability in an urban context has become an important concept for tackling with issues that generated due to fast-growing cities and increasing level of urbanization overall the world and over-exploitation of natural resources (UN, 2004), and avoiding any damage to the ecosystem, at the same time upgrading the quality of life in the urban context (He et al., 2011). Thereby, sustainable urban

development becomes a strong framework for searching for solutions to improve the quality of life in an urban area at a local and global level (Heberle, 2008).

Elkin et al. (1991, cited in Williams, Burton & Jenks, 2000, p. 3) state that; “*Sustainable urban development must aim to produce a city that is ‘user-friendly’ and resourceful, in terms not only of its form and energy-efficiency and also its function, as a place for living*”. While Girardet (2004) clarifies the goals of the sustainable city as; “*A sustainable city enables all its citizens to meet their own need and to enhance their well-being, without degrading the natural world or the lives of other people, now or in the future*” (p.6). Sustainable urban development emphasises developing built forms, infrastructure and systems that reduce human development impacts on the environment, provide healthy places to live, work and play (Athanasakis, 2009).

Sustainable urban development aims to pursue sustainably in urban communities, these aims can be interpreted as physical or spatial sustainability dealing with physical aspects of urban form and structure of urban area (Ahmadi & Toghyani, 2011). The form of buildings, structures and spaces by themselves are the physical expression of physical development. They influence the pattern of uses, the activities and movements that take in a place. The characteristic of the physical form of development can be defined through the overall layout of the place (in terms of routes and building blocks); its scale (in terms of building height and massing); and its landscape (including the entire public realm, built and green spaces) (DETR, 2000) – see Table 3-3.

Table 3-3: Aspects of Development Form

<p>Layout: urban structure <i>The framework of routes and spaces that connect locally and more widely, and the way developments, routes and open spaces relate to one other.</i></p>	<p>The layout provides the basic plan on which all other aspects of the form and uses of development depend.</p>
<p>Layout: urban grain <i>The pattern of the arrangement of street blocks, plots and their buildings in a settlement.</i></p>	<p>The degree to which an area’s pattern of blocks and plot subdivisions is respectively small and frequent (fine grain), or large and infrequent (coarse grain).</p>
<p>Landscape <i>The character and appearance of land, including its shape, form, ecology, natural features, colours and elements, and the way these components combine.</i></p>	<p>This includes all open space, including its planting, boundaries and treatment</p>
<p>Density and mix <i>The amount of development on a given piece of land and the range of uses. Density influences the intensity of development, and in combination with the mix of uses can affect a place’s vitality and viability</i></p>	<p>The density of development can be expressed in several ways. This could be in terms of plot ratio (particularly for commercial developments), the number of dwellings, or the number of habitable rooms (for residential developments).</p>
<p>Scale: height <i>Scale is the size of a building in relation to its surroundings, or the size of parts of a building or its details, particularly in relation to the size of a person. Height determines the impact of development on views, vistas and skylines.</i></p>	<p>Height can be expressed in terms of the number of floors; height of parapet or ridge; overall height; any of these in combination; a ratio of building height to street or space width; height relative to particular landmarks or background buildings; or strategic views.</p>

<p>Scale: massing <i>The combined effect of the arrangement, volume and shape of a building or group of buildings in relation to other buildings and spaces.</i></p>	<p>Massing is the three-dimensional expression of the amount of development on a given piece of land.</p>
<p>Appearance: details <i>The craftsmanship, building techniques, decoration, styles and lighting of a building or structure</i></p>	<p>This includes all building elements such as openings and bays; entrances and colonnades; balconies and roof-scape; and the rhythm of the facade.</p>
<p>Appearance: materials <i>The texture, colour, pattern and durability of materials, and how they are used.</i></p>	<p>The richness of a building lies in its use of materials which contribute to the attractiveness of its appearance and the character of an area.</p>

Source: Own construct based on DETR, 2000, p.16

3.4. Spatial Dimension of Urban Sustainability

The pillars or target dimensions of sustainable urban development have been extended to include other dimensions in addition to the basic pillars of sustainable development namely- environment, economic and society- such as physical, institutional or political dimensions as an overarching dimension or as a base and required foundation to the concept of urban sustainability (Zegras,2005). According to (Hugentobler & Brändle-Ströh, 1997; Allen, 2009; Hakmatnia, 2004, cited in Khazaie & Razavian, 2013, p.1546) these dimensions can be derived from the definitions of Brundtland Commission which are;

- *Ecological sustainability*, it is understood as non-renewable natural resources that should not be exhausted for running short-term developments, this implies to manage resources and to deal with waste produced by society in a rational way.
- *Economic sustainability*, it is defined as the ability of the local economy system to retain itself without causing any harm to natural resources that it depends on, and maximising productivity of the local economy in urban contexts.
- *Social sustainability*, it implies that the development should aim to improve the quality of the life for citizens and promoting equity, reducing poverty, fair access and distribution of rights in using natural resources and satisfying other essential needs.
- *Physical sustainability*, it is defined as the ability and appropriateness of urban built environment to consolidate human life and his activities, by ensuring security and comfortably without distributing urban region environment.
- *Political sustainability*, it implies that the democratisation and participation of the local civil society in decision-making processes is essential.

However, in rapidly growing cities and urbanized world, the built environment needs to be recognized as an important component to the liveability of the cities (Allen, 2009). Any attempt towards sustainable urban form depends on political and institutional decisions through promoting cooperation and competition between different related planning agents and considering the dimensions mentioned above. Addressing these issues has a direct implication on the spatial/physical environment in cities, especially concerning urban form and structure. The form of the city is a crucial issue when the subject is related to the planning of a sustainable city.

3.5. The City and Sustainable Development

The goal number eleven from Agenda 2030 of global sustainable development advises making cities and human settlements inclusive, safe, resilient and sustainable. The city as an entity manifests a distinctive inter-relationship between the spatial and other structural characteristics and its functional, socio-economic and environmental qualities (Frey, 2005). Hence, they are playing a great role in the process and applying principles of sustainable development (EC, 2011), therefore, cities are the domains where the confrontation and encountering between the natural environment and man-made environment occur; thus, here the situation needs a rational intervention from the side of decision-makers and other related bodies to mitigate such conflicts (Wheeler, 2004). Urban problems (e.g. urban sprawl, shortage of land for affordable housing, traffic congestion, low of air quality, depletion of agricultural land) are seen as some of the most common symptoms of unsustainable cities (Keleş, 2001).

Views regarding the sustainability of cities are divided between those who believe that cities can never be sustainable and others who believe that cities can do a great deal to be managed in more sustainable ways (Williams, Burton & Jenks, 2000). Yet, cities have more challenges to pursue sustainability, but at the same time, there are many opportunities for cities to look for a better life and prosperity.

3.5.1. Definitions and Characteristics of Sustainable City

It is hard to point out to a certain city or to concentrate on particular city performance, rather, sustainable urban development needs to concentrate on frameworks at different levels namely, local, national and international that globally can contribute to sustainable development goals (Hardoy, Mitlin & Satterthwaite, 2001). Diamantini & Zanon (2000) assert that there is no recipe to give solutions to every problem in the city, rather, every place has to look for its solutions. Exchanging ideas and comparing practices between different contexts have proven to be a successful experience, which encourages every single city to steer towards the path of sustainability by considering its characteristics (Frey, 2005). Different communities have their norms, regulations and traditional ways for arranging their urban environment, which mainly depends on lifestyle, climate requirements and religious customs. Various urban environments face different challenges and at the same time have varied opportunities. Moreover, there are many things cities have to share and to learn from each other, but the main point remains, how to investigate and analyse principles of successful experiences by taking all local consideration in case of applying them in other contexts (Soltani & Sharifi, 2012).

There is no specific and agreed definition of what the “sustainable cities” or the “sustainable settlement” mean. The definition of sustainable human settlement which is presented by Agenda 21 of UN-Habitat (2002a, p.6) is considered to be the most appropriate one in term of its generalisation and suitability for sustainable city definition, suggesting that all sustainable human settlements should;

“make efficient use of resources within the carrying capacity of ecosystems and take into account the precautionary principle approach, ... provide all people. In particular, those belonging to vulnerable and disadvantaged groups, with equal opportunities for a healthy, safe and productive life in harmony with nature and their cultural heritage and spiritual and cultural values, ... and... ensure economic and

social development and environment protection, thereby contributing to the achievement of national sustainable development goals”.

Many of the world’s countries have adopted different frameworks and guidelines of sustainable urban development which believed to ensure sustainability in their cities (Lai, Chau, Ho & Lorne, 2006). These frameworks and guideline are based on Agenda 21 and its modifications of Agenda 2030. Therefore, several strategies, many approaches and frameworks enacted to promote and enhance sustainable urban development, especially in cities of developed countries (UNCSD, 2007). What the city should attain to embrace sustainability have been led by many international and regional organisations to search for the characteristics of the sustainable city. For example the Melbourne principles for sustainable cities by United Nation’s Environmental Programme (UNEP) in 2002, the Aalborg Charter⁴, the guiding principles for the sustainable spatial development of the European continent⁵, and Freiburg Charter for sustainable urbanism⁶ and many to name. Many of these principles share close similarities and provide a set of markers for sustainable cities to develop sustainable solutions relating to their context, and at the same time help decision-makers and citizens to work jointly to pursue sustainability in cities. One of the useful set of these common characteristics is Melbourne Principles, articulated at a 2002 meeting of UNEP in Melbourne- see Table 3-4.

Table 3-4: Melbourne Principles for sustainable cities

Principles	Definitions
1. Vision	Provide a long-term vision for cities, based on sustainability (intergenerational, social, economic), political equity, and individuality.
2. Economy & Society	Achieve long-term economic and social security, move toward urban eco-villages embedded into the bioregional economies, encourage urban agriculture, adopt true costing initiatives, buy local.
3. Biodiversity	Recognize the value of biodiversity and natural ecosystems, protect and restore them.
4. Ecological Footprint	Enable communities to minimize their ecological footprints.
5. Modelling Cities	Build on the characteristics of ecosystems in the development and nurturing of healthy and sustainable cities.
6. Sense of Space	Recognize and build on the distinctive characteristics of cities, including their human value and natural systems.
7. Empowerment	Empower people and foster participation.

⁴- The charter of European Sustainable Cities and Towns towards Sustainability known as the Aalborg Charter (1994) is an urban environment sustainability initiative; it is inspired by Rio Earth Summit’s Local Agenda 21 plan. There are three related parts to the charter. See <http://www.sustainablecities.eu/aalborg-process/charter>

⁵- The 12th European Conference of Ministers responsible for Regional Planning (CEMAT), held in Hanover on 7-8 September 2000, represented the opportunity for national, regional and local authorities to finalise some activities carried out by the Council of Europe in the field of spatial/regional planning. See http://www.bbsr.bund.de/BBSR/EN/Publications/IzR/2003/7DejeantPons.pdf?__blob=publicationFile&v=3

⁶- The Freiburg Charter was developed in partnership with the City of Freiburg in Germany in recognition of winning the Academy’s European City of the Year Award 2010. The charter has 12 principles divided on three categories. See http://www.modus7.be/site/assets/files/1034/charta_freiburg_2012en.pdf

8. Partnership	Promote and enable cooperative networks towards a common sustainable future.
9. Sustainable Production & Consumption	Promote sustainable production and consumption through sound technologies and effective demand management.
10. Governance & Hope	Enable continuous improvement based on accountability, transparency, and good governance.

Source: Own construct based on principles of sustainable cities, retrieved January 22, 2014, from <https://archive.epa.gov/bns/web/pdf/melbourneprinciples.pdf>

3.5.2. Form and Structure of Sustainable City

Different interests have motivated researchers to investigate the arrangement of the spatial structure of human settlements. These interests are derived from the belief that economic efficiency can be consolidated through the sound spatial arrangements of economic activities. Alternatively, that the spatial arrangement of the demographic groups reflects and determines social structure and equity, or that the spatial arrangement of human activity can impact the quality and integrity of the natural environment (Knaap, Ding, Niu & Mishra, 2016). These concerns have become part of the notion of sustainable urban development.

Our realisation regarding problems that cities face creates a better-built environment in a way to produce adaptable urban forms. These forms should be less dependence on transportation, reducing our influence on climate change, reducing other negative impacts of cities on social and environmental systems. This realisation in a broad sense conceptualised as sustainable urban development (Dorset, 2011). United Nations conference on sustainable development in Rio de Janeiro in 2012 realised the importance of setting a vision for future sustainable development in cities, by initiating city planning which encourages the revitalisation of downtowns in old cities and neighbourhoods, promoting appropriated sustainable transport systems using clean energy, adopting mixed use planning, encouraging non-motorised mobility. These can be achieved through “... *involvement of multiple stakeholders as well as from full use of information and gender-disaggregated data, including demographic trends, income distribution and informal settlements*” (UN, 2012, p.26).

The urban form of the contemporary city has been considered as a source of the environmental problems (Frey, 2005) and its direct effects on natural ecosystem and fragments habitat, influences the decisions of inhabitants, to where they go for their daily needs and how far they travel to get around (EPA, 2013). The mobility and travel behaviour indirectly influence the natural environment by affecting air quality, losses of wetlands, open spaces and farmlands (Cervero, 1998 cited in Jabareen, 2006b, p.38). Patterns of development, building locations and design, transportations infrastructure and land use decisions directly influence the built environment.

In search of the form and structure of the sustainable city, type of the city is more sustainable on many argumentations. Three groups of debates have been identified which are; centrists, the de-centrists and the compromise positions (Frey, 2005). The first group who defended the concept of “compact city” – for more details see section 3.8.1 in this Chapter-argue that the compact city has many environmental advantages and social benefits. While the second group who opposed to compact city concept and supported the concept of “decentralised- concentration” which based on multi-nucleated city and city-region, the different uses of this model is not concentrated in the mono-core, rather, it has several

dispersed small centres shaping the heart of urban districts, towns and villages (ibid.). The third group who defended the concept of compromise positions (Masnavi, 2000; Williams, 2014) believe that at the city level, the neighbourhoods should develop a strong identity and control over the resources, this concept requires a degree of local autonomy – see Figure 3-1.

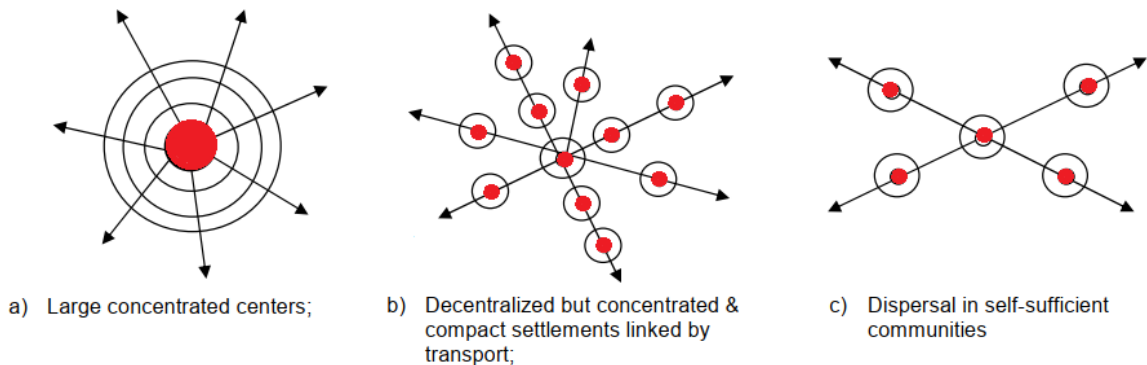


Figure 3-1: Alternative forms for sustainable cities

Source: Frey, 2005, p.42

From the national level perspective, the concept of the polycentrism occurs when the urban system is characterised by several cities at different levels, rather than being dominated by a single city. At this level, *“polycentric policies stimulate the growth of the centres and regions outside the core”*. At the regional and local scale, *“polycentricity occurs when two or more cities have functions that complement each other or even more so. if the cities cooperate with each other in order to be able to act jointly as a larger city”*. At this level, *“policies for polycentricity stimulate the functional division of labour, as well as the flows and the level of co-operation between neighbouring cities”* (ESPON, 2005, p.3). The two situations are interlinked when, for example, the polycentric integration at the regional level contributes to counterbalance the dominance of the national centre (ESPON, 2005).

Polycentric urban regions have been identified as an emergent spatial form of global cities (Hall & Pain, 2006 cited in Knaap, Ding, Niu & Mishra, 2016, p. 75), and proposed as planning solutions for achieving efficiency and sustainability goals (Davoudi, 2003). The notion of the planned polycentric at the level of neighbourhood and city region has emerged in the concept of Ebenezer Howard’s “Social city”, Patrick Geddes’ notion of regional settlement, and Clarence Stein’s brand of “communitarian regionalism” which emphasized the role of the communities as building blocks of the region (Talen, 2008b).

According to Talen, the regions can be looked at as an ‘economic units’ as well as environmentally they are ‘finite place’ containing ‘multiple centres’ within a metropolis. *“Edges should be clear, and development patterns should be contiguous, or else organized into towns, villages, and neighbourhoods.”* (Talen, 2008b, p.22).

3.6. The concept of Sustainable Neighbourhood

During the nineteenth and twenty centuries, many movements emerged seeking to improve urban performance like; utopian communes, model of factory towns, technical and regulatory reform, city beautiful, garden city, neighbourhood unit, modernist city, new urbanism and urban village (Grant, 2006). These movements were the reaction to different reasons; living conditions, urban sprawl, climate change...etc. All were tried to implement a variety of

strategies and concentrating on various levels; neighbourhood, city, city-region and metropolitan. But the overall aim has been to create a built environment that responds to the needs of inhabitants.

In 1892, the Garden city concept by Ebenezer Howard emerged as a new turn in modelling and developing the concept of cities of the twentieth century and formulating the concept of the neighbourhood and city. The idea of Ebenezer Howard in the theory of garden city derived from the social reform aimed to afford housing in a growing city and the opportunity of providing jobs for the residents. The concept tried to mix the tranquillity of British village and proximity of services in modern cities – see Figure 3-2.

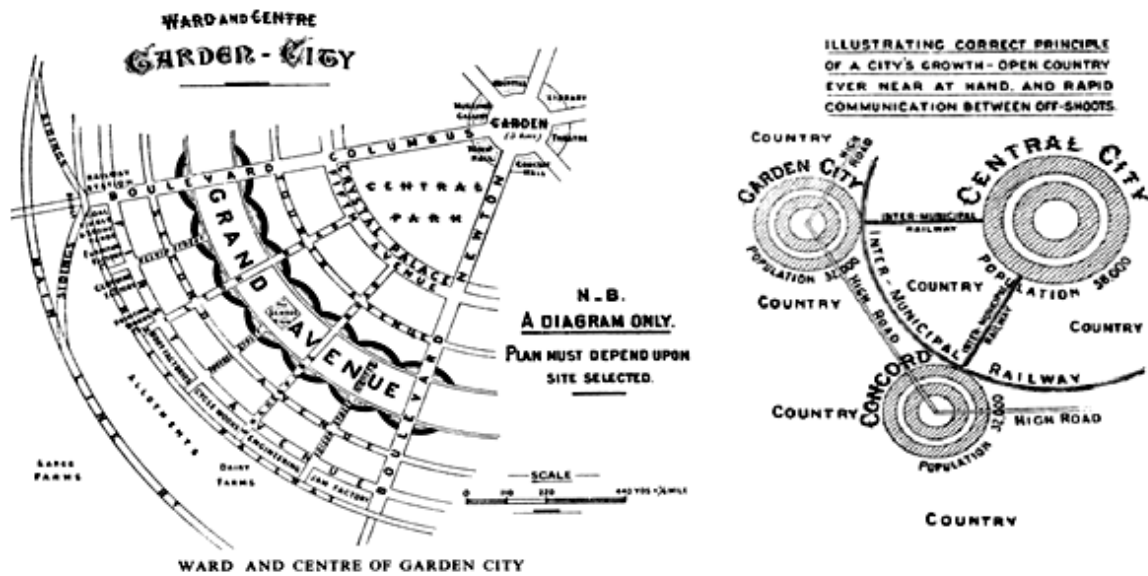


Figure 3-2: The concept of garden city
Source: Howard, 1920, p.22.

The concept of garden city motivated the planners and participated in developing the concept of neighbourhood and cities later on. Clarence Perry's in 1929 proposed the concept of neighbourhood "neighbourhood unit" basing on children and families walking to schools and services. The concept of neighbourhood built on six planning elements which are schools, boundaries, open space, institutions building, retails and internal street layout. Perry considers the neighbourhood as a component of cities, and its size based on a five-minute walking radius.

The ideas of Howard and Perry gave perceptions about the concept of neighbourhood. A shortage of clear definition of sustainable development as a concept in whole and its application at the levels of region, city and neighbourhood, make it difficult to precisely define the sustainable neighbourhood- for more details about the concept of sustainable development see Section 3.2 in this Chapter. Applying the principles of sustainable development in neighbourhood planning is crucial since most of the deficiencies that occur at the macro-scale in cities are related to the planning approach that adopted at micro-scale in neighbourhood level (Frey, 2005; Engle-Yan, Kennedy, Saiz & Pressnail, 2005). The

principles of the sustainable neighbourhood may change over time due to the changes in socio-economic and environmental factors. Promoting sustainable urban form at the local has been advocated by the United Nation through “local Agenda 21” (UNCED, 1992), and the neighbourhood is considered as the building block of the city, where the most development initiatives take place (Frey, 2005; Urban Force Task, 2005). The overall sustainability of the city depends on the sustainability of the parts which is represented by its neighbourhoods. The city is an agglomeration of neighbourhoods; therefore, no understanding of city form and structure is possible without an understanding of neighbourhoods’ form and structure at the micro-scale (Frey, 2005) see Figure 3-3.

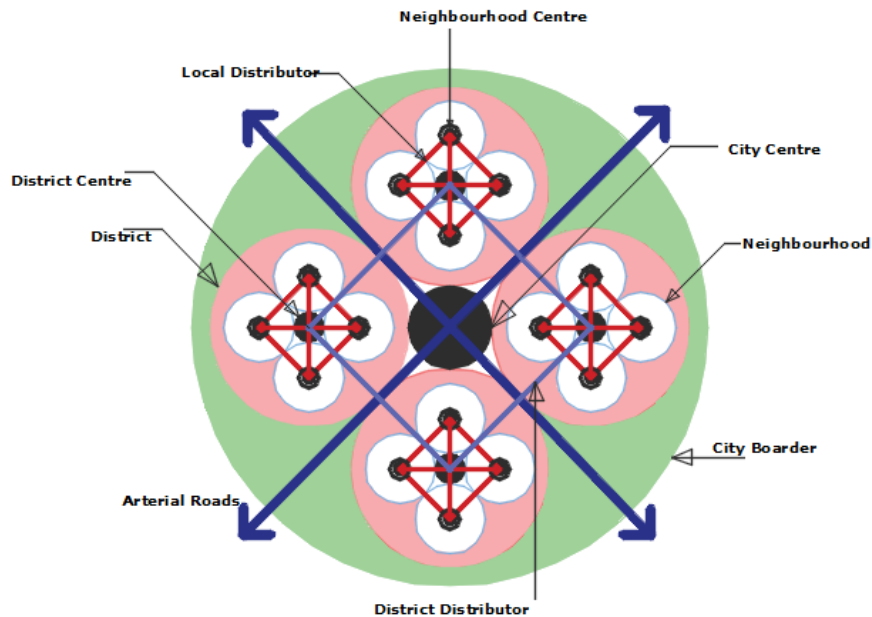


Figure 3-3: Polycentric strategy as an agglomeration of Neighbourhoods and Districts
 Source: Own construct based on Frey, 2005, p.68

The urban neighbourhood encompasses various dimensions, such as socio-economic, geographical, administration, historical, political and environmental. The neighbourhood is the places where most of the time the people can be spent there; therefore, it is the place for connections of social, economic, environmental and physical factors. The term neighbourhood is defined in accordance with social, economic, political, psychological, architectural and perceiving points of view. Each of these views has its approaches in applying the principles of sustainable development to neighbourhoods. Therefore, the neighbourhood considers as spatial unit inhabits by a group of independent people sharing access to facilities located in walking distance to their home, whether they use these facilities or not (Frey, 2005).

Planning and designing of the neighbourhood must be integrated and comprehensive to meet the resident’s requirement and accommodate future developments by considering social-economic changes and the need of the coming generations. Jacobs and Appleyard (1987) believe that the quality of neighbourhood rises from the quality of planning and design.

Alexander (1988 cited in Frey, 2005, p. 58) argues that building up a city from neighbourhood units generates a rigid structure due to overlapping between neighbourhoods in using services. Even though, the neighbourhood still to be looked at as a building block of the city and to be provided with essential services. Accordingly, planning and designing of the

neighbourhood as a significant spatial and social unit plays a role in promoting sustainability in the city. Thereby, sustainability at the level of the neighbourhood is the initial step towards achieving sustainable urban settlement - see Figure 3-4.

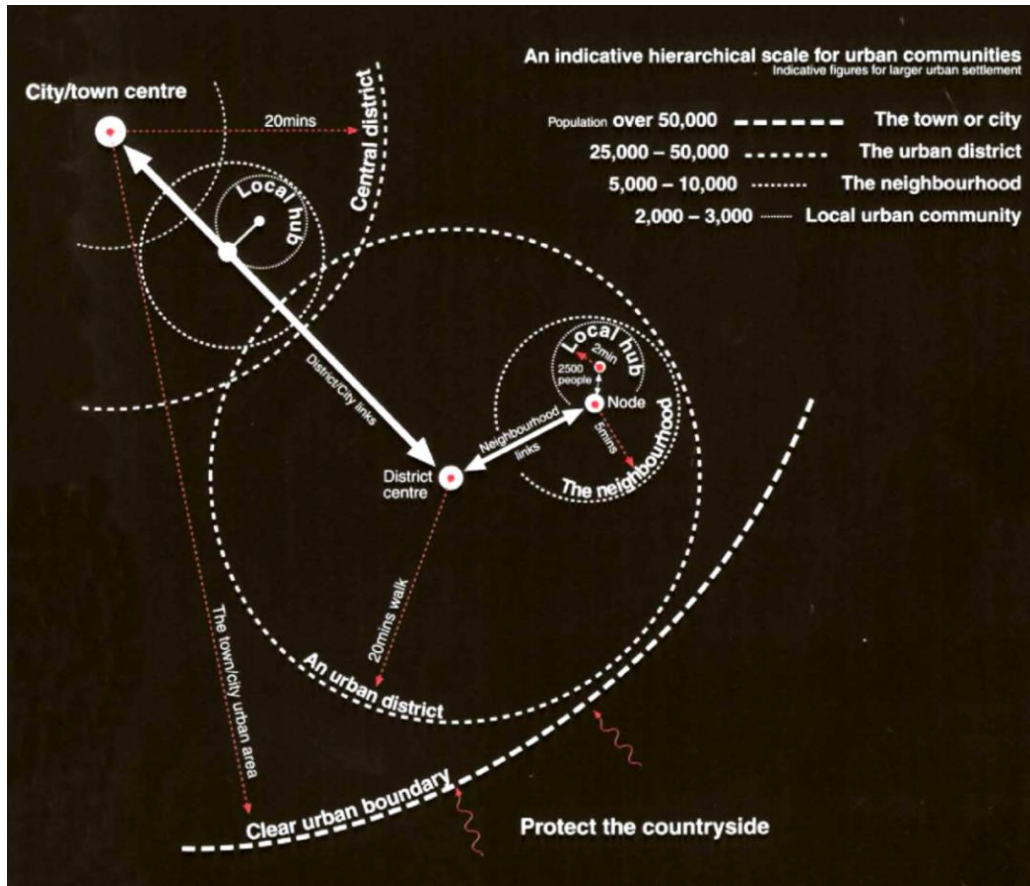


Figure 3-4: An Indicative Hierarchical Scale of Urban Community
Source: Urban Task Force, 2005, p.27

Despite that, the urban neighbourhood dominates by residential uses, but only residential use itself does not make the neighbourhood, therefore, the neighbourhood needs to comprise a mix of uses that encourage formal and informal transactions to sustain activities throughout the city. The mixing of different activities within a certain area should strengthen social integration and promote civic life. This implies the concentration of ranges of public facilities and other commercial uses in neighbourhood and district centres (Urban Force task, 2005). Condon (2010) identifies seven design rules to promote sustainability in neighbourhoods - see Box 3-2:

1. Restoring the streetcar city
2. Designing an interconnected street system,
3. Locating commercial services, frequent transit and schools within five-minute walking,
4. Locating good jobs close to affordable homes,
5. Providing a diversity of housing type,
6. Creating a linked system of natural areas & parks, and
7. Investing in lighter, greener, cheaper, smarter infrastructure

Box 3-2: Seven rules to promote sustainability in Neighbourhood
Source: Own construct based on Condon, 2010, p. ix

Also (UN-Habitat, 2013a) under the title “A new strategies of sustainable neighbourhood planning” has identified five principles for the sustainable neighbourhood, which are:

1. Adequate space for streets and an efficient street network. The street network should occupy at least 30 per cent of the land and at least 18 km of street length per km².
2. High density. At least 15,000 people per km², that is 150 people/ha or 61 people/acre.
3. Mixed land use. At least 40 per cent of floor space should be allocated for economic use in any neighbourhood.
4. Social mix. The availability of houses in different price ranges and tenures in any given neighbourhood to accommodate different incomes; 20 to 50 per cent of the residential floor area should be for low-cost housing, and each tenure type should not be more than 50 per cent of the total.
5. Limited land use specialization. This is to limit single-function blocks or neighbourhoods; single function blocks should over less than 10 per cent of any neighbourhood.

An ideal neighbourhood is the one which is designed to have a centre and a clear edge, an optimal size of 110 to 120 hectares, a five to ten minutes’ walk from the edge to the centre. In addition, a mixture of activities, diversity of buildings and different incomes, and a hierarchy of streets, careful attention to the public spaces and the location of other facilities – see Figure 3-5.

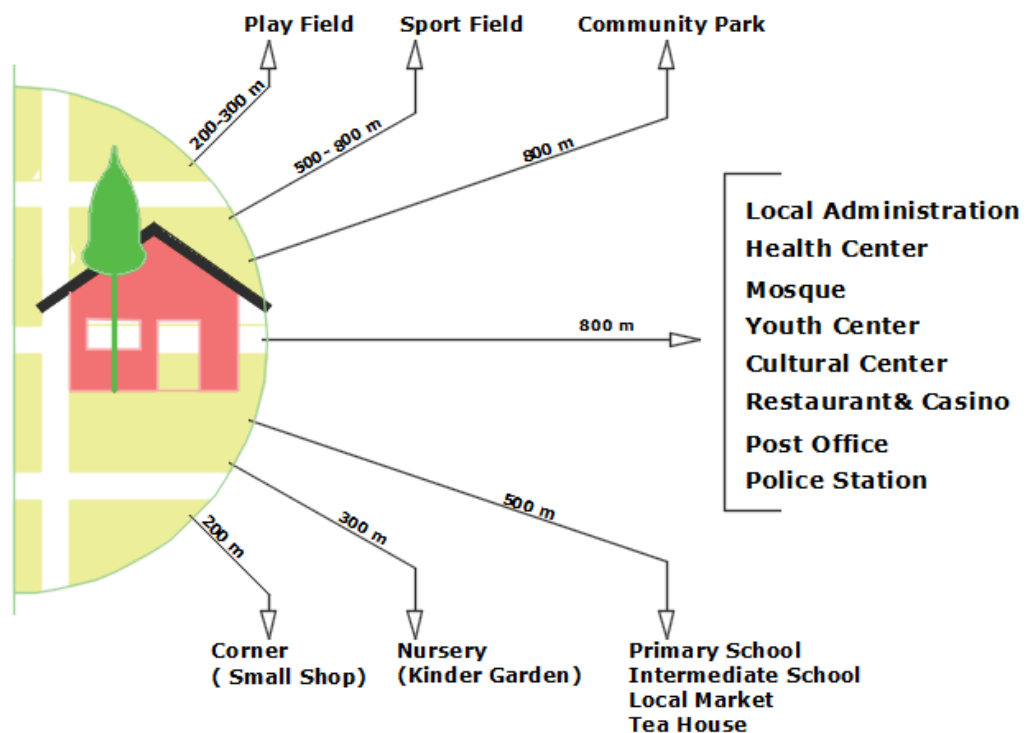


Figure 3-5: Maximum distance (in Meter) from the home to community services

Source: Own construct based on the Ministry of Construction and Housing in Iraq, 2010, p.37

The neighbourhood core may have an area of about 1 ha. The neighbourhood should provide a mixed use centre, public transport stops, housing over shops and service outlets, market place and community park, community hall, and a number of shops for daily needs and a small supermarket, a post office counter, a public house, a newsagent, a local bank,

library, local (medical and dental) surgeries, commercial units and other workplaces. Also, the neighbourhood should accommodate kindergartens, primary school, facilities for youth and children (e.g. play and sports areas). Iraqi Standards for Housing has stated many planning indicators and community facilities that should be available in the neighbourhood - see Figure 3-6 and appendix (1).

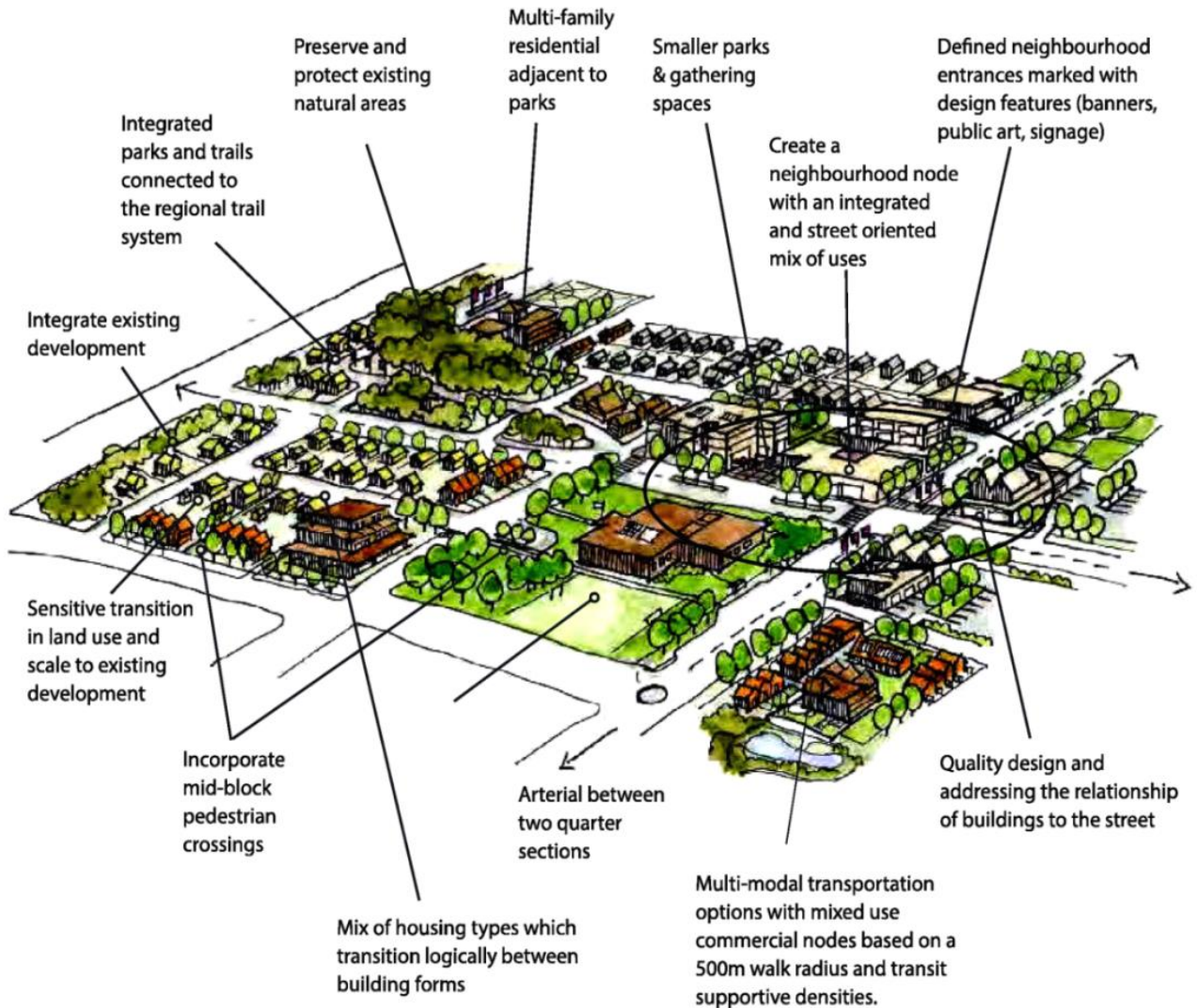


Figure 3-6: Anatomy of a typical neighbourhood model

Source: Retrieved August 21, 2014, from <http://www.reddeer.ca/business/planning/>

The traffic in the neighbourhood should be calmed through using speed zones or constraints such as humps and keeping the traffic outside completely. The places of car-parking should be confined to encourage the use of public transport and walking. The centre of the neighbourhood should not be provided with any car parking at all—except for vehicles of garbage collection or disabled people and perhaps for taxis—to discourage using the car into central facilities. By the gross, neighbourhood inhabits population between 4000 to 10000 people, in average 7000 persons occupying area between 120-200 hectares (Frey, 2005).

3.7. Requirements for Sustainable Urban Development

There are certain prerequisites in order to operate the sustainable urban development concept at the city level. These prerequisites have to be fulfilled before taking any step towards adopting sustainability. Drakakis-Smith (1995) argues that urban sustainability has to address issues at two levels namely; ethical and policy, the ethical level, deals with issues such as basic human needs, social justice, equity, integrity and environmental awareness, and at the policy level, deals with issues such as physical urban environment, infrastructure, employment, poverty, health and institutions. To report sustainable urban development in any particular urban context the following requirements should be satisfied as mentioned by Drakakis-Smith (1995, p.664);

- Equity, social justice and human rights;
- Basic human needs;
- Social and ethnic self-determination;
- Environmental awareness and integrity; and
- Awareness of inter-linkages across both space and time.

Elivert (2008, cited in Khazaei & Razavian, 2013, p.1546) refers to the following requirements as prerequisites which have to be fulfilled before taking any operational step towards sustainable development initiatives:

- Political system that encourages genuine citizen participation in decision-making in different sectors and levels;
- Production system that respects and protects the environment as a factor for any future development through policy intervention;
- Economic system that resolves disparities and unevenly development.
- Flexible management system that has the ability for self-modifying.
- Technical knowledge that creates sound patterns and an awareness of inter-linkages across both space and time.

To achieve urban sustainability, it is required to make some structural reforms through deep and fundamental changes in the institutional dimensions at three major levels, governance, management and implementation (Ahmadi & Toghyani, 2011).

3.8. Operating the Concept of Sustainable Cities

Adopting the concept of the sustainable city calls to reduce the negative impact on urban areas by improving the quality of life and economic productivity. The degree of success of the intervention adheres to the main three determinants (UN-Habitat, 2009b; Pugh, 2000; Lietman, 1999) which are;

- *Institutional factors* (management and organization of the urban energy sector, public-private modes of cooperation etc.),
- *Attitudes and behaviour of citizens* (lifestyles, mobility patterns, environmental awareness etc.),
- *Urban structure and morphology* (population density, urban form, transportation networks etc.).

Promoting the concept of sustainable development in the cities at the local level needs the concept to be socially setting (Mazmanian & Kraft, 2009). National sustainable development policies and strategies can't be effective and valid without community awareness and creating

a sense of responsibility towards the built environment (UN-Habitat, 2002a). Richardson (1994) states basic principles which should be addressed in order to promote sustainability at the city and neighbourhood level. The principles are summarised in the following points which the community has to adopt through:

- Recognising that the urban growth can occur within limited carrying capacity of the environment,
- Promoting cultural diversity,
- Sharing the values among the community members through steering sustainability education,
- Employing ecological decision-making through integrating environmental criteria into municipal government, business and personal decision-making process,
- Making decisions and plans in a balanced, open and flexible manner without degrading the social, economic and environments perspectives of the community,
- Mobilising the local efforts and resources,
- Depending on renewable and reliable sources of energy,
- Minimising harassment to the natural environment,
- Encouraging activities that have continuous cycles,
- Protecting the sustainability of other communities, and
- Do not compromise the sustainability of future generations.

The continuous cooperative efforts must come from the community that reflecting their characters, determinations and unanimous agreement. Developing the community's common vision can be the starting to embrace sustainability.

3.9. Assessing and Evaluating Sustainability

Assessing sustainability requires context-based evaluation because sustainability issues are more related to the people and the context that they live in. The new development proposals and initiatives directly affect the people. This needs an open assessment process which is continuous learning and seeking improvement.

Due to the complicated nature of the relationship between the three main dimensions of the sustainability namely; social, economic and environmental and the difficulties in operating sustainability, only the developed countries were being able to foster it. The city and spatial planning have given much importance because the environmental problems continuously associated with rapid urbanisation and increasing of the population (Al-Shuwaikhat, 2006). Therefore, many approaches and framework have been developed for evaluating sustainability in different contexts of cities. Most of these approaches and frameworks such as; Organization for Economic Co-operation and Development (OECD), United Nations Commission on Sustainable Development (CSD) and International Council for Local Environmental Initiative (ICLEI) are developed on the framework of indicators, target/benchmarking, impact assessment and monitoring. In addition to, there are many other frameworks based on indicators to enhance the quality of urban life and a well-built environment performance at neighbourhood and city level such as; LEED for neighbourhood development, BREEAM for communities, CASBEE for urban development and the Pearl Community Rating System for Steadman. Most of these developed frameworks for evaluation are comprehensive evaluating both the planning outcome and the planning process.

In general, the studies, approaches and frameworks can be classified into the following categories depending on their concentration of evaluated aspects in urban areas:

- 1- Measuring and evaluating the physical outcome of the development,
 - Evaluating existing outcome (Williams & Dair, 2007; Jarrar & Al-Zoabi, 2008; Scipioni et al., 2009; Holden & Norland, 2005),
 - Evaluating existing and future outcome (Kiziliaslan & Kiziliaslan, 2007; Nijkamp & Pepping, 1998),
- 2- Measuring and evaluating the planning process and procedures,
 - Evaluating the planning process (Cartwright, 1997; Jepson, 2004)
 - Evaluating development plan/master plan (Berke & Conroy, 2000; Bruff & Wood, 2000; Counsell, 1998),
 - Evaluating both the planning process and development plans (Al-Shuwaikhat & Aina, 2005; Conroy & Berke, 2004),
- 3- Measuring and evaluating both the physical outcome of urban development and the planning process and procedures (Al-Shuwaikhat & Aina, 2006; Choguil, 2008; Budd, Lovrich, Pierce & Chamberlain, 2008),
- 4- Measuring and Evaluating certain issues of sustainability such as; equity and efficiency (Zuindeau, 2006), sustainability and greenways (Lindsey, 2003), sustainable urban construction (Hakkinen, 2007).

Most of the researchers agree that assessing the quality and sustainability of the built environment should be based on both subjective and objective indicators. The use of both objective and subjective indicators can give a true picture of the urban quality areas, which can be easily understood by public and decision-makers, and make definitive and useful conclusions about the performance and the sustainability of the urban area.

3.10. Sustainable Urban Development: Challenges and Opportunities

Urban challenges and opportunities differ from context to another. The responses and the solutions should vary according to these differentiations between the contexts. There is no fixed global model of national urban policies with a standard outcome, which can be applied in different contexts to deal with urban growth even at the regional and local level (Ranhagen & Groth, 2012).

Developing countries are experiencing rapid urban growth; this outstrips the capacity of most countries to tackle with and to provide adequate services for their citizen (Cohen, 2006). Unguided and rapid urban growth both threatens the sustainability of urban context, in the absence of the necessary infrastructure and ineffective policies that ensuring and enhancing better life and equity (United Nation, 2014). In such a case, by getting city larger is probably result in the emergence of dysfunctional forms of urban development and generating a type of “locked-in” that is complicated to retrofit. For example, the over-crowded informal settlements are often difficult to develop and upgrade. The existed complex social structures and the awkward negotiations needed to install the required infrastructure or recognise into a more efficient spatial arrangement (UN-Habitat & Cities Alliance, 2014). Badly-managed urban growth and rapid urbanisation threaten the environment, undermine the natural resources and increasing poverty and displacement (UN-Habitat, 2002a). Unwell planned neighbourhoods and residential areas requiring improvement in order to supply inhabitants

with necessary services also need huge fiscal capabilities to compensate residents in case of removing selected dwellings to install additional infrastructures. Likewise, unauthorised buildings in environmentally sensitive areas which expose the residents to high risks, may people resist relocation to new neighbourhoods.

Growing cities tend to put pressure on existing infrastructures, consequently demanding the provision of more new infrastructures, managing programmes for funding. Therefore, authorities have to respond positively to the burgeoning in output and jobs, allocating of additional required resources to alleviate instantly needs of water, sewage and energy, reducing traffic congestions due to high pressure on road networks and dealing with environmental health problems resulting from pollution, solid and liquid wastes. The common approach in following this matter especially in developing countries is to respond incrementally and reactively instead of pro-actively, because of shallow knowledge and experiences in shaping and managing spatial development patterns (Hoornweg & Freire 2013; UN-Habitat & Cities Alliance, 2014). Adopting strategies are required to address these challenges such as sustainable land use planning, comprehensive planning (master planning), urban design standards, mixed use development, urban densification and others (Ranhagen & Groth, 2012).

By increasing population density, it is possible to admit extra population without extending and occupying new land, but the overall process typically occurs with the utilisation of new land to absorb the growing number of inhabitants (UN-DESA, 2001). If urban growth well managed, it can contribute to economic advancements, reducing poverty and improving quality of life for segments of the population. However, rapid urban growth poses many challenges to sustainable development (UN-Habitat, 2002a). Planning for sustainable urban development requires consideration of multi-dimensions of city growth (UN-Habitat, 2009b).

3.11. Approaches to Sustainable Urban Development

The search of the ideal city is traced back to Plato's Republic in 360 B.C.E., which was the result in some contradictory socio-political and economic philosophies has influenced the development of urban settlements throughout history. In modern history with growing awareness of environmental and other social problems, the search for the ideal city or more precisely the city form has been a major concern to many architects, social reformers and planners that would be able to subdue the new technologies, at the same time, creates a sort of urban quality life based on social justice.

In recent years, the landscape of the cities has changed dramatically because of increasing growth in population number. The major feature of fast-growing cities is urban sprawl which occupies high rate of land accompanied by many serious urban problems such as, inefficient land use, higher car dependency, low density and high segregation of uses. These problems resulted in the growth of a fragmented city and inefficient urban spaces (UN-Habitat, 2013a).

It has been widely recognised that cities play a role in term of increasing sustainability. Hence, it is suggested that cities should act as a vessel to contain and interpret the principles of sustainability and solving global problems (Brehon, 1992a cited in Manabí, 2000, p. 64). Sustainability is the concept that related to improving the quality of life in communities and requires a comprehensive and integrated view of development that allow the social and economic development interact and works in harmony with the environmental systems within

the context in which exists and depends upon (Manabí, 2007). Accordingly, a sustainable city is a city with sustainable urban forms that fulfil the needs of people and are friendly with the ecosystem. But to what extent the degree of scoring on the goal of sustainability is guaranteed, that depends on the context, their local conditions, choices and their approaches to urban development. Sustainability and the form of the cities have been the subject of many debates due to increased environmental awareness (OECD, 2012). Jenks et al (1996 cited in Williams, Burton & Jenks, 2000, p.10) confirm that there may be a range of urban forms that are sustainable. The challenge for the policy is to search for the most appropriate form for a particular local context. Therefore, the search for single sustainable urban form has to be reversed to search for a number of sustainable urban forms that respond to different contexts and settlement patterns (Williams, Burton & Jenks, 2000). During the last decades, many approaches and models of sustainable urban development have emerged as a way to promote urban sustainability. The following subsections present sustainable urban forms that have taken a lot of discussions and arguments which are considered as sustainable urban patterns.

3.8.1. Compact City

The term of the compact city first is coined by Dantzig and Saaty in 1973 in their book ‘compact city: a plan for the liveable urban environment’. They believed that the compacted city returns many benefits to the urban built environment. This kind of belief is rooted in the form of traditional European cities (Burton, 2000a). Later this term has been used in sustainable urban development debates.

Increasing in urban sprawl has generated many negative consequences and impacts -for more details see Section 2.3.1 in Chapter Two. The concept of the compact city emerged as a reaction to find out the solution to those problems, and it is regarded as an antithesis to spreading ‘sprawling’ pattern of urban developments which are accounted unsustainable (Burgess, 2004; Thomas, 2013).

In the late twentieth century within the rises of the environmental movement and concern for sustainable development has led the favour for compact cities (Marshall & Gong, 2009). There is widespread faith in the compact city model and their ability to promote urban sustainability in urban contexts (Jenks, Burton & Williams 1996; Burton 2000b).

The dominant discourses of urban sustainability debates revolve around reshaping the built environment profile of resources in cities through re-shaping of land uses, the layout of neighbourhoods and the design of buildings. As a result, the compact city becomes a “*today’s visionary solution*’, *hurriedly adopted by academics and politicians ‘all-embracing panacea of urban ills*’” (Fulford, 1996 cited in Williams, Burton & Jenks, 2000, p.10). The compact city has not put the emphasis on the city centre, but also to the growth of the city to have clear cut boundary avoiding any further extension of expense to its outskirts (Richards & Rogers, 1999 cited in Mobaraki, Mohammadi & Zarabi, 2012, p.3). Therefore, the compact city is counted as one of the archetypal of urban development patterns (Newton, 2000). The major advantages of the compact city could be summarised– see Table 3-5.

The compact city should have a form and scale suitable for walking and biking and the level of compactness of transportation network to encourage social interaction (Richards & Rogers, 1999 cited in Mobaraki, Mohammadi & Zarabi, 2012, p.3). The compact city encompasses two main areas; size and capacity (Khodabakhshi, 2011). The validity of the appropriate size of the compact city and the degree of density of compactness are two

concepts related to many local factors. Any evidence for “*compactness or sustainability that ‘works’ needs to be considered and the responses to that evidence will need to be specific to the place and circumstance, and allow for a range and scale of proposals from the neighbourhood to the region*” (Downton, 2004, P.312).

Table 3-5: Aspects of Compact City

Aspects of Compact City	Characteristics
Form of Space	1- Compacted settlement (High density)
	2-Pedestrian- orientated (Less using of car)
	3-Clear boundary between urban & rural
	4- Mixed land use
Space Characteristics	5- Diversity of Life and buildings
	6-Clear Identity
Function	7-Social fairness
	8-Self-sufficiency of daily life
	9-Independency of governance

Source: Own construct based on Dantzig & Saaty, 1973

Two main perspectives on the topic of the compact city exist among the researchers. The first is the proponent group who believes that compact city implies many benefits and help to solve many problems of today’s city. The advocates of compact city theory belong mostly to the European countries which have relatively compacted cities if compared with American and Australian cities (Jenks, Burton & Williams, 1996). The opponent group advocates urban dispersal and low-density development that leads to less congestion, pollution and higher quality of life (Gordon et al., 1989; Troy, 1996 cited in Masnavi, 2000, p.65). According to Khodabakhshi (2011), the opponent group believes that a compact city can result in many deficiencies like:

- Increasing environmental pollution because of increasing traffic,
- Extraordinary rise in land price,
- Increasing criminal behaviour, and
- Loss of peace and privacy.

Maximising the advantages and minimising disadvantages through adopting sound planning tools and effective urban design strategies can reduce the side effects of adopting a compact approach. Urban Task Force (2005), argues that the compact and connected city has a flexible structure and connects quarters, neighbourhoods and communities to each other across the city. In addition, it links people within localities to their homes, work-places, basic social institutions and other facilities. The compact city reveals that urban areas are ordered in concentric bands of density. The higher density can be found around public transport nodes and lower density in less connected urban areas. This arrangement of compact layout establishes clear urban boundary, prevents urban sprawl, reduces car use and encourages walkability. Thus, the compact city can contribute to urban sustainability. According to Hall and Pain (2006 cited in Williams, 2014, p. 25), the only significant adaptation of compact ‘ideal’ model has been moved from prescribing a single-centre configuration to the promotion of polycentric cities.

In Germany, France and Australia, compactness is advocated but with clear polycentric strategy (Keenleyside et al, 2009 cited in Williams, 2014, p.25). Such polycentric cities seek to provide clear distinctions between quarters and districts to maintain their identity and to keep ‘in-between’ space free from building as a green belt (Williams, 2014). Also, the concept of a compact city plays within the networks of cities. In many countries, ‘polycentric city’ plans are adopted at a wider scale to encompass a range of closely located settlements (Frey, 2005). Hence, the networks of compact poly-nucleated cities can have a different shape, forms and sizes, such as polycentric nets, fractal cities and galaxies of settlements. The settlement with high density, mixed use and contained is still to be the ideal (Olofsdotter et al, 2013 cited in Williams, 2014, p. 25). According to Marshall and Gong (2009), the compacted cities, in any case, will not be considered sustainable if they are not able to attract the users.

The degree of the compactness of ‘compact city’ model, the size of the settlement and the number of population and other issues remain disputable discourses among planners and researchers. In general, the compact city model is more context-related. The special characteristics of any context can shape the wide guidelines for the model of a compact city.

3.8.2. New Urbanism

New urbanism aims to reform the design of built environment inspired by traditional urban environment to seek better urban forms based on their physical aspects in a movement called “Neo-traditional planning” (Nasar, 2003 cited in Jabareen 2006b, p. 43). The movement has emerged as reaction to many ecological, economic and social equity problems that the modern urban areas face. So, there was a call for a new multi-scale approach to regional, town planning and neighbourhood planning. The new urbanism strives to achieve two broad-ranging goals:

- To create a greater sense of community by accommodating more diversity of land uses and social interaction in neighbourhoods by rethinking the “public realm,” especially public spaces and the typical streetscape.
- To reorient the typical community toward a pedestrian and transit-friendly environment, while also minimising negative traffic and environmental effects (Fulton, 1996, p.3).

According to many critiques, the approach of the development that neo-traditional proposes was based on the Garden City movement (Gosling & Gosling, 2002). Talen (2005) concludes in her historically-based assessment of the origin of new urbanism that the new urbanism traces back to four cultures of; instrumentalism, plan-making, planned communities and regionalism over the past hundred years.

Many development approaches go under the umbrella of the new urbanism movement. According to Jabareen (2006b), New Urbanism, Transit Orientated Development (TOD) and the Urban Village are approaches considered to be forms of neo-traditional. Among these approaches, new urbanism is well-known which is also referred to as Traditional Neighbourhood Development (TND).

New urbanism is the well-known approach to neo-traditional planning movement (Jabareen, 2006b), and has gained prominence in the 1990s “*seeks to promote qualities that urban reformers have always sought: vital, beautiful, just, environmentally benign human settlements*” (Talen, 2005, p.1). New urbanism approach is based on traditional urban forms

and advocate for design-based planning strategies. The approach was a reaction to suburban sprawl and decline in American cities to improve the physical qualities of neighbourhoods and cities. New urbanism believes that their design approach can encourage walking within the neighbourhood, mixes of uses within proximity, increases density and strengthens the sense of community for residential areas (Walter & Brown, 2004; Jill, 2006). Fulton (1996) states that all the new urbanism’s principles revolve around three major ideas:

- Walkable neighbourhoods oriented to the quarter-mile, five-minute walk.
- Primary orientation to public transit systems, rather than private automobiles.
- Greater integration of different land uses (such as housing, shops, workplaces, and schools) at the neighbourhood level.

According to the congress of new urbanism, the principles of new urbanism has divided into three levels; neighbourhood, city and regional. The transition area between urban and rural area has been divided into seven zones – see Figure 3-7 and Box 3-3.

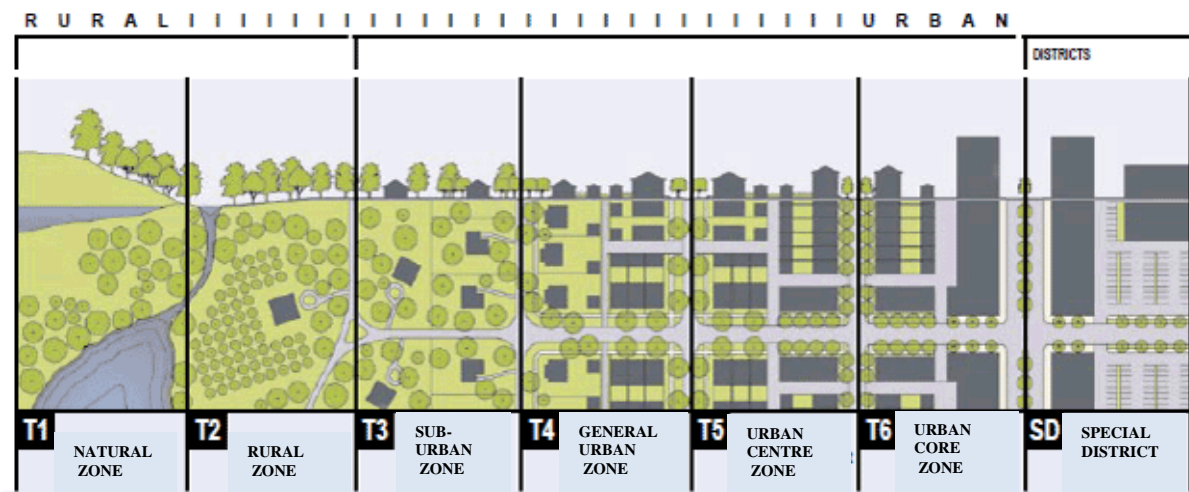


Figure 3-7: Transition zones between urban and rural area.

Source: Retrieved August 12, 2014, from

<http://www.newurbanism.org/newurbanism/principles.html>

Some researchers claim that there is a gap between the rhetoric of new urbanism and its reality in practice (Jabareen, 2006b). Designs of new urbanism show higher density, more compact, and more walkable than suburban places. *“But in many ways, their reality does not meet their aspirational rhetoric. The densities are often not much higher than conventional suburban development, they are often built on greenfield sites, and they often lack the transit, mixed uses, and other ingredients that could make them fundamentally more sustainable”* (Beatley, 2000, p.65). But, some others believe new urbanism and sustainable community to be synonymous, even though new urbanism projects are not reflecting a sound concern about reducing ecological impacts or promoting more ecologically sustainable lifestyle (Beatley & Manning, 1997 cited in Beatley, 2000, p.65).

The principles of New Urbanism

1. The neighbourhood has a discernible centre. This is often a square or a green and sometimes a busy or memorable street corner. A transit stop would be located at this centre.
2. Most of the dwellings are within a five-minute walk of the centre, an average of roughly 0.25 miles (0.4 km).
3. There are a variety of dwelling types - usually houses, row-houses and apartments - so that younger and older people, singles and families, the poor and the wealthy may find places to live.
4. At the edge of the neighbourhood, there are shops and offices of sufficiently varied types to supply the weekly needs of a household.
5. A small ancillary building is permitted within the backyard of each house. It may be used as a rental unit or place to work (e.g., office or craft workshop).
6. An elementary school is close enough so that most children can walk from their home.
7. There are small playgrounds accessible to every dwelling, not more than a tenth of a mile away.
8. Streets within the neighbourhood form a connected network, which disperses traffic by providing a variety of pedestrian and vehicular routes to any destination.
9. The streets are relatively narrow and shaded by rows of trees. This slows traffic, creating an environment suitable for pedestrians and bicycles.
10. Buildings in the neighbourhood centre are placed close to the street, creating a well-defined outdoor room.
11. Parking lots and garage doors rarely front the street. Parking is relegated to the rear of buildings, usually accessed by alleys.
12. Certain prominent sites at the termination of street vistas or in the neighbourhood centre are reserved for civic buildings. These provide sites for community meetings, education, and religious or cultural activities.
13. The neighbourhood is organized to be self-governing. A formal association debates and decides matters of maintenance, security, and physical change. Taxation is the responsibility of the larger community.

Box 3-3: The main principles of the New Urbanism movement

Source: Own construct based on <http://www.newurbanism.org/newurbanism/principles.html>

3.8.3. Transit-Orientated Development

The second type of the neo-traditional movement is transit-orientated development (TOD) – see Figure 3-8. Many terms have been used to adopt the same idea of transit-orientated development, such as ‘Transit villages’, ‘transit supportive development’ and ‘transit-friendly design’ (Jabareen, 2006b). The term transit-orientated development is widely used among researchers. According to Cervero (1998), there is no single definition that represents the transit-orientated development concept in its many forms; most of the definitions share common elements. Calthorpe (1993) as one of the pioneers defines Transit-Oriented Development as a balanced, mixed use area within a quarter-mile walking radius of a transit station. According to Calthorpe (1993), the principles that (TOD) attains to perform are:

- Organising growth on the regional level to be compact and transit-supportive,
- Placing commercial, housing, jobs, parks and civic uses within walking distance of transit stops,
- Creating pedestrian-friendly street networks directly connects local destinations,
- Providing a mix of housing types, densities and costs,
- Preserving sensitive habitat, riparian zones and high-quality open space,

- Making public spaces the focus of building orientation and neighbourhood activity,
- Encouraging infill and redevelopment along transit corridors within existing neighbourhoods.

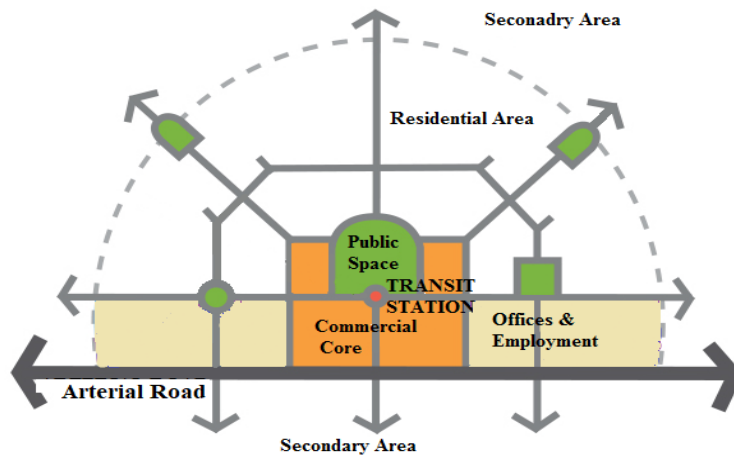


Figure 3-8: Conceptual design scheme for Transit-Orientated Development
Source: Own construct based on Calthorpe, 1993

Dittmar and Poticha (2004) state that the major five goals which Transit-orientated development tends to achieve are:

- Location efficiency
- A rich mix of choices
- Value capture
- Placemaking
- Resolution of the tension between node and place

3.8.4. Urban Villages

The third type of development which is considered as a neo-traditional form is an urban village. The urban village is a type of neo-traditional development that started in Britain in early 1970s as a reaction from the side of the urban designer to the lack of local character of the towns in Britain (Ellin, 1996). According to Landman (2003), the urban village is influenced by Garden City Concept of Ebenezer Howard and the Neighbourhood Unit of Clarence Perry among others. Aldous (1992, cited in Masoumi, 2011, p.44) points to the characteristics that urban villages should respect the following traits:

- *Size*: It must be within a range to encourage people to know each other, and at the same time be enough large to support diverse facilities and businesses. The population ranges between 3000-5000 inhabitants with an area of 100 acres.
- *Mixed usage*: Residential, commercial, retail and other public buildings are all included and combined in the urban village frame (UVF) concept. There is diversity in types and size of the houses.
- *Maximum possible self-sufficiency*: Including maximum ratio of jobs to economically active residents, live-work spaces and consideration for the “balance of usage”.

- ***Social and economic integration:*** A variety of residential and commercial tenures that make it easy for people of different income levels and wealth to live and work in proximity. Urban Villages are not as isolated elements and they should be linked to each other with cycle and footpaths. Neighbourhoods should have linkages with each other.
- ***Transport and design:*** An “attractive and civilized environment” with good transport links, good public transport, minimum car usage and a priority for pedestrians and cyclists.
- ***Management and control:*** To ensure that the Urban Village concept is achieved and endures.

The concept of urban villages reflects the concept of neighbourhood, and it has the size of an approximate neighbourhood with an aggregate of small blocks. The urban village has a mixture of land uses offering a diversity of residential choices and variety of infrastructures and function which promote social interaction. Kenworthy (1991 cited in Jabareen, 2006b, p. 44) states that the urban village is a trend that tries to respond to the looseness in social relations in addition to other factors such as congestion, pollution and infrastructure costs and the quality of life, and to bring back convenience, efficiency, beauty and connections to urban life.

3.8.5. Urban Containment

Urban containment is defined by Burby, Nelson, Parker and Handmer (2001) as a set of various regulations and public investments that are seeking to restrain urban sprawl and encourage infill development within the municipality boundary. Urban containment policies are created to impose geographical constraints on urban growth to contain urban sprawl and to confine urban growth in urban areas. In essence, urban containment prevents the outward expansion of the city and towns and force the land market to search for alternatives inside the cities. Urban containment seeks to employ public policy tools to manipulate ‘push’ and ‘pull’ factors so that to limit and define the geographical form of the metropolitan area (Jabareen, 2006b) – see Figure 3-9.

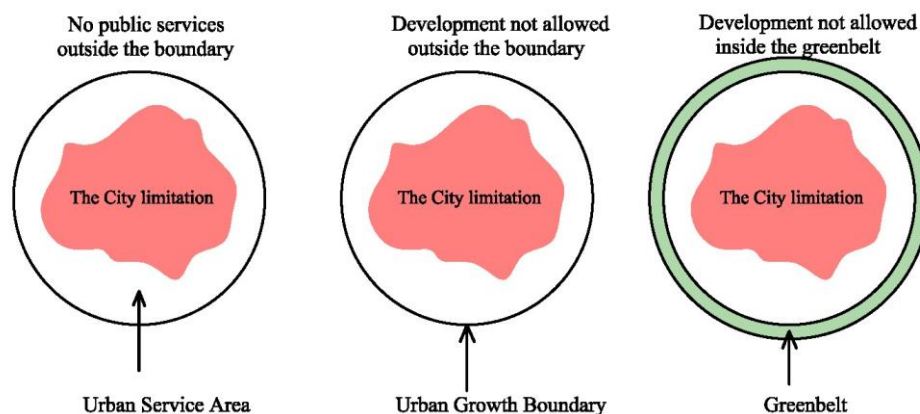


Figure 3-9: Conceptualising of urban containment policies

Source: Own construct

Pendall, Martin and Fulton (2002) refer that urban containment seeks to implement different goals through:

- Preservation of agricultural land and Ecological sensitive natural lands,

- The cost-efficient construction and optimum use of infrastructure,
- Reinvestment in urbanised areas,
- Creation of higher density land use pattern,
- A mix of uses,
- Encourage public transportation, and more efficient of land utilisation in urban areas.

Moreover, urban containment policies encourage high-density development in certain areas inside urban boundaries and discourage development outside of the urban boundary (Wasserman, 2006). Urban containment policies comprise the enactment of regulatory urban growth boundaries, restraining the further extension of utilities outlying areas, delineation and acquisition of greenbelts, controlling density and pattern of development, restricting new development on agricultural areas. Moreover, restricting the number of new residential permits issued, land preservation programs, tax incentives, and variety of other measures (Porter 1997; Razin 1998; Tjallingii, 2000; Gillham 2002; Nelson et al. 2004 cited in Jabareen, 2006b, p. 44). According to Wasserman (2008), urban containment has emerged as a reaction to increased uses of automobile travel, traffic congestion, accessibility, high level of pollution, depletion of agricultural land, high cost of duplicative infrastructure, a limited opportunity of employment, concentrated poverty, and many other negative outcomes in metropolitan areas.

In general, urban containment policies seek to use three main tools; greenbelt, urban growth boundary and urban service areas to control the further extension of urban areas. Greenbelt and urban growth boundary policies are implemented to affect “push” factors, while urban service areas are used to affect the “pull” factors (Pendall, Martin & Fulton, 2002).

Urban growth boundary (UGB) is a zoning tool which confines urban areas located inside the boundary and rural uses such as farmland, forest, and low-density residential situated outside the boundary (Pendall, Martin & Fulton, 2002; Brueckner, 2007). Fodor (2001) defines urban growth boundaries as physical or legal lines drawn to separate urban areas from rural or any other sensitive land. It is a line between the urbanised area and rural area, rather than a physical area. It is also called urban limit line (ULL), blue line or green line representing the actual physical boundary that separating urban from rural areas and restrain any further development beyond that (Jabareen, 2006b).

Growth within the urban growth boundary can be achieved based on the phases of providing services and the suitability of development area, the contiguity to existing development, proximity to available public facilities, and other considerations. Urban growth management and service provision should consider the provision of sufficient land to satisfy the market’s demand. Resizing of the urban containment policy may need as a result of the unsuccessful provision of land for adequate density and intensity and rising in the price of the land and housing. In case, the availability of land exceeds the development demand or the new development has failed to reach the required density and intensification, then the purpose of encouraging intensification and contiguous development may not be achieved (Nelson & Dawkins, 2004). All urban growth management policies are not included in urban containment, but urban containment programs that project and plan for any required growth goes undergrowth management programs (Pendall, Martin & Fulton 2004).

Greenbelt is another technique of urban containment to confine urban growth. A greenbelt usually refers to a green ribbon around a city or urban region as non-removable or at least difficult to change it. Greenbelts are created from natural open space lands, green parks or off-development rights on agricultural land. Mainly, greenbelts are open spaces designed as buffer zones to protect areas from any further development (Ewing, 1995 cited in Jabareen, 2006b, p.45). Green belts have many advantages besides its main purpose such as protecting urban areas from the dusty winds especially in arid lands and work as open areas for city residents. Urban service areas are adequately searching for suitable areas for future development. In many cases, urban service areas work as an urban growth boundary in preventing urban sprawl. Urban service areas are more flexible than greenbelt because they are easy to adapt and move.

The advocates of urban containment believe that urban containment policies preserve open space, widen transport choices, encourage a mix of uses, improve accessibility, increasing social interaction and offer employment opportunities. While the opponents argue that urban containment raises housing price, reduces location choices and reduce the quality of life (Nelson & Dawkins, 2004).

3.8.6. Eco-City

The concept of Eco-city is traced back to Richard Register in 1975 when jointly with some friend founded a non-profit organisation to “*rebuild the city with nature*” (Roseland, 1997). “*The distinctive concepts of the eco-city approach are greening and passive solar design. In term of density and other concepts, the eco-city might be conceived as ‘formless’ city or an eco-amorphous city*” (Jabareen, 2006b, p.47). The connotation of eco-city bases on functioning in harmony with the natural environment. This implies that the city should be understood as a network of interactions, thereby conceptualising the city as ecosystems (Wong & Yuen, 2011). Register’s proposal depicts the building of the city like a living system taking into account; land use patterns that underpin the healthy structure of the whole city and enhancing biodiversity to make the city’s functions to orchestrate with the dynamic evolution and sustainability (ibid.). It should be noticed that notions of ecological planning and design are not new in the planning literature, it traces back to the garden city of Ebenezer Howard in 1898. The building of an ecological city, is the path to the solving of many problems that the cities of today suffer from. According to the International Ecocity Framework and Standards (2011), the eco-city is the unison of natural and urban life - see Figure 3-10.

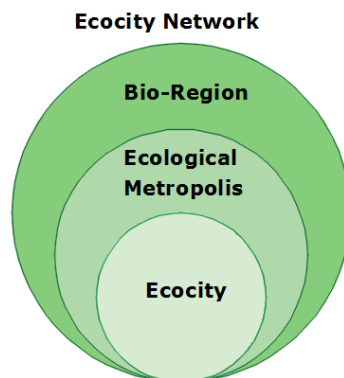


Figure 3-10: Eco-city systems hierarchy

Source: Own construct based on international eco-city framework and standards, 2011, p.5

Eco-city calls for using local material, passive solar energy, and keeping air, water and soil clean and fresh in order to minimise human effects on the environment. White (2002 cited in Hald, 2009, p.44) describes the eco-city as “*a city that provides an acceptable standard of living for its human occupants without depleting the ecosystems and biochemical cycles on which it depends*”.

The concept of the eco-city is an attempt to restore damages that caused to urban environments through revising land use pattern and promoting urban greening. Roseland (1997, p.197-198) identifies ten aspects that Eco city strives to achieve -see Box 3-4.

1. Revise land-use priorities to create compact, diverse, green, safe, pleasant and vital mixed-use communities near transit nodes and other transportation facilities;
2. Revise transportation priorities to favor foot, bicycle, cart, and transit over autos, and to emphasize 'access by proximity;'
3. Restore damaged urban environments, especially creeks, shore lines, ridgelines and wet- lands;
4. Create decent, affordable, safe, convenient, and racially and economically mixed housing;
5. Nurture social justice create improved opportunities for women, people of color & disabled;
6. Support local agriculture, urban greening projects and community gardening;
7. Promote recycling, innovative appropriate technology, and resource conservation while reducing pollution and hazardous wastes;
8. Work with businesses to support ecologically sound economic activity while discouraging pollution, waste, and the use and production of hazardous materials;
9. Promote voluntary simplicity and discourage excessive consumption of material goods;
10. Increase awareness of the local environment and bioregion through activist and educational projects that increase public awareness of ecological sustainability issues.

Box 3-4: Aspects of Eco-City Approach

Source: Own construct based on Roseland, 1997, P.197

This approach tries to function harmoniously and friendly with natural eco-systems and value their ecological assets at the regional and global levels. Planning, policies, institutional measures, regulations, urban design, collaborations and holistic long-term investment strategies are instruments that drastically minimise the damage to the environment (Suzuki, Dastur, Moffatt, Yabuki & Maruyama, 2010).

Other strategies that are adopted by Eco-city to manage the balance between the urban and nature include; building vertically instead of sprawling out, incentives for encouraging pedestrian, mixed use neighbourhoods, re-use of land using renewable energy and green tools to create self-sustaining city (Wong & Yuen, 2011). Through adopting ecological city approach, the development of the city implements the concept of sustainable development.

3.12. Conclusions

By reviewing the concept of sustainable development, it is obvious that it has gained much importance since it has been adopted by UN-Habitat as an inventible way to conserve resources, protect the environment and upgrade the quality of life. Definition of sustainable development is disputable and there is no consensus definition to be agreed by all researchers. But the point that all researchers agree on that sustainable development is a complex issue and it has multiple aspects and its application varies from country to country.

The main three pillars of sustainable development namely; social, economic and environmental are conflicting and should be balanced in operating them in real life. Some of the researchers have added another two dimensions namely; political or institutional and physical or spatial to the main pillars. Sustainable development cannot be achieved in unstable circumstance and quite related to spatial dimensions.

All governments and civil organisations have been encouraged to adopt a sustainable concept by applying sustainable development principles. The applications of the sustainable development concepts found their way in urban context since it has been announced by UN-Habitat. Developed countries have succeeded to create many frameworks for applying the concept of sustainable development in their contexts. These frameworks have mostly been effective in specific urban contexts while developing countries have still in lack of such frameworks.

Many approaches to sustainable urban development, emerged as a response to urban problems. The most well-known sustainable approaches of urban development are; compact city, new urbanism, transit-orientated development, urban village and eco-city. These approaches claim and advocate many similar design concepts such as compactness, density, mixed use, diversity, greening and social sustainability. The concept of neighbourhood is considered as a building block for promoting sustainability in any city.

Evaluating and measuring sustainability have attracted the attention of many researchers, governments and planning bodies. Therefore, many frameworks and approaches have been emerged for this purpose and mostly at the local units of the government and based on their contexts. These approaches and frameworks share much similarity with differentiation in concentrating on some aspects and scales rather than the others. They are related to the context of developed countries and alien to the contexts of developing countries. Applying these frameworks and approaches as templates for evaluating and measuring the quality of urban contexts in developing countries brings many inefficiencies and inappropriateness. This requires following certain approaches based on context evaluation.

Chapter Four: Institutions, Process and Procedure

4.1. Introduction

The impact of the institutions, planning process and procedure in shaping and creating urban form and structure is evident. Urban form and structure is the product and the outcome of a broad range of actors whose actions orientated by institutional settings during a long time of the age of the city. It is shaped within a complex environment which encompasses different actors with different motivations and interests.

Planning institutions vary remarkably from context to another. The variation is a sequence of the existing of different legal systems, land property laws, decentralisation model. These all play an essential role in defining the task of planning in the official government process and the regulatory powers that the government enjoys.

This chapter briefly reviews, the role of the legal framework in promoting a sound base for promoting sustainable development, as well as identifies the role of actors and other bodies which concerned to manage and govern urban development planning.

4.2. Institutional and Legal Framework

The legal framework is the preparations or arrangements through which the planning authorities can promote laws, process or customs aiming to structure political, economic, social and cultural transactions and relations from top to down or vice versa in the urban and regional planning system in any context. Legal framework varies between different countries, therefore, urban policies are not the same thing in all urban context; merely they are policies, as there is no a specific model or approach guaranteed to produce a desirable outcome in various contexts (UN-Habitat & Cities Alliance, 2014). In developing countries, urban planning policies and institutions have to undergo a clear reform concerning land management principles and increasing the role of local government. *“However, policy dialogue at a national level and its ability to reflect the framework that supports urban planning remains fundamental in enabling planning innovations to be institutionalised and replicated on a broader scale”* (UN-Habitat, 2010, p.16). The rapid urbanisation in the majority of developing countries challenges to meet the increasing demands for basic urban services which are aggravated by lack of competencies at local levels. To overcome emerging challenges more effective decision-making and more efficient in service delivery is required. The local governments in developing countries need paradigm shift by building strong frameworks which promote an integrated approach with wider involvement of stakeholders at local, provincial and national levels in urban planning (ibid.).

Laws, rules and regulations of all kinds have their effeteness in shaping cities which can be interpreted through the physical outcome of the urban planning. The main role of regulations is to promote better standards of building and area design, enhancing the quality of life and public realm and introducing to some degree the stabilisation in land and property development activity (UN-Habitat, 2009). The application of spatial rules, regulation and regularity is widely used in urban development and has been a staple feature of urbanism across many different socio-temporal, political, and spatial contexts (Ben-Joseph, 2005a cited in Miry & Street, 2011, p.26). The omnipresence of rules and regulations relating to building form and performance has shaped the practices of spatial planning. The main purpose of rules and regulation is setting guidelines and applicable and workable measures for delivering built

form and controlling the quality of the planning outcome. These measures should be shined in the governmental development policy and aim to identify principles and criteria that are essential in the design and directing development form. These standards and measures should be relevant to the context (European Commission, 2007).

Urban planning and development regulations are distinct aspects for controlling of physical urban development, and they are binding rules concerning “*what is built, where it is built, and when and how it is built*” (Kaiser et al, 1995 cited in Goodfellow, 2013, p.85). Generally, these can take the form of land use regulation, zoning ordinance and building codes. Such regulations have the force of law, unlike the master plan which city councils consult but are not usually bound by (Birch, 2008 cited in Goodfellow, 2013, p.85).

The design codes are a set of rules that guide urban designers in shaping the form and appearance of the urban built environment by setting specific principles for various areas of urban fabric (Zukin, 2009 cited in Guaralda, 2014, p.157). The regulation relating to urban design “*is never purely technical, nor is it value free or divisible from the exercise of political power and the organisation and control of socio-spatial relationships*” (Imrie & Street, 2011, p.26). Ideally, the urban form must not be a product of imposed coding or regulations rather it should be the result of a constant dialogue between private and public interests. It is not essential the codes to explicitly provide building typologies, uses and materials, instead to provide a flexible and variable set of principles and guidance to address every aspect of urban form (Marshall, 2011). The codes allow communities to shape their neighbourhoods through addressing physical aspects of the space and informing social and interpersonal uses of the built environment (Guaralda, 2014). Marshall (2011) argues that planning and coding have always been interwoven, even if in unclear ways.

The rules, legislations and regulations cannot be understood outside the specificity the socio-political and moral context of the society. In general, building standards can be classified into two categories;

- Qualitative (descriptive): these are mostly documented descriptions on certain requirements (e.g. safety, social, cultural...etc.), and
- Quantitative (measurements): these are related to the numeric requirements such as area, distance and capacity (e.g. the area of the plot or the neighbourhood, the setback or the distance of the services, density or occupancy rate) (Neufert, 2006).

The codes are reliable tools for growing communities to achieve desired development. Over the past decades, more explicit use of form-based zoning has been used in new urban development approaches (CMAP, 2012; Talen, 2012). The “*form-based codes offer a powerful alternative to conventional zoning*” (Globe International, 2013, p.3). The implementation of form-based codes is a way to limit unexpected outcome and control urban form and it has a great role in informing a good urban environment (Talen, 2012). The codes offer design tools for balancing order and diversity to achieve more controlled urban form and structure (Donald et al, 2012 cited in Guaralda, 2014, p.157).

Iraq housing standards are the main planning and design criteria for residential units, neighbourhoods and districts. These standards are a useful and important reference as key design solutions for creating a sustainable urban form (Ministry of Housing, 1986). Initially, these standards build on the Pol-service standards which developed in 1983 for the housing sector in Iraq and later on became the main reference for community planning. It presents

general planning indicators for density, compactness, diversity, mixed uses, open spaces and accessibility in residential areas. The indicators revolve around the neighbourhood design, land densities, distribution of public services, and amount of open spaces, car parking, and climate treatments. In addition, many detailed and particular standards about the areas of the plots, types of buildings, household averages size, number of rooms, supposed occupancy rate and others. These planning standards set the minimum and maximum allowable criteria. Unfortunately, these planning standards have not been updated and applied in very weak form by the planning institutions in Iraq and Kurdistan Region.

4.3. Process and procedures

4.3.1. Land use planning (zoning)

The disorderly development in the late of the nineteenth century, such as constructing of industrial buildings within a residential district which caused many health and environmental problems, degradation of property values and traffic congestion the zoning ordinance was adopted to regulate the development and overcome the emerging problems (Wright & Gitelman, 1997 cited in Hyunsoo, 2001, p. 31). German cities such as Frankfort and Munich were among the first cities adopted the zoning ordinance in the 1890s and created the precursor to modern zoning (Sutcliffe, 1981 cited in Wheeler, 2012, p. 587). In essence, the aim of the zoning system, was to arrange an orderly develop land and to increase and promote community welfare and enhance built environment performance. Zoning is intended to produce a better city with an ordered layout, contrarily it resulted in a set of rules that discourage density, walkability and generated a fragmented and unhealthy urban pattern.

Zoning focuses on a provision of standards and incapable to provide a controlled urban form. The undesired outcome of the applying of zoning has been both segregation of people and functions in urban areas (Talen, 2012). The strict separation of different function in cities achieved the unintended outcome and produced unsustainable settlement pattern. Restrictions on uses have encouraged a car-dependent urban form in which services were detached from the residential area, as well as, zoning had generated many problems like, traffic congestions, further isolates marginal communities (ibid.). The zoning techniques is per se not problematic, but the type of zoning and the way it was applied (Carmona, Heath, Oc & Tiesdell, 2003; Talen, 2012). Krier (1990 cited in Carmona, Heath, Oc & Tiesdell, 2003, p.181) illustrates two types of zoning; 'inclusive' zoning "*all is permitted and promoted that is not strictly forbidden*", 'exclusion' zoning based on environmental 'nuisance' or incompatibility (bad neighbourhood) and different activities can occupy the same area. Kropf (1996 cited in Carmona, Heath, Oc & Tiesdell, 2003, p.181) argues that defining of the content of zoning ordinance is more important than the controlling area by particular regulations, while other researchers suggest shifting from 'use' to 'form' (*e.g. from functional to 'typo-morphological' zoning*)" (Moudon, 1994 cited in Carmona, Heath, Oc & Tiesdell, 2003, p.181). Because zoning relies on the separation of uses, vibrant mixed use communities are hard to create. The functional zoning approaches have been criticised by Jacobs (1961), she exposes the importance of the liveability and vitality of the central parts of the cities, considering the diversity into the city's streets and districts.

According to Talen (2012), zoning has resulted in deconstruction of the traditional socially-mixed community to direct various social strata to certain areas in the city. The size

of lots, accessibility, restrictions of building and other zoning provisions have affected the distribution of people and demography of new urban areas. One of the tools to regulate land use planning is the technique of a comprehensive plan as the basis for urban planning practices. All zoning and other activities allocating on development plans should be consistent with the aim and the purpose of the comprehensive plan, which is dealing with land use in the form of zoning and subdivisions regulations.

4.3.2. Instruments

Usually, cities are required to have documentation according to national or state laws. These documentations are range from ‘general plan’, ‘comprehensive plan’, ‘master plan’, ‘local plans’ or any other means such as pictured documents to set out the vision of the future developments. These plans usually start with the main goal for the development, and after that outlining the policies in many concerned areas to achieve the visions (Wheeler, 2012). Typically, these plans contain maps illustrate current and future land use, transportation network, parks and green corridors, and in more details the layout of buildings and built-up area ...etc.

Development plans can be understood and interpreted as agendas, policies, designs and strategies for physical development, which enfolded in a “*two-dimensional layout of the physical form of the city*” (Neuman, 1998 cited in Goodfellow, 2013, p.85). Plans at three or four spatial scale may guide urban development at any location, which consists of regional plans, municipal plans, area or neighbour plans and site plans. These plans generate an interlocking legal framework that can steer development in more sustainable directions.

Cities adopt a master plan for controlling future urban growth and supplying infrastructure through zoning and subdivision regulations to promote the general welfare of the community. In using the master-plan, it is important to recognise policies, strategies and recommendations contained the plan as the guidelines and targets for city development in future. The master plan should not be a stiff blueprint but is rather a comprehensive policy direction which will be further developed and shaped by the future factors over time. This development plan should be considered as a flexible tool, and to be adapted and modified over time by the urban planning authorities of the city to remain viable and relevant for their residents. The master-plan has two basic purposes to achieve; *firstly*, provides an essential legal foundation for land use regulation such as zoning and subdivision control. *Secondly*, the master-plan of the city should represent a future unified vision for a community, reflects the aspirations of its residential, and establishes certain actions to fulfil that visions in the long-term in the future. After the legalisation of the master-plan of the city and its final approval, it becomes a tool for managing urban development in the city.

The appearance of any new development initiatives and its compatibility to surrounding built environments are relevant to the consideration of the planning application. The planning instruments can provide major transportation routes, different densities of population and the built-up area in various districts and other spatial elements of the urban environment. In order for the plan to be more effective in applying the goals and objectives, it has to be linked to implementation tools (Wheeler, 2012). The mechanisms to achieve that include:

- Zoning codes (which govern the allowable form and types of development)

- Subdivision regulations (which specify how large parcels of land can be divided into smaller ones and what parks, roads, schools and other public amenities developers must provide).
- Infrastructure, equipment and building construction programs (often known as ‘capital improvement programs’)
- Urban design guidelines
- Various legal, regulatory, or incentive changes

According to Wheeler (2012), the relation between planning and implementation is usually loose and therefore cities and regions fail to apply planning goals and desired urban form and structure because of a lack of follow-through by staff, political leaders and other public stakeholders.

Researchers have pointed out that no more the conventional planning process is effective in bringing about sustainable urban development, rather a new planning process has to be adopted which more flexible and comply with the new changes in cities. Strategic planning is one of the new instruments as opposed to conventional planning approaches. The first tends to be selective, action-orientated and based on an assessment of physical, social and economic strengths and weaknesses, while the latter comprehensive, top-down, centralised and based solely on physical strengths and weaknesses (Narang & Reutersward, 2006; UN-Habitat, 2007). Urban strategic planning is not a fixed and static process; rather it is a dynamic, must be changed to respond to the changing situations in the city. The following attributes when working and combined, define a successful strategic planning process (UN-Habitat, 2007) - see Box 4-1.

- It is oriented towards the future and attempts to foresee how the world could be different five to future are likely to look like.
- It is flexible and oriented towards the larger picture. It aligns the city with its environment, setting a context for meeting goals and providing a framework and direction to achieve the city’s desired future.
- It creates a framework for competitive advantage through thorough analysis of the city, its internal and external environment, and it’s potential. This enables cities to respond to the emerging trends, events, challenges, and opportunities within the framework of the vision and mission they have developed through the strategic planning process.
- It is a qualitative, idea-driven process. It integrates “soft” data that are not always supported quantitatively, such as experiences, intuition and ideas, and involves stakeholders in the on-going dialogue with the aim of providing a clear vision and focus for the city.
- It allows a city to focus, because it is a process of dynamic, continuous self-analysis.

Box 4-1: Attributes of Strategic planning

Source: Own construct based on UN-Habitat, 2007, p.7

The basic principles of urban strategic planning are promoting the model of governance for public policies which constitute citizen participation and cooperation between private and public actors of the city. It helps growing cities to respond to uncertainties, and manage change and improve the quality of life (Narang & Reutersward, 2006; UN-Habitat, 2007). In other words, employing urban strategic planning requires a shift from old fashions of regulations, methods, organizations and institutional structure to more flexibility in decision-making.

4.3.3. Urban Design Principles

Urban design deals mainly with the process of managing and controlling the implementation of the physical outcome of the planning practices. It is a multidimensional concept steers the physical transformation of the development within the urban area (Barnett, 1982; Rowley, 1994; Gosling, 2002 cited in Cooper, Boyko, Pemberton & Cadman, 2009, p.5). It is the art of creating a place for people, and the way places work and matters related such as safety, aesthetic. *“It concerns the connections between people and places, movement and urban form, nature and the built fabric, and the processes for ensuring successful villages, towns and cities”* (DETR, 2000, p.8). Urban design *“draws together the many strands of place-making environmental responsibility, social equity and economic viability, for example - into the creation of places of beauty and distinct identity. Urban design is derived from but transcends related matters such as planning and transportation policy, architectural design, development economics, landscape and engineering”* (Llewelyn-Davies, 2007, p.10).

Urban design is seen as a part of the national policy. The local authorities must be able to interpret the ideas to suit the local context. The private sector and other local stakeholders should be given enough space to bring their insights to each particular situation to shape specific urban design for that area (DETR, 2000). The community participation within the planning system can help the design of urban form which is safe, accessible and pleasant to use (Cooper, Boyko, Pemberton & Cadman, 2009).

According to DETR (2000), there are several ways in which the local authorities can develop policies into clear urban design ideas for particular areas and sites, concerning specific planning and design issues. The tools which are considered as urban design frameworks guide particular areas, while development briefs guide to particular sites and design guides specific topics.

Urban design should create the urban form and structure and spatial organisation in ways that promote sustainable environmental, economic, social development (Ranhagen & Groth, 2012) and geographically balanced development, which decrease the influence on the local and global environment and producing a healthy quality of life in cities (Lloyd-Jones, 2004). The main purpose of urban design is to make the cities more socially inclusive, economically prosperous and environmentally friendly. According to Moughtin (2003), the requirement of sustainable development meets and closely related to the principles of urban design. Applying the principles of good urban design at different scales namely; neighbourhood, quarter, city and region support the notion of sustainable urban development— see Table 4-1.

The objectives of urban design should be tailored to the local context. Development plan policies and other supplementary planning guidance should reflect local needs and opportunities. *“Design policies cannot take a standard format or be imported from another area. Everything hangs on how well a local authority draws up, and then uses, the tools it has available to foster better urban design”* (DETR, 2000 p.36). Urban design has to be based on the study of socio-economic conditions of the city and should be a comprehensive strategy for urban spaces, with particular concentration on land use, morphology, landscape and transportation to improve city’s efficiency and vitality through creating sustainable urban form.

Table 4-1: Criteria of Urban Design

No.	Criteria	Indicators
1	CONTEXT <i>How does is the development responds to its surroundings?</i>	<ul style="list-style-type: none"> ➤ The development seems to have evolved naturally as part of its surroundings ➤ Appropriate increases in density respect the form of buildings and landscape around the site's edges and the amenity enjoyed by neighbouring users ➤ Form, architecture and landscaping have been informed by the development's place and time ➤ The development positively contributes to the character and identity of the neighbourhood ➤ Appropriate responses are made to the nature of specific boundary conditions
2	CONNECTIONS <i>How well is connected is the new neighbourhoods?</i>	<ul style="list-style-type: none"> ➤ There are attractive routes in and out for pedestrians and cyclists ➤ The development is located in or close to a mixed use centre ➤ The development's layout makes it easy for a bus to serve the scheme ➤ The layout links to existing movement routes and the places people will want to get to ➤ Appropriate density, dependent on location, helps support efficient public transport
3	INCLUSIVITY <i>How easily can people use and access development?</i>	<ul style="list-style-type: none"> ➤ New homes meet the aspirations of a range of people and households ➤ Design and layout enable easy access by all ➤ There is a range of public, communal and/or private amenity spaces and facilities for children of different ages, parents and the elderly ➤ Areas defined as public open space that has either been taken in charge or privately managed will be clearly defined, accessible and open to all. ➤ New buildings present a positive aspect to passers-by, avoiding unnecessary physical and visual barriers
4	VARIETY <i>How does the development a good mix of activities?</i>	<ul style="list-style-type: none"> ➤ Activities generated by the development contribute to the quality of life in its locality ➤ Uses that attract the most people are in the most accessible places ➤ Neighbouring uses and activities are compatible with each other ➤ Housing types and tenure add to the choice available in the area ➤ Opportunities have been taken to provide shops, facilities and services that complement those already available in the neighbourhood
5	EFFICIENCY <i>How does the development make appropriate use of resources, including land?</i>	<ul style="list-style-type: none"> ➤ The proposal looks at the potential of higher density, taking into account appropriate accessibility by public transport and the objectives of good design ➤ Landscaped areas are designed to provide amenity and biodiversity, protect buildings and spaces from the elements and incorporate sustainable urban drainage systems ➤ Buildings, gardens and public spaces are laid out to exploit the best solar orientation ➤ The scheme brings a redundant building or derelict site back into productive use ➤ Appropriate recycling facilities are provided
6	DISTINCTIVENESS <i>How do the proposals create a sense of place?</i>	<ul style="list-style-type: none"> ➤ The place has recognisable features so that people can describe where they live and form an emotional attachment to the place ➤ The scheme is a positive addition to the identity of the locality ➤ The layout makes the most of the opportunities presented by

		<p>existing buildings, landform and ecological features to create a memorable layout</p> <ul style="list-style-type: none"> ➤ The proposal successfully exploits views into and out of the site ➤ There is a discernible focal point to the scheme, or the proposals reinforce the role of an existing centre
7	<p>LAYOUT <i>How does the proposal create people-friendly streets and spaces?</i></p>	<ul style="list-style-type: none"> ➤ Layout aligns routes with desire lines to create a permeable interconnected series of routes that are easy and logical to navigate around. ➤ The layout focuses activity on the streets by creating active frontages with front doors directly serving the street ➤ The streets are designed as places instead of roads for cars, helping to create a hierarchy of space with less busy routes having surfaces shared by pedestrians, cyclists and drivers ➤ Traffic speeds are controlled by design and layout rather than by speed humps ➤ Block layout places some public spaces in front of building lines as squares or greens, and some semi-private space to the back as communal courts
8	<p>PUBLIC REALM <i>How safe, secure and enjoyable are the public areas?</i></p>	<ul style="list-style-type: none"> ➤ All public open space is overlooked by surrounding homes so that this amenity is owned by the residents and safe to use ➤ The public realm is considered as a usable integrated element in the design of the development ➤ Children’s play areas are sited where they will be overlooked, safe and contribute to the amenities of the neighbourhood ➤ There is a clear definition between public, semi-private, and private space ➤ Roads and parking areas are considered as an integral landscaped element in the design of the public realm.
9	<p>ADAPTABILITY <i>How will the buildings cope with change?</i></p>	<ul style="list-style-type: none"> ➤ Designs exploit good practice lessons, such as the knowledge that certain house types are proven to be ideal for adaptation ➤ The homes are energy-efficient and equipped for challenges anticipated from a changing climate ➤ Homes can be extended without ruining the character of the types, layout and outdoor space ➤ The structure of the home and its loose fit design allows for adaptation and subdivision, such as the creation of an annexe or small office ➤ Space in the roof or garage can be easily converted into living accommodation
10	<p>PRIVACY AND AMENITY <i>How does the scheme provide a decent standard of amenity?</i></p>	<ul style="list-style-type: none"> ➤ Each home has access to an area of useable private outdoor space ➤ The design maximises the number of homes enjoying a dual aspect ➤ Homes are designed to prevent sound transmission by appropriate acoustic insulation or layout ➤ Windows are sited to avoid views into the home from other houses or the street and adequate privacy is affordable to ground floor units. ➤ The homes are designed to provide adequate storage including space within the home for the sorting and storage of recyclables.
11	<p>PARKING <i>How will the parking be secure and attractive?</i></p>	<ul style="list-style-type: none"> ➤ Appropriate car parking is on-street or within easy reach of the home’s front door. ➤ Parked cars are overlooked by houses, pedestrians and traffic, or stored securely, with a choice of parking appropriate to the situation. ➤ Parking is provided communally to maximise efficiency and accommodate visitors without the need to provide additional

		<p>dedicated spaces</p> <ul style="list-style-type: none"> ➤ Materials used for parking areas are of similar quality to the rest of the development ➤ Adequate secure facilities are provided for bicycle storage
12	<p><i>DETAILED DESIGN</i> <i>How well thought through is the building and landscape design?</i></p>	<ul style="list-style-type: none"> ➤ The materials and external design make a positive contribution to the locality ➤ The landscape design facilitates the use of public spaces from the outset ➤ Design of the buildings and public space will facilitate easy and regular maintenance ➤ Open car parking areas are considered as an integral element within the public realm design and are treated accordingly ➤ Care has been taken over the siting of flues, vents and bin stores

Source: Adopted from Comhshaol, Oidhreacht Agus Rialtas Áitiuil, 2008, p.10

4.4. Participation of Actors

Three main actors are involved in the process of production and shaping the urban built form of the city are; public actors who are decision-makers (political power) and public officials (managers in governmental implementation bodies), private sector (developers and investors) and civil society (residents’ representatives). The civil society must act in urban decision-making processes through active communal participation. The integration of a wide spectrum of actors and investing their knowledge within the decision-making process provide a better understanding of the mechanisms of urban form and structure production in the city. Actors have a different role in creating and formation of the urban fabric in any context. The differential of distribution of power and conflicting roles of the different actors in urban design process influences on different aspects of the urban form and structure (Punter & Carmona, 1997).

Participatory planning empowers communities and ensuing better design outcomes that are more responsive to the diverse needs of the different groups. Participation also ensures the relevance of plans in case of limited resources and also can increase effectiveness (UN-Habitat, 2010). Good governance is an essential precondition for sustainable development and the only mean for balancing the power and influence in urban planning and development process. It is important to note that there is no universally accepted and applicable model of good governance practice to be adopted in every context. Therefore, the governance practice will be different in the varied socio-cultural conditions and circumstances, and as well as within the same country (European Commission, 2011). Wilde, Narang, Laberge and Moretto (2009) refer to the governance as the procedures and mechanisms to formulate and practice the system of public policy decisions. In the urban context, governance refers to the system of decision making in a town or city and encompasses government, civil society and the private sector as the main actors involving in taking decisions regarding any development initiatives. UN-Habitat (2002b) depicts governance as the set of procedures, machinery and associations, through which public and civil societies exercise their citizenry rights, commitments and compromising their dissimilarities. Governance in a broad view can be understood as defined by Newman (2001) which refers to different ways of solving common problems, organisational, social, national and international problems. This definition refers to the way

that power and authority, patterns of relationship, rights and obligations has been practised in solving problems.

Good governance eradicates corruption, promoting decentralisation, creates opportunities for employment and sustaining the environment, while bad governance associated with restrict centralisation in certain institutions and uncountable decision making. Advancing good governance in cities is highly depending on the progress made at different levels; national, regional and local (European Commission, 2011). “*Good governance is precondition for achieving sustainable development at least at local level*” (Evan, Joas, Sundback & Theobald, 2005, p.2). Good governance is attended with a more transparent and accountable system of taking decisions. UNDP (1997) mentions a range of the characteristics of good governance – see Box 4-2.

- Participatory & Sustainable
- Legitimate and acceptable to the people;
- Transparent & Accountable;
- Promoting equity and equality;
- Able to develop the resources and methods of governance
- Able and willing to promote gender balance;
- Tolerates and accepting diverse perspectives;
- Able to mobilise resources for social purposes and Strengthen indigenous mechanisms;
- Operates by rule of law and Efficient and effective in the use of resources;
- Engenders and commands respect and trust;
- Able to define and take ownership of national (local) solutions;
- Enabling and facilitative and Regulatory rather than controlling;
- Able to deal with temporal issues; and Service-oriented

Box 4-2: Characteristics of good governance
Source: Adapted from UNDP, 1997, p.17

4.4.1. Public Sector (State)

The state is responsible for developing effective political and legal environment, a vigorous system of public sector institutions for ensuring the provision of appropriate services which can be achieved by promoting good urban form. This must be the central concern of the local government which is mainly and increasingly affected by the central urban policies of the government. This requires a democratic, dynamic, transport and efficient local government system, which includes executive, legislative, judicial and regulatory agencies. This task is not easy to perform which constraint by a series of challenges, among others;

- To protect the vulnerable groups of population and to alleviate the severe conditions of poverty,
- To foster social, ethnic and cultural integration and harmony,
- To facilitate the participation of the population,
- To play an active role as a promoter and enabler of local economic development and the creation of a conducive economic environment, and
- To promote sustainable environmental development (European Commission, 2011)

4.4.2. Private Sector (developers, Investors and Contactors)

The private sector is made up of people and companies whose main purpose is to gain a profit. Therefore, it needs encouragement environment for the market place and private enterprises. The private sector creates jobs, provides income, produce and delivers goods and services. It is the partnership with local government in mobilising financial resources and facilitates the provision and /or management of public services with private enterprises (European Commission, 2011). The private sector, especially the developers and investors have a great impact on formation urban form in the urban areas, through imposing different design prototypes in the case of the weak governmental legal framework (Ibrahim & Shaw, 2009).

4.4.3. Civil Society (Civil Society Organisations and Residents)

Civil society encompasses individuals and organisations. These are maybe formally organised or not interacting in different spheres of social, economic and political life obligated by formal and informal regulations (European Commission, 2011). The role of civil society organisations (CSOs) in urban development is essential since they represent key political actors in the local society in urban areas. They can protect the rights and interests of citizens and mobilise the poor and other disadvantages. Normally, civil society works as an intermediary organisation between the individuals and state. These organisations are the basic source of information about citizens' demands, needs and expectations (UN-Habitat, 2009). This can give an impression to the citizens that they contribute to shaping their built environment. Political leaders and local authorities today recognise that a sound urban development requires the development of a vibrant civil society.

4.5. Sustainable Urban Planning

Urban planning is a technical and political process concerned with the utilisation of land and design of the urban environment. According to Hall (2002, p.3), urban planning “*can refer to planning with a spatial component, in which the general objective is to provide for a spatial structure of activities which in some way is better than the pattern that would exist without planning*”. While He et al (2011) refer to urban planning as a multidisciplinary and comprehensive framework aiming to balance the physical organisation of space and regional development with regard to the overall strategy of the development.

The significance of sustainability for urban planning has reflected in planning theory, practices and education (Staley, 2006; Kelly, Selman & Gilg, 2004). The concept of sustainability is normative in urban planning theory and practices. Urban planning as a product of planning process promote sustainability as plans, policies, programs across all the private and public activities (Kelly, Selman & Gilg, 2004), and sustainability should incorporate into both planning policies and their implementation which reflects on the outcome (Jepson, 2001). The importance of sustainability and urban planning is increasing due to the nature of planning which produces development as an outcome.

Urban planning is an essential tool to achieve physical sustainable urban development. Sustainability and urban planning share many commonalities, moreover, they are complementary because sustainability can provide conceptual context such as; theories, goals and objectives for the activity of urban planning. According to Jepson (2001), sustainability concept and the field of urban planning are intertwined and mutually relevant.

Hald (2009) indicates that discrepancies and any negative impacts can be avoided in any urban context by adopting sustainable urban planning which balances the connections between human activities and natural environment as well as the interactions associated with these connections. Furthermore, conflicts between urban development and sustainable development can be directed and managed by sustainable urban planning (Pinson, 2004).

Inefficient urban planning impacts on the built environment through creating urban forms with little concerns to social, economic, environmental and aesthetical dimensions. Sound urban planning and urban design produce and manage physical development by promoting the proximity and accessibility of different urban functions and encourages mixed use, public transportation, walking and cycling. Urban planning should consider the following spatial issues in order to promote physical urban development- see Box 4-3.

- Accurate locating, optimal design and planning for new towns;
- Surrounding the city with the productive ecosystems or those which are able to absorb and degrade human waste and sewage;
- Regular distribution of cities in space based on a hierarchy and according to the capacity of ecological context of each city (Land Spatial Planning);
- Considering the specific situation of the environment as a main factor in the development
- Using the integrated system of public transportation;
- Producing the building materials with minimal destruction and damage to the environment;
- Determining standards of urban design and planning to reduce air, noise and visual pollution;
- Planning and design of biological useful spaces to a better performance;
- Distributing balanced spaces of public facilities in urban areas;
- Recycling and reusing of the unused and destruction spaces;
- Careful attention to the mixed use and using of multipurpose spaces;
- Compressing cities fabric to reduce distances and saving in energy consumption;
- Increasing density based on precise study of amount, identification and definition of the density distribution in urban space;
- Taking into consideration the importance of walking passages and spaces;
- Creating suitable ways for bicycle traffic and encouraging its use;

Box 4-3: Spatial consideration of urban planning to promote physical sustainable development

Source: Own construct based on Ahmadi & Toghyani, 2011; EC, 2011

4.6. Conclusion

The legal framework of planning varies from country to country which can be translated through the applicable policies, laws and regulations and the institutional arrangement, these may differ in the same country because of the variation in social, economic, environmental and political factors.

Legal instruments in urban development and planning are the means of defining the right, responsibility, obligations and procedures. These specify the formalities among the planning institutions and other actors in urban development and management.

The task of urban design and urban planning is to enable and enhance urban sustainability through maximising of city's advantages and minimising the disadvantages. Urban planning and urban design are essential tools in promoting sustainable urban development in the urban context through shaping and controlling the development outcome. Without a clear connection between the rules and physical outcome, the urban form of the city remains a field for testing the regulations.

Three main group actors namely; public, private and civil affect the formulation of the urban form and structure and directing the physical urban development. Their effectiveness varies depends on the distribution of the responsibilities and balancing the power which can be achieved through good urban management and good urban governance.

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Chapter Five: Understanding Urban Form and Structure

5.1. Introduction

All human settlements without exception are subject to evolution, changing and transformation during the time. Cities have intrinsically fractal elements and properties that are in touch with different living systems and display diverse degrees of forethought and perceptive design in their layout and functions. Therefore, urban form as a concept is considered a vessel in which all human actions and responses are interacting through complex systems and are manifested at the end as a spatial entity with various characteristics. These actions are undoubtedly influenced by natural and man-made determinants. The determinants have a great influence on the form, structure and morphology of the cities. Adopting new development and redevelopment initiatives to accommodate increased population growth has caused cities to expand spatially and has given unique characters to form and structure of cities.

The urban form has been studied by different disciplines with various approaches, which in turn have generated different views and perspectives in defining the term. At the same time, there is a huge overlapping between the area of investigations of urban form, urban morphology and urban structures which make it difficult to outline precisely the area of intervention of each of them.

Urban planners have traditionally been concerned with searching and proposing ideal or optimal physical forms of urban areas which uplift the quality of life. Usually, this involves envisaging certain combinations of the characteristics of settlement such as; built form, size, density and urban layout with other urban functions. To consider the urban form and structure of urban areas needs to put practical significance on studying and investigating the elements of urban form and structure in the context of growing cities to draw solutions and guidelines for the current situation and future developments.

The following sections try to review different definitions of urban form, urban structure and urban morphology and the area of intervention. At the same time discuss the main elements of urban form which have a direct effect on shaping and defining physical urban development.

5.2. Perspectives in Understanding Urban Morphology, Form and Structure

Urban form has been investigated by a range of disciplines, each having different scope and approach to understand and establish different definitions and conceptual frameworks. Clinton, Ewing, Knaap and Song (2008) point out that perspectives on the urban form can be categorised from different points of view such as; economic structure, landscape ecology, community design, transportation planning and urban design. These categories have provided a framework for further discussion in the area of urban form, therefore, the term urban form has been defined from different points of view.

There is an ambiguity in defining and using the terms of urban form, urban structure and urban morphology and the consensual definitions are lacking. Often, these terms are interchangeably used to mean same things or with great overlapping in the area of specialisation despite that urban form is one of the fundamental concepts in urban studies, but at the same time, it is the elusive one. Urban form is a difficult concept because it comprises

many urban phenomena (Sorensen, 2011). In search of a clear and explicit definition of urban form, Bourne (1982, p.29) encounters an “*immense diversity and frustrating inconsistency*” in the way that researchers have used the term of urban form and urban spatial structure.

In the following sections, the research tries to shed light on the most usable definitions of urban form, urban structure and urban morphology.

5.2.1. Urban Morphology

Urban morphology is “*the study of the form and shape of settlements*” (Carmona, Heath, and Oc, & Tiesdell, 2003, p.61), more specifically, it is an investigation and spatial expression of the urban structure and form, and the systematically way in which all physical components related and interacted (Vance, 1990). It is believed that the city can be read and analysed through its physical form (Moudon, 1997). Land uses, urban blocks, building structures, plot pattern and street pattern are considered to be the most important elements of studying the morphology of urban settlement (Conzen, 1960).

Occasionally, urban morphology referred to as the ‘urban structure’ or ‘urban fabric’, investigating certain shape or aspect of the built environment and dealing with the configuration of buildings and their particular features at different scales (Adolphe, 2001). American Planning Association (APA, 2006) refers to urban morphology as a study of the city and concerns to analysis the evolution, transformation and dissecting different components of the urban fabric in the city. The city is the accumulation and integration of different factors that have helped to shape and mould its characteristics. Mugavin (1999, p.99) indicates that the domain of urban morphology represents through “... *description and analysis of town or city as place and form [...], identification of isomorphic patterns between physical fabric and institutional regime*”, while Moudon (1997) explains that urban morphology focuses on tangible results of social and economic forces in the city. Also, studies the outcomes of idea and intentions as they take shape on the ground. Topçu and Kubat (2012) give a broad definition to urban morphology and they describe it as an approach that can provide an understanding of the urban form through its creation, transformation process, spatial structure and the character of the settlements in addition to the analysis of development process and the essential elements which compose and outline the settlement. According to (Madanipour) “*urban morphology is the systematic study of the form, shape, plan, structure and function of the built fabric of towns and cities, and of the origin and the way in which this fabric has evolved over time*” (1996, p.54).

Based on the following definitions, urban morphology can be considered as a systematic way for investigating and determining the transformation process, effects and historical roots of spatial and functional structures of those elements which constitute urban form.

5.2.2. Urban Form

Urban form directly affects habitat, built environment, ecosystems, fragmentation of natural covers, and its definition is greatly influenced by the approach in which undertakes. It is worth to review ranges of definitions and how it is spatially interpreted.

However, the urban form itself is considered as a property of a city and it is in static in a given point in time, while urban growth is referred as a dynamic process which changes urban form (Schwarz, 2010). According to Kropf (1998) forms relatively change slower and more stable over a short time, while activities tend to be more changeable and are not static during a

short time. Urban form as a multidimensional entity reflecting human concerns and environmental aspects through its physical build features which are considered long-lasting aspects of any city such as; layout, order, geometry, language, pattern, landscape and fabric (Kostof, 2004). The urban form of a certain context is the outcome of many of factors which have their influences such as, topography, demographic, socio-economic, development and previous bids during the age of the city (Batty & Longley, 1994). It is defined as the spatial distribution model of human activities in a certain point of time (Anderson, 1996 cited in Mobaraki, Mohammadi & Zarabi, 2012, p.2), moreover, urban form defined in term of its spatial configuration such compact versus dispersed or single versus multi-nuclei.

Urban form can be referred as the spatial configuration of fixed elements of the urban settlement represents by its spatial patterns of land uses and densities including of transport networks, and it can be depicted as spatial patterns of human activities in specified point in time (Anderson, Karangelou & Miller, 1996). Bently and Butina-Watson (1990) define urban form as “*the physical layout and design of the city taking into consideration density, street layout, transportation and employment area and other urban design issues*” (P.67). Board of the city of Redwood defines urban form as it “*... refers to the physical structures and infrastructure that influence how we experience an area, including street design and the circulation system, the size and shape (or “massing”) of buildings, and how accessible a certain area is*” (2011, p BE-08). Whyte (1968, cited in Batty & Longley, 1994, p.42) sums up this confusion about the urban form and says, “*“the word form’ has many meanings, such as shape, configuration, structure, pattern, organisation and system”*. Moreover, Harvey (1985) says that diversity in the definitions of urban form emanated from the fact that urban fabric is the artefact of human being which include both physical and social aspects.

The urban form reflects the changes that the city has gone through, urbanisation, development and redevelopment process or formation of new suburban nodes and satellite towns. Dempsey et al (2010) explain that urban form can be analysed through its physical aspects (e.g. size, shape, scale, block structure layout, building type, and open space) and other non-physical aspects (e.g. density, land use pattern, social relationship). Urban form shapes urban flows and process and considered as determinants of enhancing the urban quality of life, liveability, efficiency and betterment of public health (Batty & Longley, 1994). This required to investigate how the urban form created and evolved, and to understand the historic concepts that have resulted in current outcomes and to enhance better integrating into subsequent development initiatives (Vance, 1990).

Generally, based on the above mention definitions urban form refers to the spatial characteristics of the city which embodies its size, shape, density, plot divisions, urban grains, the layout of urban blocks, land use pattern, settlement configuration and development patterns as tangible elements. In addition to intangible elements such as population density, aesthetical features, social relationship and traffic flow of pedestrian, freights and transportation means, and it can be analysed and investigated in different spatial resolutions.

5.2.3. Urban Structure

The term “urban structure” is ambiguous, comprehensive and abstract. It is related to the physical characteristics of buildings, streets and open spaces, and it can be realised at different levels of spatial resolution. It refers to the order or arrangement of buildings, streets, open

space, landscape and development blocks which constitute urban area, and represents the interrelationship between all these mentioned elements, rather than concentrating on their particular characteristics that joint elements together to make up a place. Urban structure applies equally to the centre of city, suburb, city region, metropolitan and the village (Llewelyn-Davies, 2007). It must be understood in historical perspective since its elements are subject to continuous replacement and transformation (Moudon, 1997). Bently and Butina- Watson (1990) explain that “*urban structure describes the arrangement of land use their access and connectivity in urban areas*” (p.67). In the same way, Batty and Longley (1994) describe the urban structure as the arrangement and organisation of land use, and as a spatial structure which concerns to the arrangement and manifestation of public and private spaces and their access and connectivity in an urban area. Zheng, Ying, Song and Li (2012) define urban structure as “*the relationship among basic element of the city, such as the form and the manner of their interaction, the economic structure, residential structure and employment structure and so on*” (p.100). Apart from physical characteristics, urban structure studies social classes and its population characteristics and economic distribution of activities shape urban structure (Gonzalez & Medina, 2004).

A city can be structured in accordance to the perspective in which investigate and analyse (e.g. social, economic, political, cultural, imaginary, human ecology, spatial configuration), each of these perspectives has many dimensions such as; spatial, institutional, organisational. The structure of any urban settlement is a multi-layered concept and can be defined through understanding the way in which different linkages work between the elements of the urban area. It is believed that each settlement has a certain structure with an order which can be defined through various spatial characteristics. The order influences by social, economic, historical, cultural, institutional, political and geographical aspects of that area and manifests quite differently from other areas. It is evident from the above definitions that there is a huge mixing between urban form and urban structure area of investigation.

5.2.4. Area interventions of Urban Morphology, Urban Form and Structure

Based on the above definitions and discussions in sub-sections (5.2.1, 5.2.2 & 5.2.3), it is clear that the area of investigating morphology, urban structure and urban form exposes huge overlapping and ambiguity. Despite that, one can conclude that urban form is largely concerning the static entity of the city, while the urban structure is more concerning to study the relations between the elements of urban form. The area of intervention of urban morphology, urban form and urban structure could be summarised as follow-see Table 5-1.

Table 5-1: The area of intervention of urban morphology, urban form and urban structure

Urban Morphology	Urban Form	Urban Structure
<ul style="list-style-type: none"> • Studies the form of human settlement & the process of its formation, evolution, and transformation across time. • Investigates spatial structure of the human settlement & its characteristics, components, patterns & the process of its development. 	<ul style="list-style-type: none"> • Studies spatial elements of physical design, the layout of settlement & its components. • Describes physical infrastructure & transport system. 	<ul style="list-style-type: none"> • Studies the arrangement of land use in urban settlement. • Investigates the relationships, linkages between urban form elements & its underlying interactions of people, freight & information.

Source: Own construct

The area of investigation of urban form, urban structure and urban morphology fields are not distinctive and there is no clear-cut borderline in between these concepts. Therefore, in the course of this study, the term urban form and structure is used to refer to the combinations of the terms of urban form and urban structure as done by (Frey, 2005).

5.3. Urban Form and Structure at Different Spatial Scales

Based on the previous definitions it is apparent that urban form and structure is related to scale and has portrayed as the “*morphological attributes of an urban area at all scales*” (Williams, Burton & Jenks, 2000, p. 7), and “*It can be considered at different scales: from regional, to urban, neighbourhood, ‘block’ and street*” (Williams 2014, p.6). Also, Alford and Whiteman (2009) confirm that the city’s physical characteristics can be investigated at two scales: at a macro and micro-scale. The macro-urban form of a city depicts the overall form and type of the city, which deals with the city and its suburbs and fringes, in addition to the patterns of development which can be investigated in term of its dispersal, compactness and density (Dempsey et al, 2010). While micro-urban form describes as the characteristics of urban form and structure at the neighbourhood or district scale such as building density, street patterns and urban design issues. Moudon (1997) confirms that urban form and structure can be studied and analysed at different levels of resolutions and two scales, four of these levels are common and recognised by researches namely; at micro-scale are building/lots and street/blocks and at macro-scale are city and region. Therefore, any investigation can carry on at different scales and levels in the city.

5.4. Determinants of Urban Form

Two determinants of urban form have been mentioned by Kostof (2004) and Morris (1994) which confine urban form; natural and man-made determinants influencing the form and structure of planned and unplanned cities.

Natural determinants – the conditions of place -such as mountain range, rivers, sea coast which could limit and determine the expansion and growth of the city (Morris, 1994). Geography of any location has three major determinants namely; topography, climate and availability of materials for construction purposes on shaping any settlement. The topography of any area has an underlying effect on the establishment or growing of any urban settlement. It is a crucial factor in the creation and identifying of urban dimensions (Morris, 1994), and it influences on shaping street networks, blocks, alleys, building’s location and the overall settlement layout and patterns. Climate is another determinant has its influence in addition to mentioned elements on the direction of buildings as a unit and the settlement as a whole. It is evident, that settlements on arid climate have different urban forms than in rainy and wet climate especially in term of building design and construction materials which give different building styles and architecture.

Man-made determinants are such trade-economy, religion, political and social power that have their effects on shaping urban form and structure in any settlement. This kind of determinants refers to the effects of human as individual and society and their interventions as a significant factor in shaping the urban form of any settlements. The man-made determinants consist of religious, social, political, commercial, urban infrastructure, city legislations, urban transport, urban planning system, aesthetics and defence. All the mentioned determinants

have a clear influence in shaping the streets, block layout, open spaces and building types and the geometry of city (Kostof, 1992; Morris, 1994), and these determinant's effects and influences are differing from one period to another and mould the shape and the form of settlements to manifest in different ways. For instance, Rykwert (1989) concludes the main factors affected city form in ancient cities were symbolism in terms of mythical and ritual, and the cities were organised according to the divine laws.

5.5. Identifying Elements of Urban Form and Structure

The word elements may refer to the components, principles or ingredients which give specific definitions and descriptions of the context of urban form. According to ISUF (International Seminar of Urban Form)⁷, there is an agreement that the city or town can be analysed and read through its physical form. Further, there is almost a consensual acknowledgement that;

- Urban form is defined by three principles physical elements which are buildings, plots or lots, open spaces and streets.
- Urban form can be understood at different spatial levels namely; buildings/ lot, street/block, the city and region.
- Urban form can be only understood historically since its elements are subject to continuous transformation and replacement (Moudon, 1997).

To get a better understanding of urban form and structure, it is necessary to recognise the basic elements of urban form and structure, which have an important role in identifying key solutions to the built environment. The urban form of urban settlements can be investigated through analysing several key elements which considers as land use, building structure, plot pattern to be the most important elements that characterising urban fabric (Conzen, 1960 cited in Carmona, Heath, Oc, & Tiesdell, 2003, p.61; Krier, 1984). Scheer and Scheer (2002) list eight broadly accepted elements of sustainable urban form, namely; compactness and density of urban form, balancing land use, preservation of existing built form, open space availability, parcel size, size of the building, a mix of the building type. Therefore, elements can range from very small localised scale elements such as fenestration, façades and building materials, to at a broader scale such as housing type, street type and their spatial arrangement or layout (Dempsey et al, 2010).

The literature on the urban form has put a great emphasis on physical urban elements; recently, there is much emphasis on non-physical elements. The urban form should be understood through a mixture of physical and non-physical components (Dempsey et al, 2010; Lee, 2012). For example, land use, location of facilities, building type, layout and street network considered as physical components, while non-physical components are urban activities, which generated through the interaction between physical components and their inhabitants, such as socio-economic and environmental factors (Lee, 2012), and manifest physically in housing, schools and other services, facilities and infrastructure. Many physical

⁷ - ISUF is the international organization of urban form for researchers and practitioners. It was inaugurated in 1994, bringing together urban morphologists worldwide. It seeks to advance research and practice in fields concerned with the built environment. Members are drawn from several disciplines, including architecture, geography, history, sociology and town planning. <http://www.urbanform.org/>

components applied for measuring and evaluating urban form which is; size, shape, building density, land use, building types, block structure layout, street network and distribution of open space. These components constitute urban form in a certain urban environment and identified on the basis that they claimed to influence sustainability and human behaviour (Dempsey et al, 2010).

The following matrix is drawn to capture main elements of urban form which used as variables for analysing urban form and structure or applied as indicators by different scholars-see Table 5-2.

Table 5-2: Matrix identifying elements of urban form and Structure

Elements of Urban Form & Structure	Scholars
Settlement layout & pattern	Lynch (1980); Bourne (1982); Bently & Butina (1990); DETR-UK (2000); Jenks & Burgess (2004); Scheer & Scheer (2002); Paneri, Castex, Depaule & Samuels (2004); Jabareen (2006b); Bramley & Krik (2005); Alford & Whiteman (2009); Dempsey et al (2010); Board of city of Redwood (2011)
Urban Block	Krier (1984); Conzen (1960); Shirvani (1985); Paneri, Castex, Depaule & Samuels (2004); Bramley & Krik (2005); Mead, Dodson & Ellway (2006); Alford & Whiteman (2009); Dempsey et al (2010); Board of city of Redwood (2011); Krizek, K.J. (2003); Hess et al. (1999); Ibrahim (2008)
Street Pattern	Krier (1984); Conzen (1960); Bourne (1982); Shirvani (1985); Bently & Butina (1990); Jenks & Burgess (2000); Paneri, Castex, Depaule & Samuels (2004); Bramley & Krik (2005); Ewing, Pendall & Chen (2000); Song & Knaap (2004); Hess et al. (1999); Ibrahim (2008)
Open Spaces (Voids)	Krier (1984); Lynch (1980); Shirvani (1985); Jenks & Burgess (2000); Scheer & Scheer (2002); Jabareen (2006b)
Land use	Bourne (1982); Shirvani (1985); Bently & Butina (1990); DETR-UK (2000); Jenks & Burgess (2000); Scheer & Scheer (2002); Bramley & Krik (2005); Handy (2006); Song & Knaap (2004); Holden & Norland (2005);
Traffic Flow	Lynch (1980); Shirvani (1985); Mead, Dodson & Ellway (2005); Handy (2006); Dempsey et al (2010);

Source: Own construct

After reviewing the elements of urban form and structure, it is worth to describe each of these elements, how it is identified, and understood their impacts on the sustainability of urban development in the following sections and subsections.

5.6. Elements of Urban Form and Structure

5.6.1. Settlement Pattern and layout

There is a renewed need and desire to consider what possible patterns of urban form and structure exist in urban areas, and what is the optimal for today's requirements and needs in growing urban contexts.

Settlement pattern at city scale constitutes the layout and the type of development which formed by urban form and structure features and elements such as; land use pattern, density,

patterns of streets, open spaces and pattern of the development. Thus, settlement pattern considers the ground plan of the settlement as two dimensions by overriding the third dimension of building aspects (e.g. height, elevation details and fenestration) and excluding other architectonics of individual buildings and streets like ground materials, street's furniture and fixed infrastructures. The topic of the urban pattern can be delimited “...as firmly or as fuzzily as desired. But in principle, the term urban pattern can be applied at any scale considered to be of ‘urban’ relevance” (Marshall & Gong, 2009, p. 9).

The settlement pattern in term of its spatial characteristics can be categorised into two types; in-situ expansion and enclave expansion: the former is the consecutive expansion around the existing core, and the latter is the development of new towns, separate from the original urban settlements (Chen & Ye, 2014). In in-situ expansion, the category includes ranges of urban development forms which some have been covered by ‘urban sprawl’ such as contiguous suburban growth, leapfrog development, linear patterns of strip development, scattered development, compact and poly-nucleated development. The pattern of the development is the consequences of many factors, social, environmental, economic, technological and legislative.

The overarching concern of sustainability is the key significance of urban settlement patterns, which includes in particular:

- The need to create layouts of urban forms that minimise the demand for energy and carbon, through the creation of urban blocks patterns, mixed use and increasing accessibility.
- Minimising the need for motorised travel, in particular, encouraging walking and cycling, through the creation of street patterns; and
- Increasing the greenery and open spaces, through intensification and compactness.

Planning policies are mostly declared in term of regulations, such as encouraging or prohibition of development of certain types or certain areas. Usually, pattern-related concepts underpin the regulations that created it (Marshall & Gong, 2009). For example, a green belt can be understood as a regulatory policy, which acts as urban growth boundary (UGB); or as the geographical area to which, that policy applies; or to the spatial pattern that results from the applied policy. So, the effect of green belt policy can be understood as a combination of these interpretations; or more precisely, the application of certain regulatory policy to produce the desired pattern.

One of the key challenges concerning the development pattern is urban sprawl (EEA, 2006 cited in Diş, 2014, p.21). Urban sprawl concept is positioned against the ideal concept of a compact city that has high density, centralised development and a spatial mixture of functions and services. It is considered ranges along a continuum of more compact to completely dispersed and scattered development. It “is a matter of degree, not an absolute form” (Chin, 2002, p.3) – for more details see Subsection 2.3.1 in Chapter Two.

Sprawl is an undesirable feature of contemporary urban development patterns. Various urban forms of development have been identified such as; low-density contiguous growth, ribbon (linear), leapfrog development (Ewing 1994; Razin & Rosentraub 2000; Peiser 2001 cited in Chin, 2002, p.3; Glaster et al, 2001), compact development and poly-nucleated development (Glaster et al, 2001). Some of these urban forms are considered less

economically sufficient and less sustainable. According to Barnes, Morgan, Roberge and Lowe (2001), low-density urban sprawl is highly consumptive of land for continuous demand for new development. Ribbon sprawl is the development that follows major transportation routes outwards from the existing city core. Lands which do not have direct access remains undeveloped and with rural uses/covers. Over time, these remained lands may be converted to urban uses with increasing in their value due to extending infrastructure perpendicularly from major lines. While the discontinuous pattern of development is known as leapfrog development, with patches of development lands that are separated from each other and form new boundaries. There are many factors behind the occurrence of leapfrog development like the geography features of the area such as rugged terrain or water bodies that preclude continuous development (Bhatta, 2009; EEA, 2006 cited in Diş, 2014, p.21.). Poly-nucleated or decentralised-centralisation pattern of development has gained much attention of scholars and widely accepted as sustainable development models (Jenks & Burgess, 2004; Frey, 2005). The process of city growth and new development changings reflect in the shape of the settlement, “...and in the way these processes are moulded by physical and planning constraints” (Longly, Batty & Shepherd, 1991, p.76). A variety of urban development forms can be found by using density and spatial configuration as a typology for classification - see Figure 5-1.

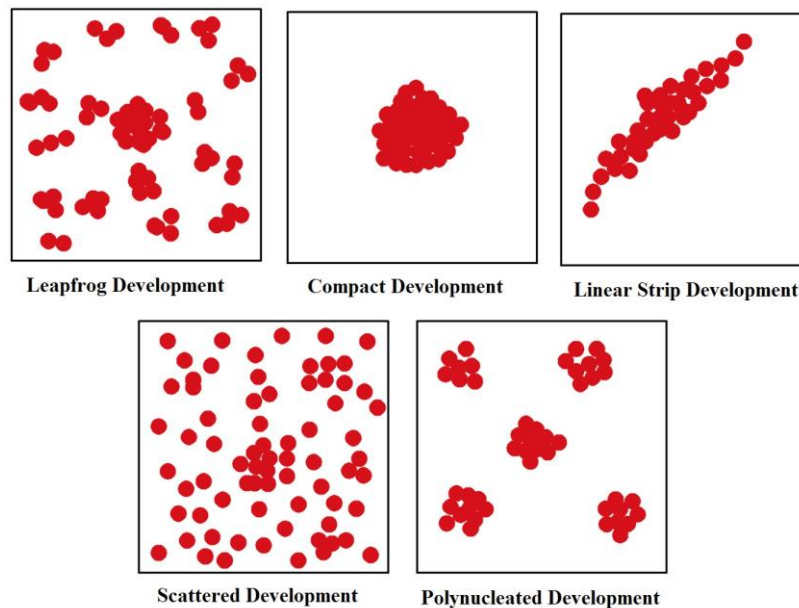


Figure 5-1: Spatial patterns of urban development
Source: Own construct based on Glaster et al, 2000, p.691

In spatial term, the togetherness of many urban blocks, the street patterns, open spaces and built-up areas are shaping the settlement pattern and define the whole city. According to Frey (2005), any physical part of the city has a specific and distinguishable form. The orchestration and the harmony of different parts generate specific urban form and structure that evolved based on commonly understood and accepted development patterns.

5.6.2. Urban Block Structure

Urban block is a primary element of urbanism in cities and a unit of developable lands. The block as an element in urban hierarchy associated with ever-growing cities and the most

important feature of the cities' form. Admittedly, block constitutes a single or group of buildings regardless of their size, shape which in turn defines the layout.

There are many terms, synonyms and phrases used to describe blocks like a building block, urban block and city block (Kostof, 2004) or community block (Oikonomou, 2015) or development block (Llewelyn-Davies, 2007). The terms, block, super-block and mega-block imply a changing in size and capacity of urban form over time.

Urban block is determinate on each side by streets or alleys which are the channels of streaming the flow of pedestrian and vehicular. Blocks work as essential elements of the urban fabric and the basic element of shaping and identifying the form of neighbourhoods and the city. The edge is directly adjacent to the street and is considered as the public realm while the interior is as a private (Panerai, Castex, Depaule & Samules, 2004). Spatially, urban blocks considered as the smallest area of land surrounded by a planned street network which determines the size of urban grain (Frey, 2005).

Urban blocks vary in shape and size according to configuration and pattern of streets (Krier, 1984), and different configurations of blocks exist like square, rectangular, triangular, rhombus, circle or irregular layouts which depend on design approaches. However, urban blocks must be flexible to respond to different socio-cultural environments.

Block structure is related directly to its components; block layout, size and form, the plot pattern and other key elements such as land use pattern and building type, these components identify the functional relationship of the physical structure of the urban block. As a result, block structure is the sum of interactions of these three elements – urban layout, land use pattern and building type and expressed in spatial dimensions in each period of development.

5.6.2.1. Block Layout, form and size

The layout identifies the spatial configuration and arrangement of block structure at the scale of street, block and building. The layout and configuration of urban block structure play a crucial role in defining the pattern of movement and designating parameters for subsequent initiatives development. The layout has a significant role in determining the accessibility of pedestrian movement and connectivity of different space and places to each other (ODPM, 2005; Ray & Vadiya, 2011). According to (Llewelyn-Davies, 2007) many factors are affecting the shape of the block layout and street pattern which provide different spatial configurations. These factors are:

- The shape and form of the urban block, divided into two patterns; organic and planned blocks.
- The size of the urban block, characterised by small or large blocks which define block layout and street pattern.
- The plot characteristics which define the property of block structure layout and street patterns.
- The orientation and topography of the area.
- The density of urban blocks in term of built-up area and population density.
- Land use categorisation affects the type of social life that creates in the street and alleys.

There are two major categories of classification- according to the heterogeneity - of urban block patterns; The first class is an irregular-or unplanned- urban block which generated as a

result of organic urban form (DETR, 2000; MIAMI-DADE, 2011). The organic urban form is generated from the accumulation process of growing urban fabric without existing previous intention to direct urban development. It is characterised by irregular configurations and layouts of urban blocks. The other class is regular - or planned- urban block which has been designed in different arrangements and organisations as a result of a deliberately planned scheme for urban development to follow and characterised by regular layouts and configurations of urban blocks- see Figure 5-2.

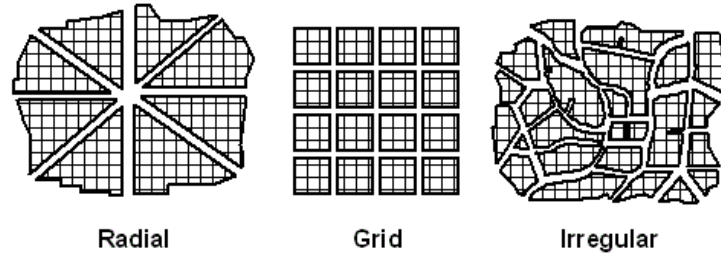


Figure 5-2: Patterns of urban blocks

Source: Retrieved June 18, 2014, from <https://www.google.de/imgres>

There are many types of arrangement of blocks forms with different typologies. Urban planning practices create various modular arrangements of blocks. Some of these blocks are widely-used as linear blocks, periphery blocks, point blocks or freestanding blocks – see Figure 5-3.

Rectangular blocks allow more block area in proportion to street spaces and maximise developable land while square blocks maximise circulation space, and the large blocks tend to fragment until an optimised size is reached which provide denser urban centres (Siksna, 1997). The diversity of building configurations and arrangement within the urban block can provide different open spaces, floor area ratio (FAR), built-up area ratio (BAR) and types of development (Roger Evans Associates, 2007).

The design of the neighbourhood is the result of an aggregating of blocks connected by a network of streets. The neighbourhood should be formed by blocks that afford suitable building sites for various uses and facilities (MIAMI- DADE, 2011). The size and the shape of the urban block is a significant contributor to enhancing local environment character and reflecting the degree of compactness and accessibility (Carmona, Heath, Oc, & Tiesdell, 2003). The design of the block also determines the ability to mix different land uses. Block arrangement must have flexibility in their design, and the blocks must be smaller to generate diversity (Jacobs, 1961).

The small block intends to promote pedestrian permeability, mobility and social use of space. Smaller blocks result from the more integrated street system. The smaller the block is the finer the grain of development will be created and the more permeable the neighbourhood is for movement. Creating small urban blocks help circulatory flow in the city and restrain any parts of the street to become a dead zone, and making access easier through generating more corner locations for more vitality and vibrancy of street space.

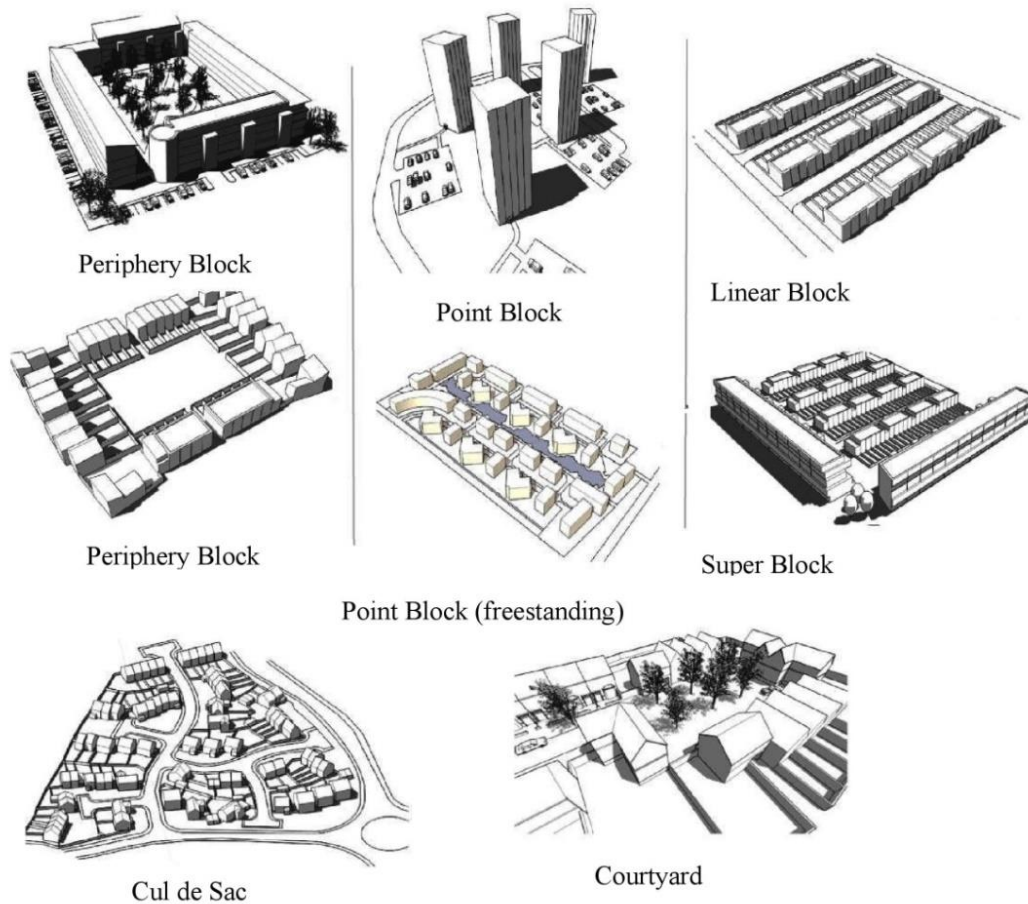


Figure 5-3: Widely-used urban blocks
 Sources: Own constructed based on Biddulph, 2007, Pp. 50-52

While larger blocks are the sequences of a non-integrated street system dominated by dead-end streets and provide an optimum distribution of built form and open space (Carmona, Heath, Oc, & Tiesdell, 2003), it separates people in diverse channels and paths and scarcely these channels intersect, which result in splitting up different uses in spite that they are close to each other (Jacobs, 1961). The large blocks tend to seclude the buildings form the street (Scheer & Petkov, 1998), and are subject to develop internal routes (Moudon, 1989), passages or private streets (Jiang, 2010) to access the centre of the block.

Large blocks could provide limited intersections for vehicular movements, while the smaller blocks create several intersections. Many urban planners were advocated for fewer and larger urban blocks and fewer streets and intersections to overcome the congestion problems in the city and to create greater efficiency (Montgomery, 1998). While Bentley, ALcock, Murrain, McGlynn and Smith (1985) advocate for smaller blocks, because small blocks give more choices of routes than the large blocks, therefore, smaller blocks increase physical permeability for a given area. Several factors and inputs contribute to form urban block size, to achieve the balance between smaller blocks and large blocks are needed to increase accessibility and social interaction- see Figure 5-4.

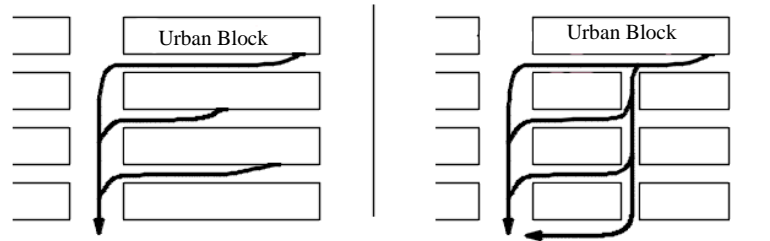


Figure 5-4: Accessibility in large and small blocks
Source: Own construct based on Jacobs, 1961, p.179

In case of undertaking development initiatives in established context or on brownfields, the size of blocks maybe figures out “by an ‘urban healing’ approach [...] and/or creating new linkages with the wider context that facilitate movement and integration of the new development with its surrounding context” (Carmona, Heath, Oc, & Tiesdell, 2003, p.82). In case of new development initiatives, the size of urban blocks could be determined by analysing the location characteristics, conditions and requirements of particular land use (e.g. housing, offices, commercial, and industry) “or through the use of historical precedents - that is, patterns that have endured and accommodated growth and change over time” (Carmona, Heath, Oc, & Tiesdell, 2003, p83).

According to the Metrasys Project- Sustainable Mobility for Mega-City- (2012), the convenient grid for residential areas to provide an optimum network for motorised traffic, pedestrian and cyclists are between 80 to 100 meters. In central areas with huge flow of pedestrian, grid spacing between 60 to 80 meters is the ideal. In the case of large urban blocks, to increase permeability the using of minor roads and footpaths through blocks is the best solution to increase walkability. Llewelyn-Davies (2007, p. 58) recommends that “blocks of external dimensions of about 90 m.x90 m., containing private or communal gardens, provide a good trade-off between biodiversity and other considerations”. Montgomery approves these dimensions for a new city and confirms that the blocks dimension should not exceed 91x91 meters. “Building would not tend to be set back from the street or positioned centrally within a plot but rather around central courtyards” (1998, p.108). The block size should be small to respect the human scale and provide walkable neighbourhood, therefore block perimeter should not exceed 400 m (MIAMI-DADE, 2011).

Many proposals and design criteria have been suggested by scholars to reach the optimum size of urban block which are viable spatially, environmentally and economically. But the context and the uses have their effects on shaping and determining the size and form of the urban blocks. A range of block sizes encourages diversity of building types and land uses and offer more chances for mixed uses, pedestrian accessibility. The ideal size of urban blocks can be determined through 'comparison and experience' and more appropriate sizes of urban blocks can be deduced to form a 'complex urban pattern' (Krier 1990, cited in Carmona, Heath, Oc, & Tiesdell, 2003, p. 82)- see Figure 5-5 and 5-6.

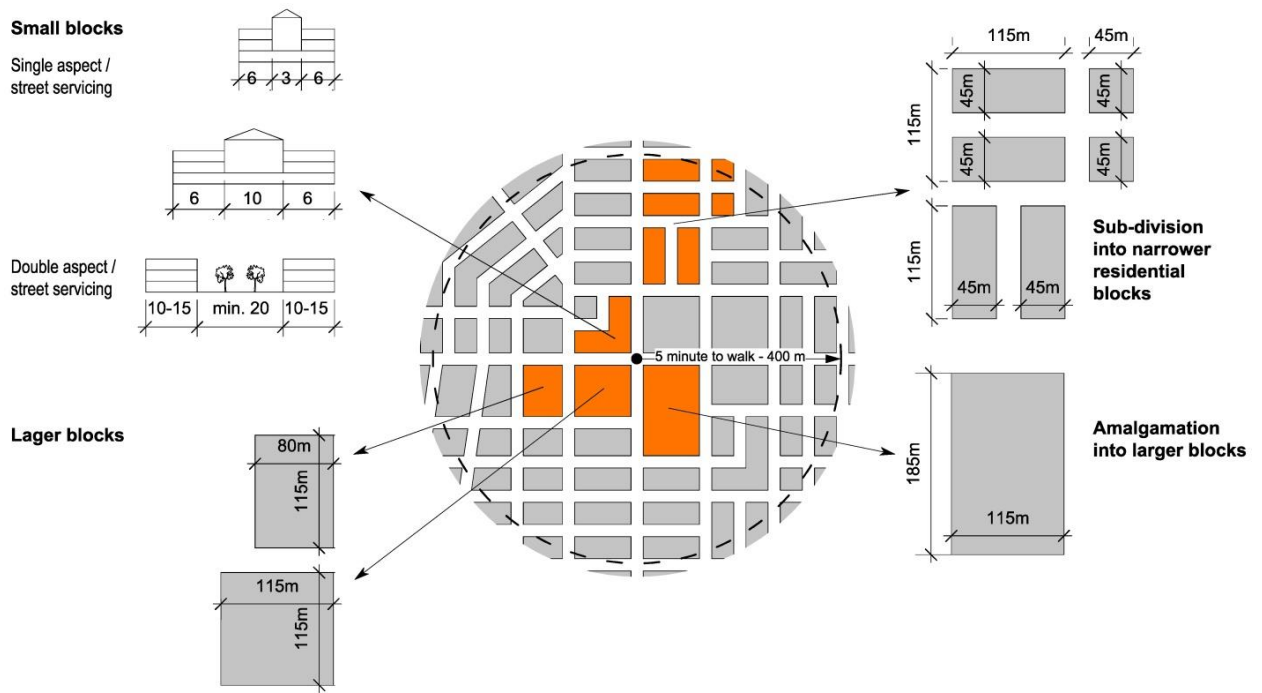


Figure 5-5: Range of block sizes to promote diversity
Source: Metrasys Project 2012, p.19

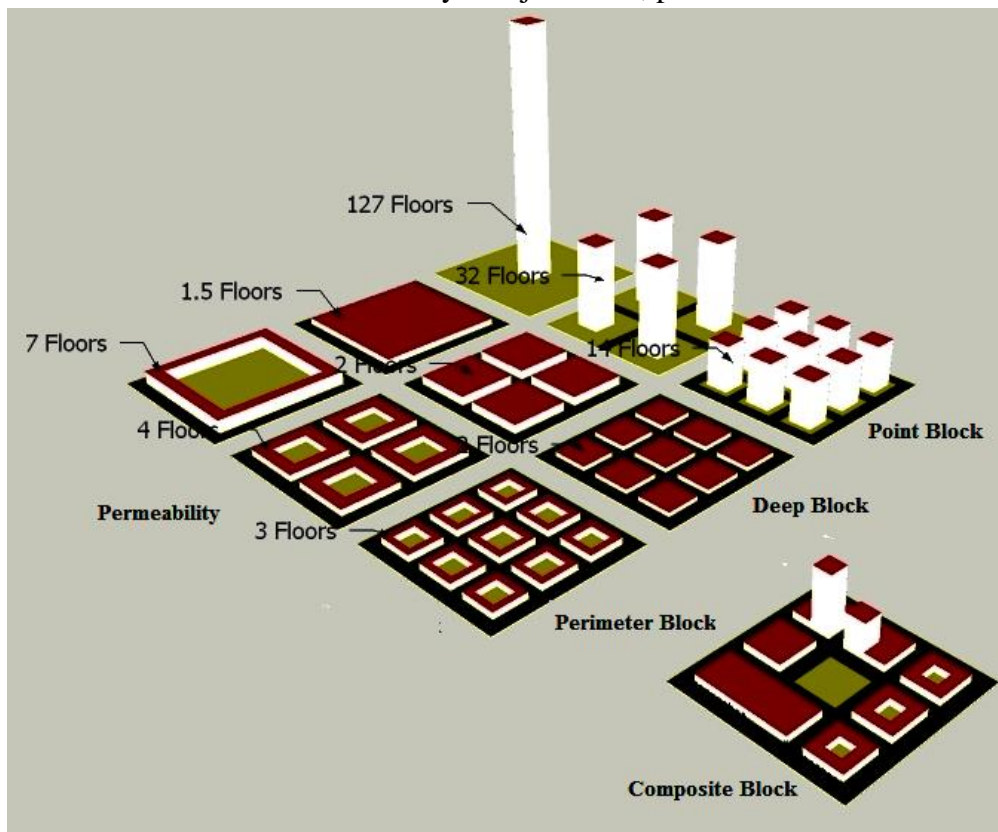


Figure 5-6: Strategies to diversify building configurations and arrangements to achieve the same density
Source: Own construct based on Roger Evans Associates, 2007, p.88

5.6.2.2. Plot Patterns

Often urban block represents several land parcels or a single land parcel. Urban blocks “are typically subdivided or ‘platted’ into plots or lots” (Carmona, Heath, Oc, & Tiesdell, 2003, p. 63). The parcels are contiguous sharing one or more of its sides and each parcel is unit of land use. It is spatially defined by boundaries regardless of its size and form. Parcels are often distributed by private and public ownership. Land tenures have their influence on uses in an urban block.

The boundary and uses of plots have changeable characteristics during the time because of the ownership properties and market conditions. Large parcels may be subdivided or re-joined to form new building structure and plot pattern. In some cases, the whole parcels in the urban block may be amalgamated to form a new plot pattern, or several urban blocks amalgamated to form larger urban block. Thus, “... plot and block amalgamations remove most of the evidence of earlier forms” (Carmona, Heath, Oc, & Tiesdell, 2003, p. 63). But at the same time gives more opportunity for redevelopment and promotes new initiatives for mixed uses, compactness, diversity, increasing open space and accessibility.

The plot may have a frontage onto the street and share the boundary at the rear with other plots, or plot may also face onto the street and has the alley for services at the rear. Also, the plots may have frontages onto streets at each end, or three sides for those at the corners, or four sides for those which constitute the whole block- see Figure 5-7.

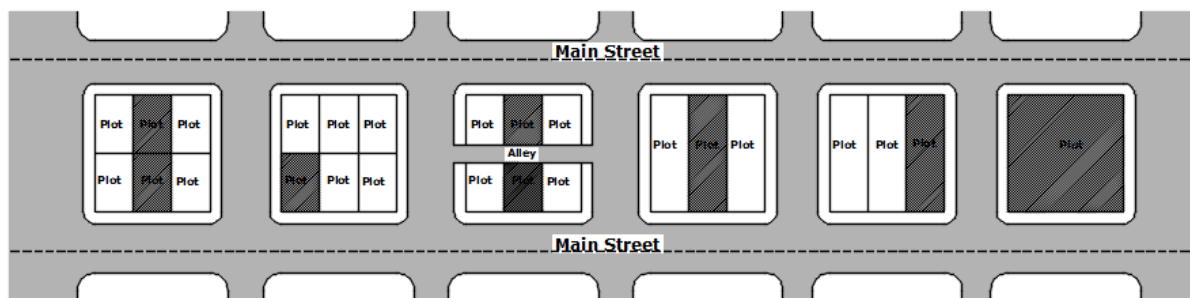


Figure 5-7: Typical design of plot pattern in relation to the street

Source: Own construct

The actual plot size is considered as a basic module for development which is related to the building setback, street width and open space distribution. Furthermore, plot size is related to the design of building form. The size of the plot and the area that can be built up - plot coverage area- provide the dimensions of the visible aspects of density. The plot size is context-related and varies from country to country (Acioly & Davidson, 1996). To keep the grain fine, the development parcels must be subdivided and apportion them to different developers to generate a richer mix of building types, uses and tenures. The grain should be finer towards the city centre (Llewelyn-Davies, 2007, p. 67). The plot size in residential is mostly depended on several factors such as; the size of the family, availability of land, the cost of land and construction and other socio-economic factors.

Sub-dividing development parcels into small and narrow plots are more practical and promote a diversity of forms. The small sub-divisions of regularly shaped and narrow plots, say 5m x 20m accommodate a range of building and make the most efficient use of land. The large sub-divisions usually required for commercial, industrial and civic buildings. Sub-divisions of 15-20 m width and 30-40m depth provide more flexibility for land increments for

the central area. Confining large plots with smaller plots curtain rear elevations and servicing from exposing to the street (Lynch, 1990; Lang, 2005; Llewelyn-Davies, 2007). To create a mixed use environment, the parcels should be combined with private and public ownership or to diverse the activities through changing uses of lands. Then, the city as a whole can provide (e.g. social housing, public facilities, parks...etc.) and the urban block as a unit of distributing private functions.

5.6.2.3. *Building Type*

In general, building types and forms could be arranged in different typologies. Various arrangements of buildings provide varieties of possibilities and enhance urban form and structure -see Figure 5-8. Design and formation of the buildings are mostly related to the function, topographic features of the site, construction material, cost of construction and maintenance, architectural style, implementation plan conditions, municipality regulations, approaches of development, political or development actor's expectations. These factors at the end formulate the building layout, the density and degree of compactness. The flexibility of plans in buildings can easily adapt to any future changes, and mixed use in activities to enhance social cohesion and economic benefits (Lynch, 1990; Lang, 2005; Biddulph, 2007).

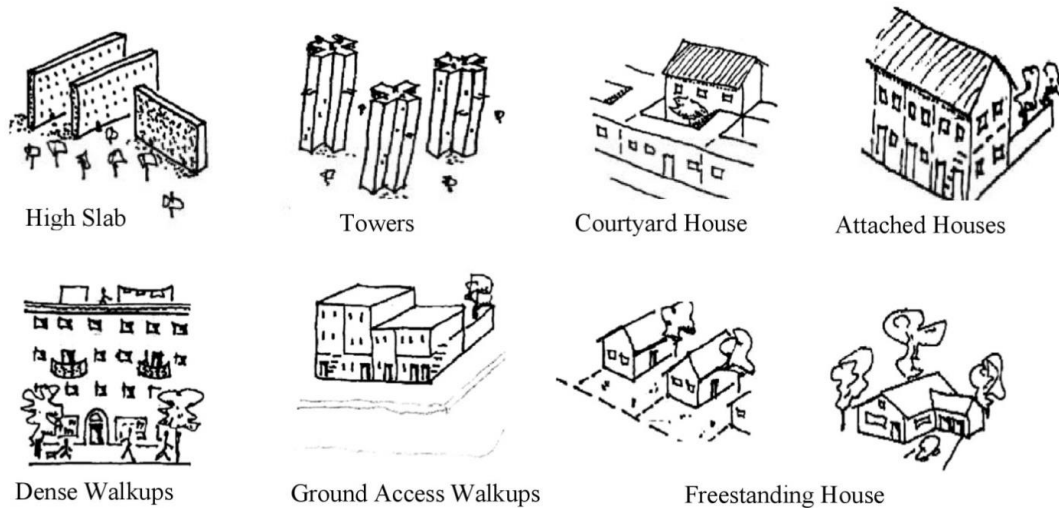


Figure 5-8: Different typologies of residential buildings
Source: Adopted from Lynch, 1981, p. 410-415

According to (Dempsey et al, 2010), building types and characteristics within urban settlements influence on everyday living of their inhabitants, it is recognised that the residents who live in detached low-density housing with spacious gardens having discrete experience of an urban environment, in contrary, residents who live in high-rise density apartments they don't have the same experience. However, the influence of building characteristics goes further the physical density of urban living. Other features of buildings like; type, height, size and age influence a number of matters. Various typologies of buildings create a liveable environment and pleasant atmospheres (e.g. different heights, FAR, building materials, various openings, green walls, playful facades...etc.) (Lang, 2005; Biddulph, 2007).

5.6.3. Street pattern

The street pattern represents the networks that provide circulation and access for vehicles and pedestrian to various uses in the city. Moreover, it defines the spatial channels for movement. The most important point in the designations of the circulation channels is their accessibility. The street consists of physical elements and also social facts, and it is a place where traffic flows of vehicles and pedestrian pass through and *“the movement of goods to sustain the wider market and some particular uses within the street”* (Moughtin, 2003, p.129-133). Streets’ pattern differs in their width and types depending mainly on hierarchy which based on their vehicular and pedestrian flows. The quality of the city much depends on the quality of its streets. Mainly the character of the streets depends on the character of their urban blocks - the widths of their roadbeds and sidewalks, the nature of the adjacent building setbacks and heights, the frequency of entrances to buildings, the presence or absence of shop windows, etc. (Lang, 2005). In addition, the type and speed of vehicular passing along them, and the arrangements of car parking affect the quality.

5.6.3.1. Types of Street Patterns

The street network shapes the urban form and structure of the settlement and *“in turns sets the pattern of development blocks, streets, buildings, open space and landscape”* (UN-Habitat, 2013a, p.3). The layout and configuration of streets determine the urban form of the settlement or its districts and neighbourhoods. They have taken innumerable forms which range from carefully planned to arbitrary construction (Kostof, 1992; Rykwert, 1982). There is no precise typology all the researchers agree about, and this makes it difficult to identify a typology that consensually is accepted. Because different disciplines carry different point of views in investigating streets (e.g. transport engineer looks to the street as a one-dimensional link in a traffic network, the planner looks to the streetscape as land use and the architect or urban planner looks at as a three-dimensional concern) (Marshall, 2005).

The street pattern is largely influenced by the block size and their numbers, the degree of connectivity (number of intersections) and accessibility (number of access points) (Vialard, 2013). The most important factors are; government system, population size, design techniques, building methods, transport modes, paving materials and social values that reflect in topology and geometry of the streets.

The street patterns can be classified under different criteria, one of the most familiar classifications based on the typology of networks (Lynch, 1990). The classification which is based on the form of the pattern is one of the main early classifications- the regular and irregular types- of the street pattern. The regular type refers to regular geometrical shapes that deliberately and consciously have been designed and are widely become prevalent after spreading of cars. Irregular type of street pattern refers to irregular geometrical shapes, prevailed in old cities (Carmona, Heath, Oc, & Tiesdell, 2003), and can be found in informal settlements. The irregular street pattern has a mixture of the components and different urban block sizes and shapes. According to Kostof (2004), the irregular grid of street arrangements in cities of the pre-industrial era often arose as paths for people and animals. These paths were generated as a result of constructing buildings near to each other in irregular order and usually followed the contours of the site. The paths were developed to be mounted to manageable grades. The very steep paths turned to stairs in many cases.

Marshall (2005) introduces a typology to reflect street patterns in a different stage of the growth of the cities, as stretching outwards from the historic core of the settlement to its outskirts. Four types of the street pattern have been defined; Altstadt, Bilateral, Conjoint and Distributor- see Figure 5-9.

- Altstadt (Old Cities) is indicated as irregular and fine-scale angular streets; these streets are mostly short and not straight with different widths and directions.
- Bilateral is the common street pattern in the cities which shaped as gridiron with crossroads.
- Conjoint/ Characteristic pattern is a type which mixes between both irregularity and regularity and is found in various positions of settlements.
- The Distributory associated with curvilinear layouts of distributor roads, forming looping with many tree-like configurations.

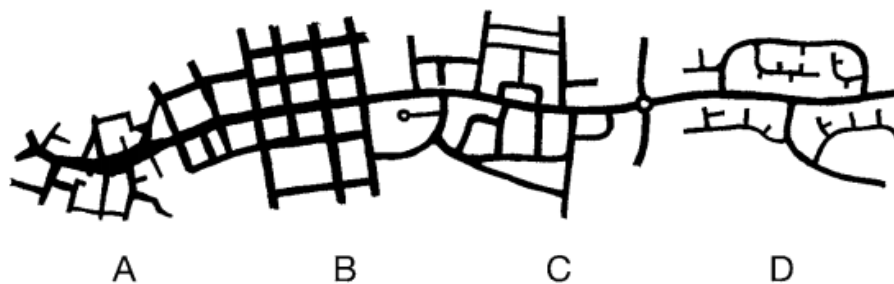


Figure 5-9: Major street types in the cities. A- Altstadt, B- Bilateral, C-Conjoint and D- Distributory

Source: Marshall, 2005, p.85

Variety of regular street patterns can be identified such as; grids, curvilinear, diagonal overlay and eccentric with different width and lengths. The grid is usually rectangular and common throughout the world. This pattern has advantages such as simple layout, regular building plots, flexible traffic flow, and logical orientation. At the same time, it is associated with problems, such as “*visual monotony, a disregard of topography, difficulties for travel on the diagonal, and the threat of fast traffic on any street*” (Lynch, 1981, p. 425). Notwithstanding, non-gridded street pattern is common in suburb area as one of the urban sprawl development characteristics and most of the tract are laid out in cul-de-sac to eliminate traffic through on most streets. Streets are usually curved in these areas, sometimes respecting topography of the site (Crawford, 2005). The discontinuous and closed patterns of streets affect neighbourhood connectivity and hampering pedestrian accessibility. There is a limitation on accommodating such streets to change (Vialard, 2013) – see Figure 5-10 and 5-11.

The classifications of street types have to consider both; the capacity and character as criteria (Marshall, 2005).

- Capacity: how the movement of every kind can be accommodated safely.
- Character: the role of the street in the urban realm and the types of building and landscape that line it.

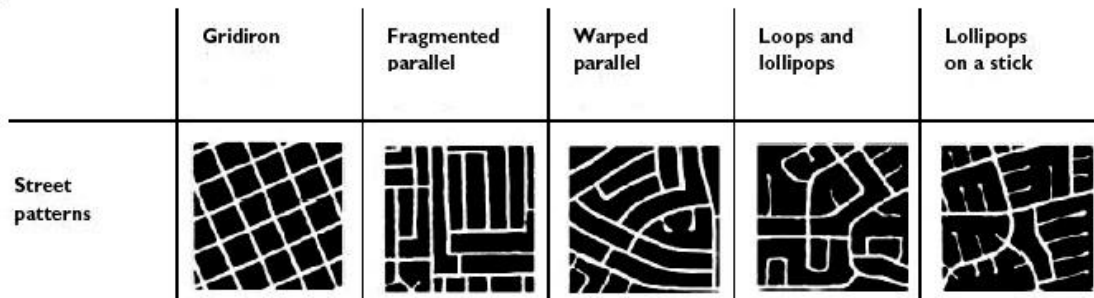


Figure 5-10: Street pattern at the neighbourhood level
 Source: Retrieved June 18, 2014, from <https://www.google.de/imgres>

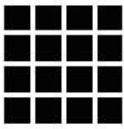



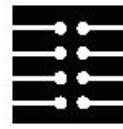
					
	Square grid (Miletus, Houston, Portland, etc.)	Oblong grid (most cities with a grid)	Oblong grid 2 (some cities or in certain areas)	Loops (Subdivisions - 1950 to now)	Culs-de-sac (Radburn - 1932 to now)
Percentage of area for streets	36.0%	35.0%	31.4%	27.4%	23.7%
Percentage of buildable area	64.0%	65.0%	68.6%	72.6%	76.3%

Figure 5-11: Patterns of the street and the percentage of the street area and buildable area
 Source: Retrieved June 18, 2014, from <https://www.google.de/imgres>

The conventional engineering-led approach to street classification mainly based on vehicular traffic capacity, which considers streets as channels of vehicular movement and ignoring their multifunction role in promoting the quality of life and social interaction in cities. The new terminology is required to indicate the role that streets play in creating a successful place in cities (Llewelyn-Davies, 2007). Urban streets can be classified according to the amount and the type of vehicular traffic they carry and the degrees in which pedestrian flow use it - see Figure 5-12.

In general, classification of streets varies from country to another. These are ranges of street types widely used in the classifications within cities which depend on the function and traffic flow of the streets (MCPD, 2009, p.11):

- **Boulevards:** Wide, six-lane streets with medians that carry significant through and local traffic. These streets will establish an attractive character for towns.
- **Main Streets:** Two - to four-lane streets that distribute traffic. City life occurs along these streets due to adjacent activating uses such as retail, office, and residential uses.
- **Local Streets:** Two-lane streets with permanent parking will provide internal circulation within each district. These streets do not have significant activating uses and they are quieter, side streets within the districts.
- **Greenways:** These streets have a recreation function in addition to a transportation purpose. Linear parks, bikeways, and other recreational facilities are provided within the right-of-way.

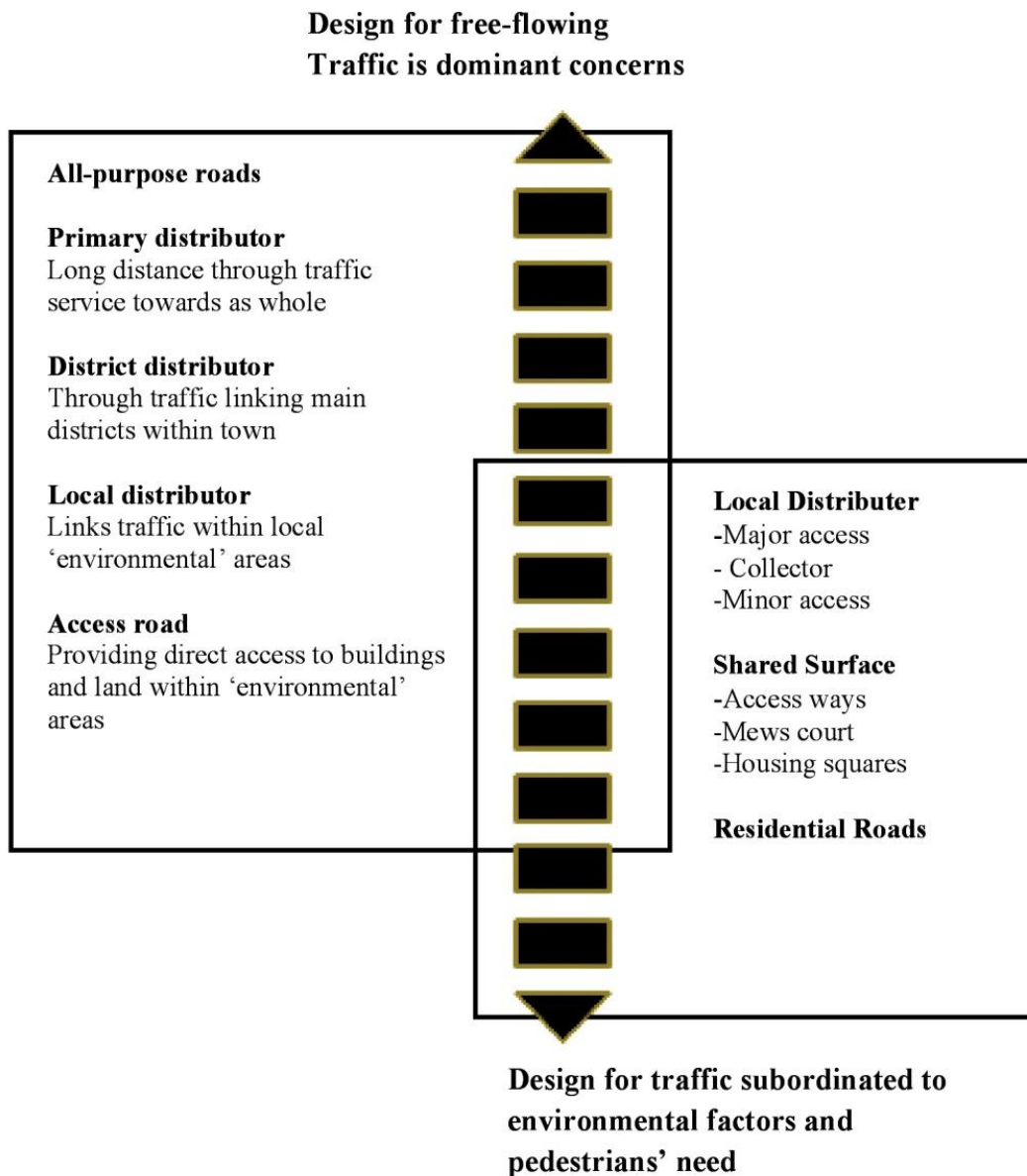


Figure 5-12: Classifying of streets according to their traffic flows and main uses
Source: Own construct based on Bentley, Alcock, Murrain, McGlynn & Smith, 1985, p.28

5.6.3.2. Traffic Flow of vehicles and pedestrians

Every urban settlement form can be depicted through two major class of physical things; movement and physical facilities that support that action. According to Lynch (1981) “both of these can be subdivided once again between features that permanently and repetitively occupy a fixed location, and those that are either moving between locations or are part of that system of movement” (p.351). Based on this argument the traffic flow can be subdivided into pedestrian’s and vehicle’s movement. The network and structure of movement and access influence the urban form and structure pattern (Marshall, 2005) and “...can have a form, a degree of specialization and many of these characteristics can be described in the mathematical language of graph theory” (Lynch, 1981, p. 357).

Traffic is the movement of vehicles, goods and pedestrians. Its spatial distribution depends on time, space, the number of people, the choice mode of transportation and the route of travel. There is consensus agreement that the different types of land use generate various kinds of movement and amounts of the flow of both vehicles and pedestrian in any part of the city. The traffic flow is highly affected by the allocation of land uses, and there is a mutual relationship between traffic flow and uses of land. Opening new routes or changing the conditions of existing routes inevitably affects the movement and the amount of traffic in other parts of the city. Generally speaking, the traffic flow of the vehicular and pedestrian can be divided into three domains; area of clear vehicular movement, area of clear pedestrian movement and area mixed between vehicular and pedestrian movement. Each of these areas of domain implies different requirements and urban design standards and criteria to increase accessibility and safety.

Pedestrian flow helps to obtain the degree of interaction with the existing urban built form and activity patterns within the physical form of the city. There are many key issues in pedestrian planning to be considered such as accessibility, attractive and liveable public spaces, safety and providing access and spaces for delivering goods and property requirements. One of the most important issues that urban planning and urban design have been concerned is balancing between pedestrian and vehicles movement.

Pedestrian circulation in street is important for urban vitality through avoiding making large urban blocks and long building and any mix and cross-cutting between traffic and pedestrian circulation (Jacobs, 1961; Jacobs, 1993; Siksna, 1998; Montgomery, 1998; Frey, 2005). There are many strategies and methods can be used to increase the opportunities of pedestrian circulation and flow, in particular to the downtown parts of the city. Such strategies for existing streets and roads can range from the pavement width, road-narrowing schemes, closing of subways and reintroduction of surface-level crossing and controlling the vehicular speeds through designing zone speeds, regulations, and constructing of speed humps or other obstacles (Carmona, Heath, Oc & Tiesdell, 2003). To increase and attract more pedestrian flow, it is required to provide suitable street furniture and greening and other adequate facilities. Also, there is a need to facilitate the vertical direction of pedestrian movements through designing interior pedestrian circulation within and around the building blocks. These require providing adequate stairs, ramps, elevators, escalators, and as well as providing arcades, passages and alleys for increasing mobility and permeability within and through the buildings and blocks. The fine grain of pedestrian network and public spaces create easiness of movement and diversity in urban fabrics, which encourage people for walking in the street and within urban blocks.

According to Frank, Greenwald, Kavage and Devlin (2011), findings the more pedestrian-orientated urban form which characterised by increased sidewalk availability and mixed land use – greater accessibility to destinations- is associated with lower CO₂ and vehicle mile travel (VMT) generation. The density of signalised intersections, the number transit routes, mixed land use and the design of sidewalk and their appropriateness to the pedestrian movement have great impacts on the pedestrian circulation and flows (ibid.). The efficiency of the pedestrian movement and circulation depend on the quality and the type of interaction between the urban open spaces and activities that take place. For example, the most sitting places are those areas which are adjacent and near to pedestrian movements, which allow

visual interaction between people and activities that taking place in nearby areas. The most pedestrian flow density is in the places where enjoy a diversity of facilities and safety. So the provision of adequate and safety walk-sides and other open spaces are crucial to the users.

For increasing vehicular traffic efficiency, various arrangements and design approaches have adopted in the urban built environment in previous decades. In many cases, more attention has been given to the vehicular movement rather than pedestrian movement. However, the pedestrian movement is supposed to be given more attention to provide vitality in an urban area – especially in the area where is dominated by pedestrian movement such neighbourhood and city centres, residential areas and recreational areas. Those areas have to be provided with many public transportation alternatives and modes to carry the flow of pedestrian movement to the destinations, at the same time, to avoid any direct cross-cutting between the flow of the vehicular and pedestrian circulation to provide safety and accessibility. Most of the contemporary sustainable urban development approaches give priority to pedestrian movement through designing of pedestrian circulation mesh and encouraging walkability.

The modern hierarchical road system is considered to be the most effective traffic arrangement model to separate nodes of travel from each other. The idea is to distribute traffic routes according to the amount of traffic flows and their directions and creating roads with one direction movement to increase efficiency. Therefore, some of the routes have constructed to carry heavy and fast traffic with less connection with private routes (Moughtin, 2003; Marshall, 2005; Marshall & Gong, 2009). This has required less degree of the cross-section between pedestrian and vehicular movement and provides more safety for pedestrian and faster speed for vehicles. Constructing of less number of connections between vehicles and pedestrian routes from other side has created more restrictions for urban mobility.

5.6.3.3. Planning and Designing of Streets

Every street is a part of its surrounding community and land use, and also a part of the city's and region transportation network. The planning of streets has to start with clear-defined goals and their design with an understanding of the role that the street plays at the local and larger scale of the context. The development initiatives should not address only pre-existing issues that have been identified, but also other needs of the city and stakeholders that the development can meet as well. The urban development process should address the following issues in street planning, design and management (NYC-DoP, 2009; NACTO, 2013) - see Figure 5-13.

Street Planning	Street Design	Street Management
<ul style="list-style-type: none"> • Community priorities • Land uses & users type • Demand & usage patterns, major trip generators • Safety-related needs • Local vs. through traffic, • Bus routes, bicycle routes, truck routes, critical connections • Access management (driveways) • Existing environmental & public space conditions 	<ul style="list-style-type: none"> • Target & design speeds • Alignments & widths • Horizontal & vertical geometric elements • One-way or two-way operation • Public spaces • Roadway, sidewalk & lighting materials • Grading & drainage • Utilities, Materials, Lighting • Furniture, Public Art • Trees, vegetation & storm water controls 	<ul style="list-style-type: none"> • Speed limit • Traffic controls • One-way or two-way operation • Part-time or full-time access controls • Curb-side regulation • Maintenance/cleaning • Public space programming • Short-term operational improvements utilizing temporary materials • Enforcement

Figure 5-13: Street Issues to be addressed during the urban development process

Source: Own construct based on NYC-DoP, 2009, p.28

To design a street network in a high-density area, the amount of land required for roads and parking have to be determined. According to Arnold and Gibson (1996 cited in UN-Habitat, 2013a, p.3) results on urban impervious surface coverage, the area with high population density and different land use patterns require high street coverage. The research indicates that 20-30 per cent of total urban land and 40-60 per cent of commercial centre land is used for roads and parking. In high-density mixed use urban area, it is recommended that at least 30 per cent of land is allocated for roads and parking- see Figure 5-14.

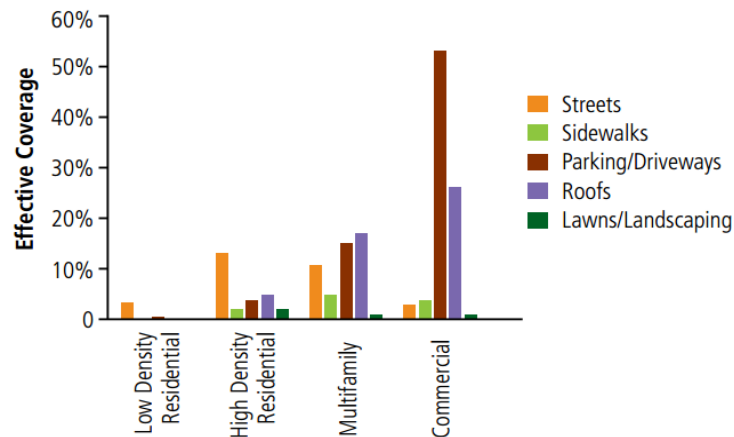


Figure 5-14: Surface coverage indicating the percentage of required land for streets

Source: UN-Habitat, 2013a, p.3

The number of intersections and access play a great role in promoting accessibility and connectivity. The design of junctions, connections and streets' width depend on the street types. Moreover, building height plays a role in determining of street width and capacity. Public transport catchment is an important factor in planning and designing of the street network- see Table 4-3.

Table 5-3: catchment area for different Transport Modes

Transport Mode	Stop Interval	Corridor width area served	Catchment per Stop
Minibus	200m	800m	320-640
Bus	200m	800m	480-1,760
Guided Bus	300m	800m	1,680-3,120
Light Rail	600m	1000m	4,800-9,000
Rail	1,000 m+	2,000m+	2,400m+

Source: Own construct based on Llewelyn-Davies, 2007, p.74

Public transport catchment and walkability should be combined; the suggested distance between two arterial routes is between 800-1,000 m (UN-Habitat, 2013a). This distance constrains the street grid design, urban structure design and neighbourhood size. The simple street network model is presented by (UN-Habitat, 2013a) consisting of 18 km street length per square kilometre. This model has nine vertical and nine horizontal streets to form a street network in one square kilometre area of the neighbourhood. The distance between adjacent streets is 111m and both urban block size and street hierarchy have been considered. This model shows the balance between street and other land uses in the neighbourhood and “encourage efficient traffic, sustainable accessibility, social interaction, public safety and access to amenities” (UN-Habitat, 2013a, p.3). Urban planners should adjust the design pattern of the street network in accordance to their contexts.

Street network has to be well-connected to services and other facilities and support pedestrian access leading to more concentration of multiple uses and activities to streets. This can be considered at three scales namely; neighbourhood, District and city, each with different needs and strategies (Jacobs, 1961; Ray & Vadiya, 2011). To develop sustainable accessibility, the street network should consider the following aspects (Frey, 2005; Llewelyn-Davies, 2007; Habitat, 2013) - see Figures 5-15, 5-16 and 5-17

- Road hierarchy is highly interconnected
- Public transport is encouraged
- Streets are walk-able and cyclist-friendly
- Sufficient parking space is provided

The streets are the essence of urban life which ample diversity to make them available to anyone and at any time. They should encompass a variety of uses for different people who use them at different times for different purposes.

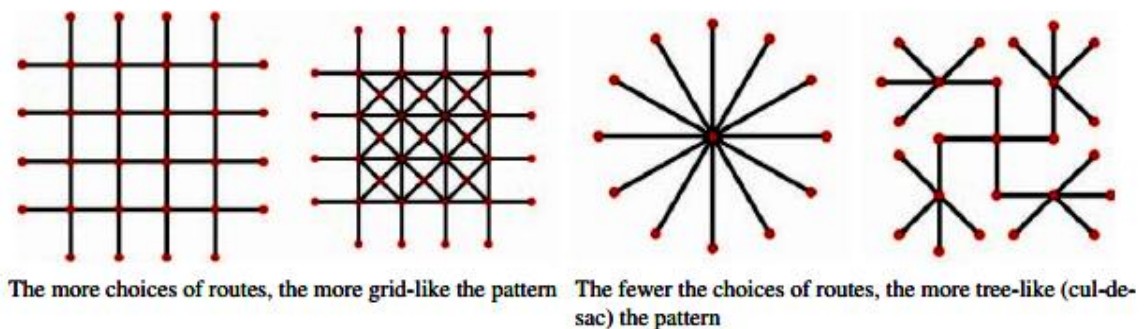


Figure 5-15: Development of access structure in the city and districts

Source: Dempsey et al, 2010, p.259

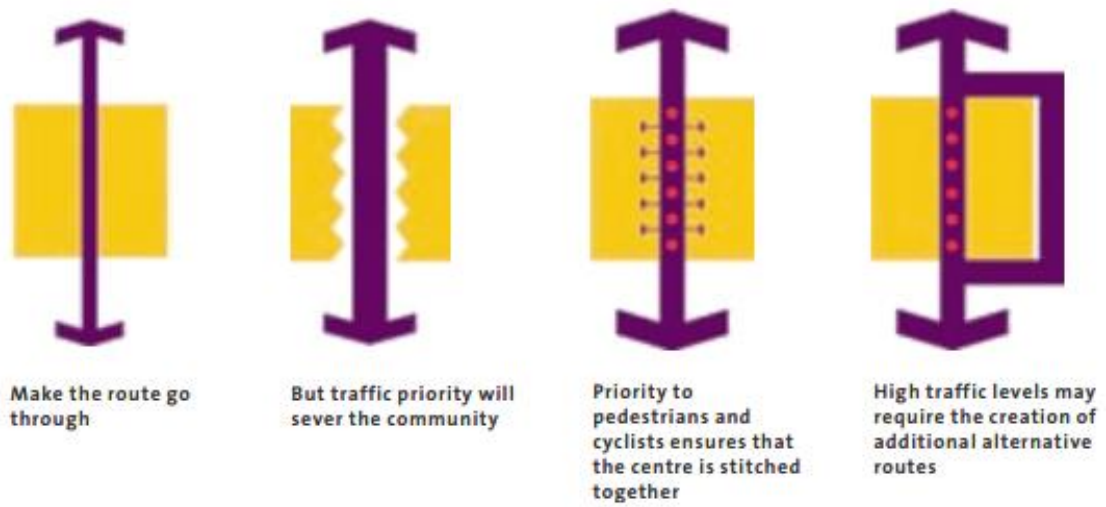


Figure 5-16: Strategies to promote accessibility and avoiding street congestion.
Source: Llewelyn-Davies, 2007, p.74

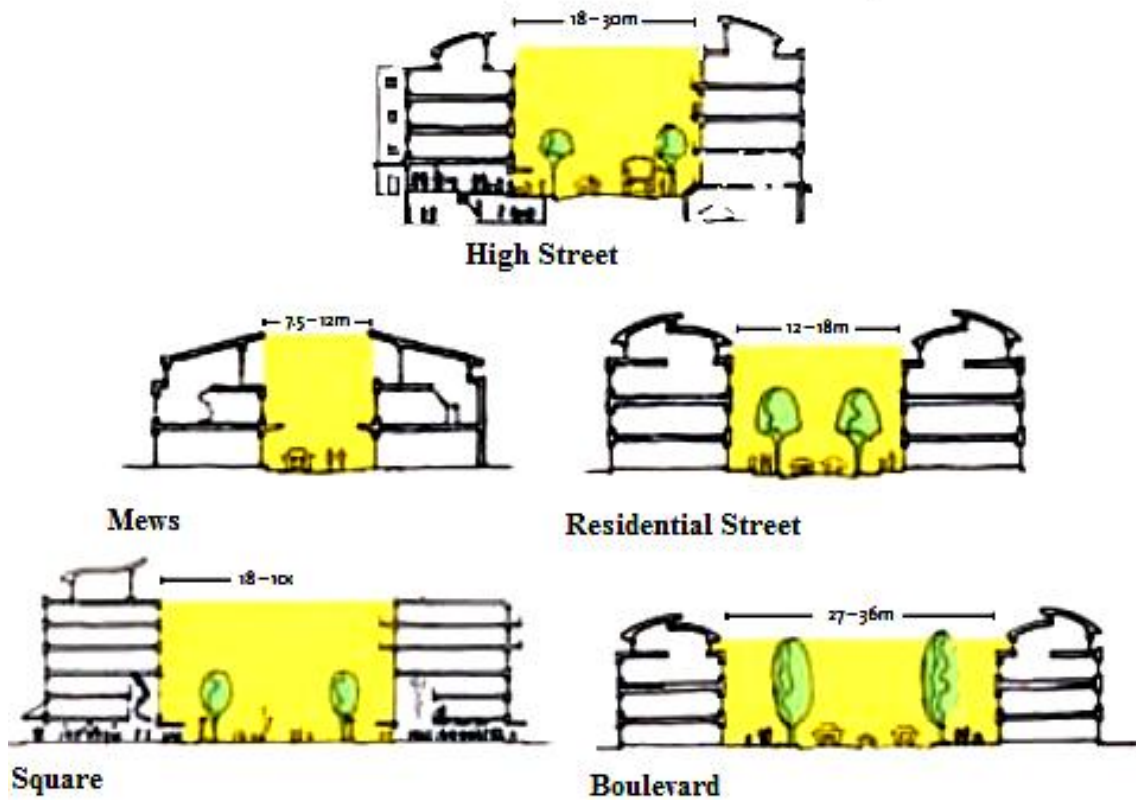


Figure 5-17: Street width in relation to their type and the building height
Source: Llewelyn-Davies, 2007, p.74

5.6.4. Open Space

Commonly, urban open space constitutes both green and other spaces which dedicated to public activities or as preserved areas for environmental sensitivity in the urban area. In recent years, urban open space has emerged as an important area of particular interest for landscape architects and planners (Chiesura, 2004).

One of the simplistic and general definitions of urban space is of Krier (1978) which defines urban space as all types of spaces located between buildings in towns. The open space is understood through both space and place (Madanipour, 1996). While urban open space is defined as all freely accessed places that are often- not always- owned by the government, which planned and built for community activities and enjoyment (Esbah & Deniz, 2007; UNDOC & UN-Habitat, 2011). This may include parks, streets, downtown plaza, squares, community gardens, neighbourhood playgrounds, natural and golf play yards. In a broader sense, urban open space includes all unbuilt land in urban areas (e.g. towns, cities) which represent public spaces, private gardens, streets and squares. Therefore, it links together all spaces and the flows of people and transport around and between buildings, thereby forming the context and connecting different parts of the city with each other and with its surroundings. Spinks (2001) argues that urban space should be dealt with as dual-categories as both physical in term of the built environment and as symbolic in term of perceptions.

From the morphological point of view, urban open space is defined as the unbuilt space, empty space or the void, which separates building volumes and their surfaces from each other. So the shape and the form of urban open space are “*characterised by a relationship of strict duality with the 'filled elements' that surround it: buildings, vegetation, fences, and screens*” (Teller, 2003, p.339). This holistic perception of urban open space establishes a concrete basis for its strategic planning, design and management and as a vital element of shaping urban form and structure. While in practical urban open space should be differentiated into its components. This depends on which point of view (e.g. management, accessibility, structure, and ownership) is looked to open space. Urban open space can work and activate through establishing a direct relationship between space and the people who use it and live and work around it. This can be true in case of increasing accessibility, mixed uses and greening (Urban Task Force, 2005).

In the past, open space has been considered as secondary part to the building form and massing, while in contemporary planning approaches (e.g. New urbanism, smart growth) open space has been an essential part of urban form and structure which should be considered early in the design process (Shirvani, 1985). To achieve an urban integration needs a shift from the traditional thinking of urban open space- be it a street, park or square- as an isolated part from urban fabric to thinking of it as a vital part in shaping and defining urban form within its own specific set of functions (Urban Task Force, 2005).

Planning and designing of urban open space have been developed through using modes which are adapted to ecological functions and formal principles of open space planning by taking into regards environmental standards (Loures, Santos & Panagopoulos, 2007). Thus, there is a motivation to consolidate urban open space with green structures and adapting it appropriately to climate change and conform to the natural environment. This can be achieved by integrating the issues of climate-sensitive planning into the planning and design process to enhance the urban built environment.

Variety of urban open space models exist and each is adhered to certain urban plan and related to an approach (Maruani & Amit-Cohen, 2007). Some of the known models can be briefly reviewed which concerned with urban open space inside the urban areas:

- Landscape-related model: It is usually related to scenic open spaces (e.g. mountains and streams). So it is widely concerned to preserve natural area outside urban areas (Aelan, 1992; Cook, 1991 cited in Sutton, 2008, p. 35). According to (Robinson, Newell & Marzluff, 2005) this model has gained more attention during the last decades for the planning of the urban area and as an effective tool for environmental protection.
- Space standards (A quantitative model): It is widely depended on quantitative data as its basic foundation and does not rely on social and ecological aspects (Maruani & Amit-Cohen, 2007). A space standard is related to the minimal requirement of designing and planning of urban open spaces (e.g. green area per person, sidewalk width, the distance between trees, proximity to the residential area, accessibility). The model is widely accepted, easy to practice, and becomes an effective tool for urban environmental planning and design.
- A comprehensive planning model (Garden City): It is a comprehensive approach to urban planning considers open space as an integral part of the development of the city. It is widely used as a response to urban environment deterioration and unhealthy living conditions in the cities (Clark, 2003). This model adopts the system of interconnected open spaces in the city by using green trails to allow continuous movement through the city and encouraging other species to move freely (Maruani & Amit-Cohen, 2007).
- Shape-related model: It is concerned with form and spatial configurations and dispositions of urban open spaces. The spatial configuration of urban open space is shaped in relation to the form and spatial arrangement of the adjacent built-up zone and to the elements of urban open space itself (Bengston & Youn, 2006). Shape-related models are effective in combination with other models which take a population and different users' needs into consideration. Different arrangements and spatial distributions of urban green spaces can be found within the residential areas.

Urban space might be personal, private, public or mixed and cannot be considered as isolated spatially, but as changeable according to individual situations (Spinks, 2001). In term of privacy, public and private realm urban space has been divided into public, semi-public, semi-private and private, these terms are widely used to define the boundary and determine the function of each space and emphasis on gradual transition between these types of space (DETR, 2000). Carmona, Heath, Oc and Tiesdell (2003, p.111) divide the public realm in a broad sense into three categories of spaces that are accessible to the public includes;

- External public space: include all outdoor spaces that lie between buildings in urban areas like squares, streets, parks, parking lots, etc. and in rural areas forests, coastline, lakes, and rivers, etc.
- Internal public space: constitutes institutions, airports, town halls, transport terminals, etc. and

- External and internal quasi-public space: although legally considered as private places such as universities, sports grounds, restaurants, cinemas, shopping mall, etc. This category described as privatised (often but not exclusively external).

Public and private space cannot be seen as independence space, rather they are complementary to each other, “*and people need access across the interface between them. Indeed, this interplay between public and private gives people another major source of richness and choice*” (Bentley, ALcock, Murrain, McGlynn & Smith, 1985, p.12). Creating realms of the interface between public and private in cities supposed to be studied during the development initiatives and concerned with urban design (Biddulph, 2007). The role of each space- public, private and communal spaces- should be explicit with clear boundaries to define each of them (DETR, 2000). The activities of individuals in cities and towns take place in public and private spheres.

The provision and distribution of urban open spaces should be considered as an important element of urban form, thereby, this issue has taken much attention from the side of planners and policymakers (Chiesura, 2004). The amount of urban open spaces in cities is usually represented by the percentage of the green area among the total area of other land uses of a city or green area per capita. In evaluating of open spaces many criteria should be investigated to give the real situation and explain the function of all aspects of urban open spaces, such as accessibility, quality and spatial distribution of open spaces (Song, 2012).

5.6.5. Land Use Pattern

In general, land use is the term that used to refer to the various functions within the urban environment, and it is an important instrument that underpins and determines the nature of an urban form and structure. The land is a limited recourse; it can be used for all practical purposes in the urban area. The demand for land for different purposes is continuously increasing and simultaneously with the increase in population and economic growth of cities.

According to Lillesand and Kiefer “*The term land use relates to the human activities associated with a specific piece of land, factures present on the earth surface*” (1987, p.74). Land use pattern has been defined by (IPCC, 2000) as “*the total of arrangements, activities and inputs that people undertake in a certain land cover type*” (P. 21). Moreover, “*Land use is an important determinant of public transportation and sustainable urban form and plays at city, zonal and neighbourhood scales*” (Ray & Vadiya, 2011, p. 35). The use of land in the city is predominantly residential, but urban contexts need services and facilities, such as commercial, industrial, administrative and other infrastructures.

The rapid and further growth of urban areas incorporates the haphazardly developed areas and imbalanced land use pattern. Normally, the growth of the cities extends outwards of the cities to the direction of fringe areas creating unplanned development (Zope, 2013). Ineffective land use patterns threat urban sustainability of the city and creating deficiencies in the transport system, open urban spaces and spatial distribution of other activities. Therefore, there is an urgent need for policymakers and planners in the area of land use management to gauge the sustainability of urban land use and to precisely allocate the uses and functions (Olima & Obala, 1998 cites in Zhang, Wu & Shen, 2011, p. 142).

Land use is traditionally used to be separated due to unwanted externalities by zoning process which separates uses and functions (Talen, 2012). The traditional patterns of land use such as concentric zone model and radial or sector model are no more effective in producing

sustainable urban development because it raises problems to the transport systems and losing of a green area (Zope, 2013). The conventional land use planning tools tend to divide the development area into districts which the land is restricted to certain function and classification. The shape, size and location of the districts reflect the major uses indicated by these tools (Crawford, 2003) – see Figure 5-1. Now there is a strong tendency towards mixed uses as advocated by many sustainable approaches such as new urbanism (Grant, 2006) and compact city (Jenks & Burgess, 2004). The spatial micro pattern distribution of land uses is crucial in order to bring the efficiency of a city for achieving sustainable urban forms (Dempsey et al, 2010).

Land use pattern at any given time is the product and the outcome of many factors such as social, economic, environmental and political, including the technology of constructions, the size of the population, the location and availability of suitable land, the right of the ownership and state of the planning regulation. The land use pattern besides having economic and social implications it has environmental and ecological dimensions (Singh, 1997).

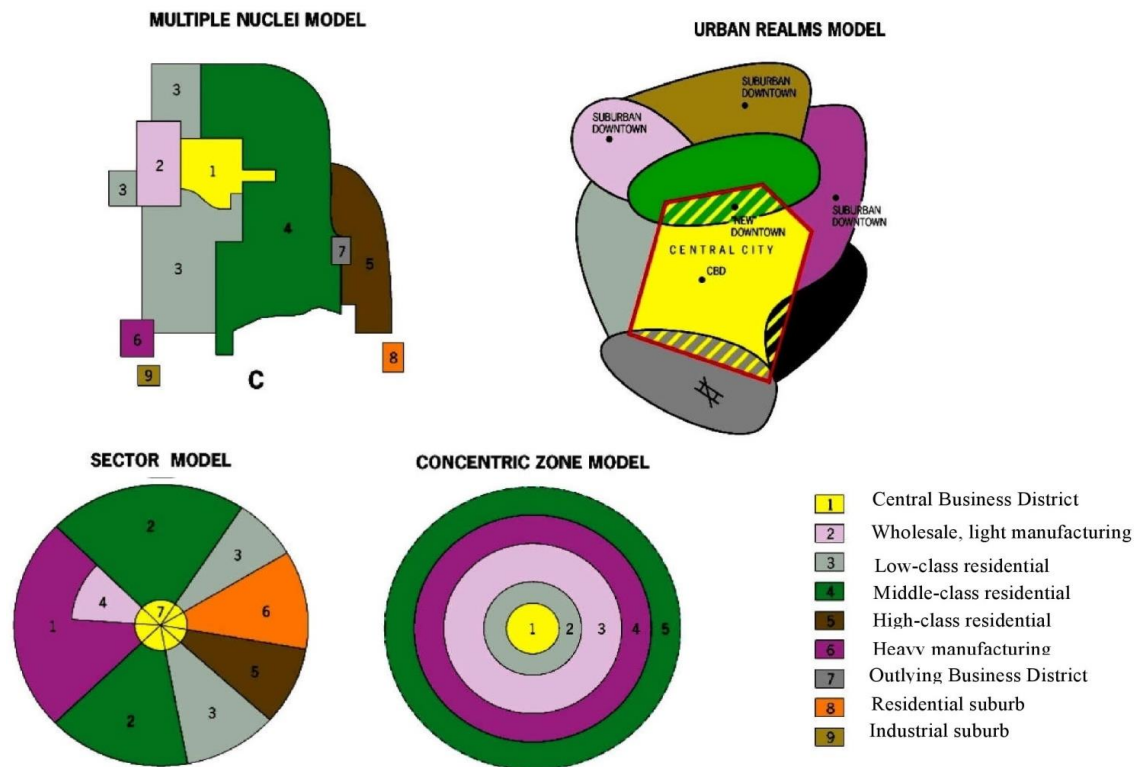


Figure 5-18: Models of land use distributions in the cities

Source: Retrieved July 25, 2013, from

<http://teacherweb.ftl.pinecrest.edu/snyderd/MWH/readings/Urban/Urban2.pdf>

Any economic, political changing or new investments of the city, undoubtedly are resulting to change the use of the land pattern over time. Constructing new buildings, re-joining or subdivisions of the existing plots or changing the street patterns and widths affect the land use types, and there should be an adaptation to new conditions and uses. Thereby the land use pattern affects the size and formation of the urban block and street pattern due to the

requirement of the functions and uses, and new development initiatives create new requirements of physical form and structure of the city to comply with.

Finding solutions for promoting sustainable urban form through land use mechanism are unique for each context, and cannot be replicated and imitated. However, there is a common ground and principles can be applied for all cities.

5.7. Conclusion

Urban form, urban structure and urban morphology are three areas of studies interrelated and overlapped. Urban form is largely related to the static entity of the city such as, buildings, streets, and infrastructure and transport system which are not changeable for short period, although they are subject for change and redeveloping for a long period. Therefore, urban form is concerned with the physical design, the layout of the settlement and its components.

The urban structure is mostly related to the studies of the arrangement of land use and investigates the relationship and linkages between urban form elements and underlying interaction of people, freight and information in the city.

Urban morphology is concerned to the study the form of settlements, the process of its formation, evolution and transformation; therefore, it is mostly related to investigating the settlement's characteristics, patterns and the process of its development across the time. These three areas are very intertwined in spatial planning studies and no distinctive boundary can be observed between these three fields.

To steer physical urban development towards more sustainability, it is required to touch and investigate many principle elements of urban form and structure which have a crucial effect on shaping the pattern of physical urban development. These principle elements are not working independently; rather they are inter-related and depend on each other. For example, the size and the shape of urban block inevitably affect street patterns and the distribution of open spaces and likewise the flow of vehicles and pedestrians, as well as the determine the degree of compactness, density and ease accessibility.

Chapter Six: Sustainability and Urban Form and Structure

6.1. Introduction

In recent years, the urban form has taken much attention of researchers and becomes the topic of political debate especially in Europe. There is a need for more attention from the side of the planners in developing countries, especially; these countries are witnessing rapid urban growth of cities and excessive urban sprawl with many other problematic urban issues concerned to urban form and structure.

The growing cities of the 21st century look forward to achieving environmental-friendly development, resource and energy efficiency and economic prosperity. To be inhabitants of an urban area permits the residences to have advantages of many opportunities of proximity, accessibility, green open spaces, diversity of urban features and goods, degree of compactness that maintain resources. So urban planners engaged in studying and investigating the relationship between sustainability and urban form and the degree in which urban forms can produce sustainable built-environment. The priority for physical urban development is pursuing sustainability through creating urban forms that are in an all-encompassing sense of social, ecological, economic and aesthetic responsibility.

The following sections and subsections investigate the relationship between urban form and sustainability through discussing many key characteristics of sustainable urban forms, then to derive a set of spatial criteria for promoting sustainability of an urban form and structure in growing cities.

6.2. Urban Form and Claims to Sustainability

The term of sustainable urban form and structure is disputable. What it encompasses, how to achieve it, and how it influences by the context and other factors is an arguable issue – see Subsections 5.2.1, 5.2.2 and 5.2.3 in Chapter Five. Therefore, it is the subject of continuous debate (Landman, 2003). Vale and Vale (1996) denote that the city must be considered as a series of interacting systems, of which the physical urban form is one. This offers a foundation – among other dimensions- to consider the meaning of a sustainable urban form. Recently, much attention has focused on the relationship between urban form and sustainability. The form of the city is among many other various factors that affect cities like environment, geographical location, urban management and social-economic, and it is the entity that creates a sustainable ecological cycle.

The main objective of the spatial planning is to improve the quality of urban life; this is why it has focused on the various functions of the city, and sometimes the size, layout and compactness or instead 'new ' forms and structure (Levent & Nijkam, 2009). Thus, the sustainability of cities and urban forms has focused on increasing the density of development, containing urban sprawl, ensuring mixed uses and achieving social and economic diversity and vitality (Jenks & Dempsey, 2005).

The physical dimensions of urban form and structure consist of its size, shape, land use configuration and distribution of open spaces, including the city's transportation system and urban design features have significant considerations in achieving sustainability (Handy, 1996 cited in Jenks & Jones, 2010, p.1; Llewelyn-Davies, 2000).

In order urban form to be more sustainable and improves the quality of life, five essential physical characteristics for urban form have been identified by Jacobs and Appleyard (1987) as essential goals for a good urban environment which are;

- Live-able streets and neighbourhoods.
- Minimum density of residential developments.
- Integration of activities, including living, working and shopping.
- Creation of public spaces, and
- Complex arrangements and relationships between building and space.

Moughtin (2003) confirms that the sustainable city is a city that approximates to a sustainable form, and is characterised by compactness, a flexible structure which the whole parts of the city are interconnected and clearly articulated public spaces. As well Dempsey et al (2010) state that the city which has a sustainable urban form is characterised by compactness, a mix of uses, interconnected street layouts, efficient public transport network, environmental control and high standard management. In the same context, Jabareen (2006b) identifies seven design concepts to sustainable urban forms: compactness, public transport, density, diversity, mixed land use, green space and solar energy. All tend to advocate urban forms that are accessible, compact, mixed use, greened, and as well as socially diverse and economically viable (Williams, 2000; Talen, 2003; Urban task Force, 2005; Jenks & Jones, 2010; Dempsey et al, 2010; UN-Habitat, 2013a; Williams, 2014). The concept of sustainable urban form can be found in different approaches of urban development (e.g. Compact city, new urbanism, urban villages, Transit-orientated Development, Urban containment and Eco-city). In general, the concept of sustainable urban development models is categorised by Haughton (1997) within four categories as:

- (1) The redesigning cities, improving urban life and protecting nature through more compact city forms, high residential density and mixed land use. The key assumption is that such changes in urban form reduce travelling long distances, the result saving energy and land and decreasing environmental degradation.
- (2) The self-reliant cities, advocate for intensive internalisation of cities and economic and environmental activities, circular metabolism, bioregionalism and urban autarky. Restoring nature through a better balance between human actions and their impacts on the ecology system are meeting local needs through local businesses with minimum ecosystem disturbance.
- (3) The externally depended cities include a diagnosis of urban environmental problems and a policy approach centered on the need to resolve market inefficiencies.
- (4) The fair shared cities, the political, social, environmental and economic circumstances should be considered in terms of fair trade through reforming the terms of trading of environmental assets and assessing regional carrying capacity as a way to exchange both resources and pollutants.

According to Haughton (1997), *“each model has value in pointing towards improved policies for the sustainable city, but none of them provides all the answers”*.

The sustainable urban forms and structure reduce urban sprawl, reserve fertile land and protect the ecosystem, more efficient use of land, a mixture of uses in much proximity,

encouraging alternative modes of travel, such as walking and cycling and decreasing the cost of infrastructure and transportation. Dumreicher et al (2000 cited in Jabareen, 2006b, p.40) ask for an urban form that is easily walkable, small enough to eliminate the desire for using a private car, and large enough to provide a variety of opportunities for viable economic and urban services. However, how and in what way urban form influences a city's environment and contributes to sustainability and how exactly is manifested remains unclear and arguable and needs more investigation (Jenks & Jones, 2010). Moreover, a lack of theory and absence of a common conceptual framework restrained researchers to evaluate the degree of a certain urban form -or forms- to sustainability or even to compare different urban forms according to their objectives and approaches (Jabareen, 2006b). Notwithstanding, some sort of consensus agreement and a shared ground among researchers are existed, that the urban form and structure affect the sustainability of an urban context and it is the source of many inefficiencies in cities.

6.3. Key Characteristics of Sustainable Urban Forms

There are many different approaches to urban form attaining sustainable urban development as discussed in Chapter Three. Each of these urban forms contributes to steering cities towards sustainability. Most of the sustainable urban forms emerged as a reaction to the various urban problems that faced the community and related to the context of developed countries, like urban sprawl, consuming agricultural land, segregation of services, increasing the number of cars, deterioration of natural environment and looseness in social interaction and many to name; therefore, these approaches are shaped to some extent by the impact of these problems and advocated some strategies and design concepts overcoming these problems and improving built environment performance. In general, these forms share similarities in advocating certain design concepts for promoting sustainable urban development - see Table 6-1.

Table 6-1: Prominent characteristics of sustainable urban forms

Sustainable Urban Forms	Main Characteristics
Compact City	Compactness, high density, mixed land use, pedestrian- orientated, clear boundary, diversity of life & buildings, social fairs, a clear identity, self-sufficiency, independency of governance
New Urbanism	Diversity, sense of community, mixes of uses, pedestrian-friendly, social interaction, greening, proximity, increasing density, integration of land use, self-governing neighbourhood, creating public spaces
Transit- Orientated Development	Growth organising, mixes of uses and types of housing, mixed land use, preserving habitat, pedestrian-friendly, density, encouraging infill development, diversity, placemaking, social interaction
Urban Villages	Sense of community, mixed use, diversity, density, social coherence, open space, self-efficiency, the ratio of jobs, open spaces, social interaction
Urban Containment	Restrain sprawl, higher density, encourage public transportation, mixed use, social sustainability, land preservation, re-investment, more land utilisation

Eco-City	Revise land use priority, diverse choices of housing, mixed land use, greening, social justice, encouraging walkability, supporting local agriculture, resource conservation
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Source: Own construct

6.4. Criteria for Promoting Sustainable Physical Development

Urban forms can have a great role in effecting on the built environment, and considered as a significant factor in ensuring urban sustainability. In broad, the key design concepts that advocated by sustainable approaches are regarded as criteria for sustainable urban form namely; compactness, density, mixed of uses, pedestrian-orientated movement, social sustainability and greening.

The key characteristics used by sustainable urban forms are comprehensive and cover different aspects namely; physical, environmental and socio-economic dimension of the sustainable city. However, within the framework and the limitation of this research, the focus is on the physical aspects of the city development. This research concentrates on the criteria which promote physical sustainable development. The interdependency of the selected criteria has taken into consideration to bring a clearer understanding of the form and structure in the context of growing cities and achieving considerable improvement towards more sustainability. The following criteria advocating by sustainable development approaches can be used to appraise the performance of the urban form and structure of a growing city.

Relying on different approaches in quoting the criteria which can promote sustainability in different contexts is more realistic since the frameworks of sustainability which adopted by the developed countries is problematic to the context of growing cities in developing countries. Referring to the above section 6.3 the following key characteristics are identified to promote physical sustainable urban development in the context of a growing city – see Table 6-2.

Table 6-2: Main criteria of sustainable urban form

Criteria of Sustainable Urban Form	Sustainable Urban Forms					
	Compact City	New Urbanism	Transit-Orientated Development	Urban Villages	Urban Containment	Eco-City
Compactness	•		•		•	
Density	•	•	•	•	•	•
Mixed use	•	•	•	•	•	•
Diversity	•	•	•	•	•	•
Accessibility	•	•	•	•	•	•
Greening		•	•	•	•	•
Social Sustainability	•	•	•	•	•	•

Note: (•) refers to the characteristic that is advocated by the urban form approach

Source: Own construct

The following subsections try to shed light on the selected criteria and how it is understood and how it is promoting sustainability in urban development.

6.4.1. Compactness

The compactness of the built environment is widely advocated as an important strategy by different urban forms to achieve more sustainable urban development. It implies urban contiguity and connectivity that encouraging future urban development to take place adjacent to existing urban structures (wheeler, 2002, cited in Jabareen, 2006b, p.39). There has been a belief among many researchers, planners, policymakers and others that intensification can be a positive force for steering sustainability. Among the proponents is Jane Jacobs (1961) who favours compact development. The supporters suggest a dense, mixed use and transport-orientated urban form which creates more walkable communities with ready access to facilities, creates variety and diversity of uses which add many advantages to the community such as; ‘eye on the street’ for enhanced security, and social cohesion and increase economic vitality (Jenks, Burton & Williams, 1996; Masnavi, 2000; Oktay & Conteh, 2007). Thus, compactness becomes the crucial typology to be adopted to achieve sustainability. Dumreicher et al (2000 cited in Jabareen, 2006b, p.40) argue that the sustainable city should be compact, dense, diverse, and highly integrated. The sustainability of the urban compactness greatly depends on the density and crowding tolerance of residents, the density tolerance threshold is different from context to another (Khodabakhsh, 2011).

Intensification is a major strategy for achieving compactness leads to use land more efficiently through increasing the density of development and activities in an area. The intensification may include in the development of previously undeveloped land, redevelopment of existing urban structures or brownfields, subdivisions, conversions and additions or extensions to urban fabric (Jenks, 2000). Applying the concept of compactness to existing urban fabric refers to the containment of further urban sprawl through infill development initiatives or urban containment (Oktay & Conteh, 2007).

Compactness can be better achieved within areas that are served by public transport, or public transport provision is required to booster the development (Petersen, 2002; Newman, 1999 cited in Nallathiga, 2008, p. 56). According to Masnavi (2000), there is no practical evidence that the compactness can reduce the necessity for using the car since the car is the main transport mean and frequently used for going to work and bulk shopping in many urban areas. Moreover, there is no evidence that compactness, mixed use areas are associated with the increasing use of public transport means. The higher densities or mixed uses are not alone able to eliminate the use of cars and encouraging walkability, rather the combination of higher densities and mixed uses is more beneficial for promoting sustainable urban development.

The impact of compaction may affect the quality of the life of users and socially is not welcomed and may affect the poor (Burton, 2000a), therefore, adopting concepts such as compactness and intensification in any context should be dealt with careful attention because may socially are not acceptable. The density that is acceptable in china or developing countries’ cities might not be acceptable in developed countries. Zhang (2000) argues that the environmental benefits may be achieved through an acceptable degree of urban compaction, after a certain level, it may be difficult to achieve the claimed benefits and instead may cause

social and environmental problems. The point will remain to investigate the degree to which the urban compaction can increase the advantages and decrease the disadvantages. The issue of compactness will remain more related to the context. There are many strategies for promoting compactness such as; plot subdivisions, adopting high residential housings.

6.4.2. Density

Density is an important aspect of urban form and has received attention because the density of any particular area has the potential to impact upon many aspects of social, economic and environmental sustainability (Tsai, 2005; Bramely & Power, 2009; Dempsey et al, 2010). Typically, density refers to the measure of people living in a given area of land, although it can be measured in term of numbers of dwelling pre certain area of land (e.g. urban block, neighbourhood, district, city, metropolitan area and national). Density and its spatial distribution is a basic characteristic of urban form (Johnson, 2007). High density essentially refers to the concentration of people and their activities in a certain urban unit (UN-Habitat, 2013a). Density is a significant variable in urban settlements, causing differentiation along the areas, and as a considerable element to affect the form of the city and the overall measure of urban form, particularly when the issues concerned to the concept of compactness versus urban sprawl in an urban area (Towers, 2005 cited in Rani & Shamsuddin, 2013, p.1162). Density is a multi-faceted concept encompasses many inter-related dimensions (Ray & Vadiya, 2011). It is an essential concept in formulating the overall sustainable patterns of cities and creating a sustainable urban form (Jones & MacDonald, 2004 cited Ibrahim & Shaw, 2009, p.1), and as an integrated component in urban planning policy (Taylor & Nostran, 2008).

Adopting high density as a strategy has a direct response to population growth and rapid urbanisation over the world. To prevent urban sprawl and promote physical sustainable urban development, it is necessary to achieve high density as a basic element to the sustainable neighbourhood (UN-Habitat, 2013a), and the population should be mixed, as regards income levels (Frey, 2005). The density should carefully be determined, that is neither fit for suburban nor urban use. The neighbourhoods and cities need a critical mass of population concentration to support a cultural and economic life (Jacobs, 1961).

Density can express and measure in different manners which is suitable for a certain situation. There is no consensus on a certain way for measuring density, and on the way to express the density threshold in planning polices (Taylor & Nostran, 2008). Simply, density can be measured and expressed as a ratio of residents, jobs, or built form to a given land base to quantify a human activity, or can be expressed as a number of dwellings per hectare or population per square kilometre of land area (Taylor & Nostran,2008; Jabareen, 2006b).

Petersen and Wilson (2011) argue that density does not necessarily describe the intensity. Density is dependent on plot size, floor space ratio, building height, street width and parking requirements. But the intensity of a place is also affected by the width of plot frontage, the topography, front setback and gardens, street design. While density measures may be used as indicators of intensity, they are never complete descriptors.

Due to the differentiation in contexts and cultures, there is no 'one size fits all' for density to be applied in different urban environments. However, different cultures and contexts have

to look to their problems and opportunities for deciding upon the way to express and measure the density (Pont & Haup, 2009). Nevertheless, UN-Habitat has recommended average built-up area density of 150 p/ha as a minimum for a sustainable neighbourhood (2013a). Other socio-economic characteristics of density also have an important role to play in making a decision regarding the density value (Ray & Vadiya, 2011).

Many support high-density urban areas and considering density as a major indicator for sustainability, and it can bring many advantages (Jacobs, 1961; Burton, 2000; Jenks, 2000; Burgess, 2004; Frey, 2005; Jabareen, 2006b; Dempsey et al, 2010), while others believe that high density brings many disadvantages (Gordon et al., 1989, Gordon et al., 1991; Troy, 1996 cited in Masnavi, 2000, p.65). The argument has been that there is a trade-off between the positive points of high density such as easy access to facilities and efficient use of land, and negative points such as more crowding area, lack of open spaces and interrupting personal privacy (Bramley, Brown, Dempsey, Power & Watkins, 2010). But others who advocate strongly against the process of increasing densities on the grounds that high density and mixed use cities lead to traffic congestion and overcrowding, local air pollution, more crime, noise, social conflict and neighbour nuisance (Breheny 1992; Chen, Jia & Lau 2008 cited Ibrahim & Shaw, 2009, p.1).

According to Transportation Research Board of the National Academy in the USA (1996 cited in Jabareen, 2006b, p.41) as density increases, automobile ownership decline and automobile travel also decrease. Similarly, transit use increases with density. Keeping the mix of land uses, residents of high density are more likely to commute by transit, walking, bicycling, or combinations, and encouraging to less likely to drive, than people who live in lower-density areas. There is an inherent conflict between lower densities and a good transport system, where lower densities encourage car use (Jabareen, 2006b). However, the advantages of high density are more than its disadvantages; the issue needs to be carefully dealt with – see Figure 6-1.

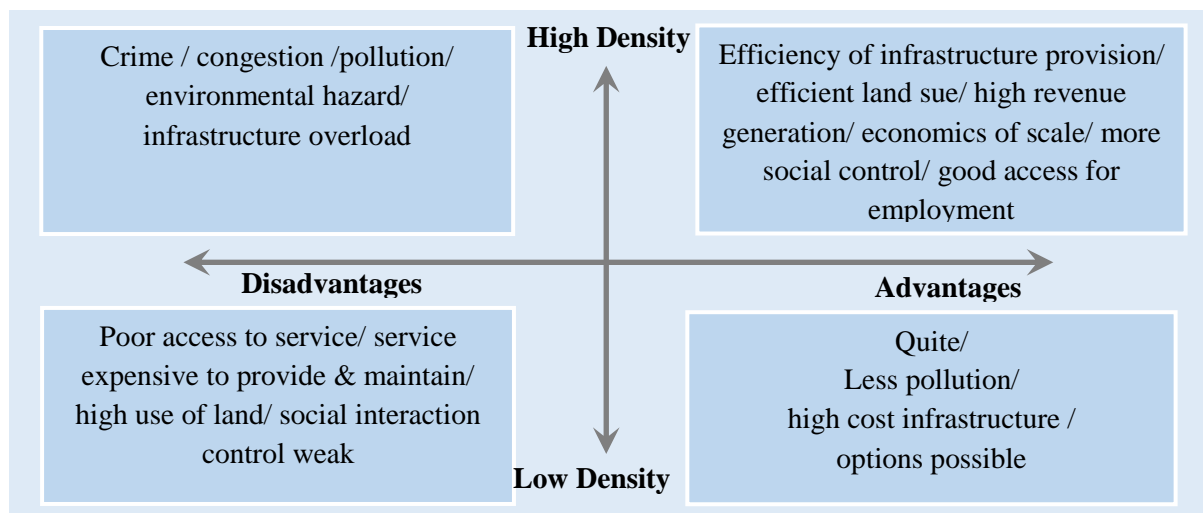


Figure 6-1: Advantages and disadvantages of high density and low density

Source: Own construct based on Acioly & Davidson, 1996, p.7

Residents may worry about the perceived connection between high density and social problems, such as crime, depression and poverty. According to the Victoria Transport Policy Institution (2009), there is no such correlation between high density and social problems if other factors such as income accounted for. A well-designed and organised neighbourhood can be safe and comfortable, but the prerequisite of sound urban planning and design are essential to achieve viable areas with high density (UN-Habitat, 2013a).

6.4.3. Mixed use

At the end of nineteenth century and aggravation of many social, economic and environmental problems, with introducing of modern urban planning concepts, the land use zoning approach is applied and single function of land came to existence. The single land use zoning strategies has brought many problems for the cities such as; increasing of urban sprawl, declining of urban centres, car dependence movement and traffic congestion. To solve these problems, the concept of mixed land use has emerged as a reaction to the single-use of land (UN-Habitat, 2013a). Simply, mixed use refers to a variety of activities, such as the existence of retail and recreations facilities, the local industry in residential areas. It is a combination of different land uses within certain areas of an urban unit (e.g. urban block, neighbourhood, town, and city).

Mixed use has been advocated by many researchers (DETR, 2000; Moughtin, 2003; Jenks & Burgess, 2004; Frey, 2005 Llewelyn-Davies, 2007; Marshall & Gong, 2009; UN-Habitat, 2013a) as a strategy to curb many problems that are generated because of applying mono-functional zoning and to create vibrant mixed use communities. Mixed land use becomes an inherent part of cities and as a pillar of sustainable urban development (UN-Habitat, 2013a). Promoting mixed use as a strategy remains a sensitive and contextual issue in any urban area. The advantages of applying of mixed land use as a policy are; creating local jobs, promoting the local economy, reducing car dependency, encouraging pedestrian and cyclist traffic, reducing landscape fragmentation, providing closer public services and supporting mixed communities. Mixed land use can be applied at different spatial levels: city, neighbourhoods, blocks and buildings (UN-Habitat, 2013a).

Mixed use development needs special attention and consideration due to the privacy requirements of the inhabitants of the area and creativity in forming the block structure and its components to provide flexibility and adaptability for any new land uses to comply with market demands. The same thing is true to mixed uses in a vertical direction. In addition, design variety of the building types that provides opportunities to the needs of different developers and investors. *“When different functions are mixed in one neighbourhood, economic and residential activities should be made compatible and well balanced by careful design and management”* (UN-Habitat, 2013a, p.5).

The need for mixed primary uses in a neighbourhood and district have to integrate the different uses; residential, commercial, office, local industry and public open space within the proximity- from 400 to 600 meters- to create active relationships and maximise the quality of life of the city. These interactions between the activities and the residents should be so varied for different people at different times, also the same street to be used for different purposes at different times and in different ways (Jacobs, 1961; Frey, 2005; UN-Habitat, 2013a). In many

cases, the mixing uses may happen spontaneously through the market forces and conditions. To respond to such circumstances, the appropriate physical development patterns can increase the possibility of transforming from single-use to mixed uses during the time (Carmona, Heath, Oc & Tiesdell, 2003). For example, promoting mixed use in a certain area by introducing residential uses into non-residential areas or vice versa.

To provide flexibility for land uses in many ways Llewelyn-Davis (2000, p. 96) introduces some suggestions to promote mixed uses in residential areas:

- Inserting managed workspaces or compatible employment uses into ‘backlands’, or block interiors;
- Introducing mews lined with single-aspect offices, workshops or studios;
- ‘Grading’ uses, for instance, from general industrial uses, through light industrial / workshops/offices to residential;
- Creating hybrid building types that can serve as a buffer between different use areas, such as live-work units or foyers, that serve as one-stop centres for training, advice and young person’s accommodation;
- Encouraging temporary or ‘meanwhile uses’ such as small arts and crafts workshops or markets to bring life to an area until permanent accommodation has been constructed.

According to UN-Habitat (2013a), the suggested floor area distribution for a sustainable neighbourhood is 40 to 60 per cent for economic use which based on research analysis on Central Business District CBDs, 30-50 per cent for residential use and 10 per cent for public services. The recommended standards are ranges to allow for flexibility so that different urban context can adapt them in accordance to their situations.

6.4.4. Diversity

The term diversity can be interpreted in different ways in urban literature. Urban designers refer to diversity as mixing building types; planners conceive diversity as mixed uses or class and racial/ethnic heterogeneity; sociologists and cultural analysts concentrate on racial/ethnic aspects. *“Some writers focus on only one of these interpretations; many, however, see each type of diversity as linked to the others, even while there is considerable disagreement as to the direction of causality”* (Feinstein, 2005, p.4). However, diversity is *“multidimensional phenomenon”* (Turner, Robyne & Murray, 2001 cited Jabareen, 2006b, p. 42).

There are some similarities between the concept of diversity and mixed land uses. In the realm of urban planning and design, the diversity is *“the combinations of mixtures of activities, not separate uses, are the key to successful urban places”* (Montgomery, 1998 cited in Talen, 2008, p. 34). In urban form studies, diversity simply refers to building types (e.g. mix, high and low rise structure) and a range of architectural styles (Fainstein, 2005), and also refers to the diversity of land uses, housing and public domain (e.g. streets, plazas and open spaces) (Queensland Government, 2010).

According to Talen (2008a), there are three sets of factors namely; policy-related, historical/economic/social, and physical/locational affecting diversity in an urban area and these factors are interrelated as conceptualised below – see Figure 6-2.

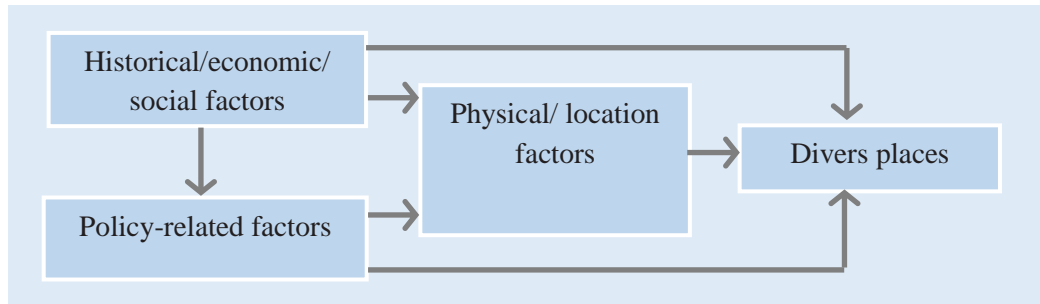


Figure 6-2: Conceptual framework of factors that explain the diversity

Source: Own construct based on Talen, 2008a, p.24

Jacobs (1961) advises planners to search for cities that people can interact and characterise by short streets, mixed uses and multiple interactions among strangers which make the city socially and economically viable and stimulate creativity, thus, Jacobs links “*physical, economic, and social diversity and gives physical differentiation a causal role in producing the other types*” (Fainstein, 2005, p .5).

Diversity promotes more desirable urban features, including mixing of different housing type, building densities, household sizes, tenure types will encourage a mixture of social and income levels in the neighbourhood (Frey, 2005; Talen, 2008a). In case the development is not diverse, then the built environment may not look attractive due to the homogeneity in urban features and elements which produce monotonous urban landscape (Wheeler, 2000).

It is essential to identify the level that diversity is investigated; the city at macro scale may look diverse, but at the neighbourhood level- micro scale- is homogenous (Talen, 2008a). Jacobs (1961) exposes the importance of the liveability and vitality of the central parts of the cities, considering the diversity into the city’s streets, neighbourhoods and districts. To achieve diversity four conditions have been suggested as below:

- (1) The district and indeed as many of its internal parts as possible must serve more than primary function, preferably more than two.
- (2) Blocks must be short, that is, streets and opportunities to turn corners must be frequent.
- (3) The district must mingle buildings that vary in general and condition.
- (4) These must be a sufficiently dense concentration of people, for whatever purposes that maybe there (Jacobs, 1961, p.163).

Diversity describes the spatial, social and economic context of urban form which in turn helps secure viability of services and community provision. Sustainable urban development is a diverse development which contains a mixture of land uses, building and housing types, architectural styles, rents, people, incomes...etc.

6.4.5. Accessibility

The concern is; how to plan and design for widely accessible development and promote easy access to different service and everyone’s needs and offer travel choices, therefore, it deals with objective characteristics of urban form such as land use and street network rather than the subjective factors of socio-economic. In spatial planning concern, the matter is how

to promote a development that offers people different travel choices which are widely accessible and meet the needs of everyone in the community at a different level of neighbourhood, city and region. Despite the academic and policy-makers' recognition of the importance of accessibility; in developing countries, there is a little attention paid to land use and transport policies in the real practice (Silva & Pinho, 2006). According to (Handy & Neimeirer, 1997; Halden et al, 2000; Halden, 2002; Bertolini et al, 2005 cited in Silva & Pinho, 2006, p. 2) in many developed countries, the concept of accessibility has been suggested as a useful framework for design and planning for integrated land use and transport planning, since accessibility can easily have operationalised and interpreted.

The concept of mobility in a broad sense is viewed as a combination of proximity, connectivity and accessibility (Talen, 2003; Frey, 2005; Ray & Vadiya, 2011; UN-Habitat, 2013b; Guaralda, 2014) – see Figure 6-3.

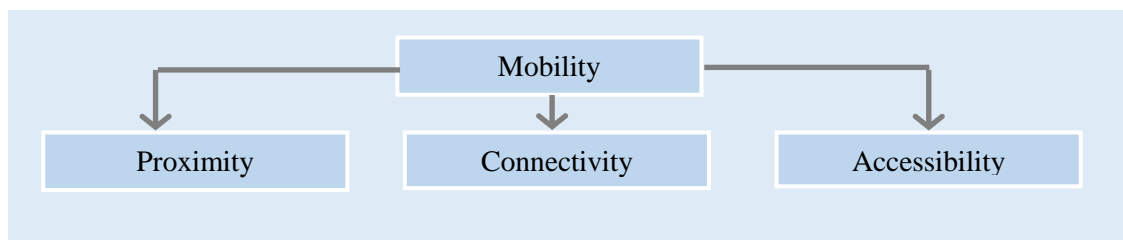


Figure 6-3: Mobility and its components

Source: Own construct

Accessibility is defined as the ease with which a resident can reach to a certain destination (Levine & Grab, 2002 cited in Silva & Pinho, 2006, p.4; Talen, 2003; UN-Habitat, 2013b), while mobility defined as an 'ease of movement' and can be treated as means for enabling people to access other peoples and places (UN-Habitat,2013b). Accessibility refers to the distribution of the city facilities and the ease of access to destination points within the neighbourhood and city/town (Talen, 2003; UN-Habitat, 2013b). The ease of access is evaluated based on walking to the destinations at the level of the neighbourhood and travelling by transport means to other destinations inside or outside the city. These destinations are mainly local retail, school, health centres, open spaces and parks, in addition to other facilities that should be available at the scale of the neighbourhood. The accessibility of a neighbourhood is conditional to the characteristic of the neighbourhoods' layout which also influences the movement fluency of pedestrian. As well layout affects the socio-cultural vibrancy of a neighbourhood (UN-Habitat, 2013b).

Accessibility is a fuzzy notion implies a range of aspects such as the distribution of destinations, the character, the magnitude and the quality of activities, the performance of the system of transportation, the characteristics of individuals and their ability to participate in activities (Handy & Niemeier, 1997; Liu & Zhu, 2004 cited in Silva & Pinho, 2006, p.4). Talen (2003) associates accessibility with transport infrastructure (e.g. streets, railways, pedestrian access ways), as it determines the fluency in reaching buildings, other spaces and places. The degree of ability defines the level of accessibility to the area that residents and user can access, in addition to, availability of transport means for the residents to carry them to reach and access places and other utilities outside their residential area, while Vialard

(2013) drives accessibility by the size and the location of the buildings, urban blocks and street types. Also, there is a close relationship between accessibility and density, land use and block layout's features and characteristics (Ray & Vadiya, 2011). Guaralda (2014) argues that density, proximity and other elements of urban form impact on the accessibility, productivity and efficiency of cities. The degree of accessibility depends on urban connectivity which is related to the street density and street design and patterns. Connectivity can be measured by the numbers of the intersection, their proportion and density per square kilometre of given areas (Vialard, 2013). Therefore, Liu and Zhu (2004) consider accessibility as a layered concept depending on several variables.

To enhance accessibility in an urban area needs the planner to promote settlement pattern that priority is given to increase the access between residents, workplaces and the services they need. Therefore, to provide a vital local street, the street should be used and accessed by both pedestrian and local vehicles. The short distances between the intersections will encourage walkability and gives proper rhythm to buildings on the block (Katz, 1994).

Moreover, accessibility can be enhanced through connectivity. The street with high connectivity is characterised by finer grain, small urban blocks and a greater number of intersections and junctions, and the number of access points affects the type of accessibility. The internal connectivity of a neighbourhood depends on the street intersections, the density of housing per block and the amount of block perimeter, while external connectivity depends on the distance from ingress and egress (Vialard, 2013). Streets that are easily accessed and have well-connected to other facilities attract more pedestrian and frequently accessed. In turn, this leads to a concentration of more uses on these streets. This applies to all other scales; neighbourhood, district and city level (Jacobs, 1961; ODPM, 2005; Ray & Vadiya, 2011).

The proximity of an intended activity described as how efficiently with less time and travel distance a person can reach. It is simply measured as the distance to the nearest intended activity. Proximity mainly depends on the accessibility of the travel means and the land use planning (Johnson, 2007 cited in Kotharkar, Bahadure & Sarda, 2014, p. 4264). The maximum distance between resident's houses to local services is the length of 5 minutes to walk. The distance estimates as a quarter-mile from the edge of the neighbourhood to its central area. The reason behind providing access by proximity is reducing the need for travel by allocating commercial, retail, bus stop and other educational and health facilities close to housing. This strategy tends to balance accessibility by pedestrian, car and other transportation modes at the destination and origins.

There are different street patterns that can be adopted to elevate access at neighbourhood or city level. The radial roads are mainly concentric road patterns which based on a centre point, and any expansion may seem to be very limited. Most of the traffic concentrates on the centre point leading to constrain easy access and generating traffic congestion. The circular road can function in conjunction with radial roads or the place where two grid streets meet. The grid-iron pattern of streets covers all urban area alike; it gives more flexibility to be expanded in all directions (UN-Habitat, 2013a). There is a difference between internal streets which are designed for pedestrian access to the heart of urban blocks, like passages. These streets do not have the same impact in term of density and accessibility as streets that have

been purposefully designed for car access to the centre of the blocks, because of the differentiation in the size and density of blocks (Vialard, 2013). Therefore, the long length of streets and the big size of urban blocks are not recommended for new developments. According to UN-Habitat (2013a) the maximum street length in the neighbourhood should not exceed than 111 meter, which gives also an indication of the size of the urban block likewise. Within one square Kilometre of the neighbourhood area, there should be eighteen kilometres of street length (UN-Habitat, 2013a). Hence, the combination of high-density settlements, mixed land use, appropriate design and layouts of streets and neighbourhoods, building configuration and density, the arrangement of arterial streets, roads and open spaces, in addition to high-capacity public transport systems are responsible to enhance accessibility (UN-Habitat, 2013b). Elevating accessibility can place human and spatial dimensions at the core of sustainable urban development (UN-Habitat, 2013b).

Accessibility to urban open spaces has been also gained the attention of many researchers and investigated from various perspectives; the methods they adopted for measuring accessibility depended on the objective of the researches. According to (Erkip, 1997; Oh & Jeong, 2007; Landry & Chakraborty, 2009; Chang & Liao, 2011 cited in Song, 2012, p.1) many of the researchers rely on simple methods such as traditional gravity model and measuring proximity. Some researchers use utility-based models, while others developed an integrated approach to assess the accessibility and attractiveness of the place (Herzele & Wiedemann, 2003 cited in Gondo, 2012, p.1384).

6.4.6. Greening

Urbanization has seen as a barrier between people and the natural space expansion (Li et al, 2005 cited in Gondo, 2012). Rapid urban growth creates challenges for the environment recognised by the global community. Nonetheless, it is argued that green open spaces and urban parks are important elements for enhancing the quality of life in cities of increasingly urbanised contexts (Esbah & Deniz, 2007). Urban green space can be described and understood in different ways depending on the point of view and the scientific approach that explains and defines it. Socially it is understood as a place of meeting, politically as a public realm and environmentally and ecologically as green areas (Teller, 2003).

Open Space and green infrastructure in neighbourhoods and cities are manifested in different forms. They should be in a range of forms and offer a variety of opportunities to people. The green infrastructures are an indispensable element of urban space and play a role in enhancing the urban quality of life. Moreover, they are environmental assets of the great importance of any urban settlement- see Figure 6-4.

The public awareness increased regarding the necessity of urban open spaces by using natural elements and components in the urban context (Loures, Santos & Panagopoulos, 2007). Urban green open space produces many functions and benefits to the city (Haq, 2011), therefore, its efficiency is used as a way to evaluate the sustainability and the liveability of any city. The quality of life of the city is a core issue of sustainable urban planning and urban development through considering the criteria and indicators of a sustainable city such as the amount of public green space per inhabitant, urban parks and other recreation areas (Chiesura, 2004; Urban Task Force, 2005; NYS, 2007).

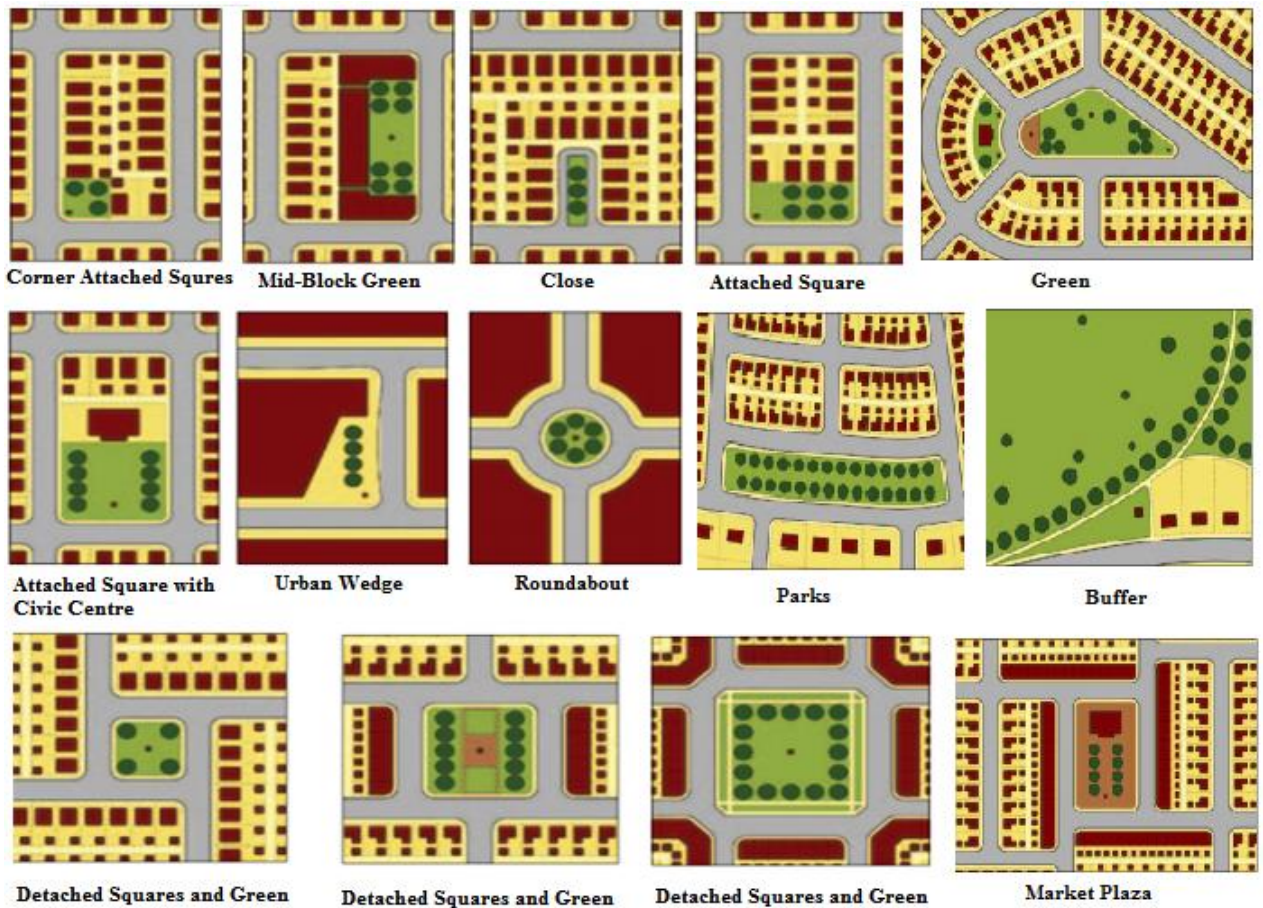


Figure 6-4: Typology of distribution of green spaces in the residential area at the neighbourhood level

Source: MIAMI-DADE, 201, p.29

Open green space has a great impact on the local environment. Moreover, it provides opportunities for social activities which are accessible for all and participates in generating unique urban environment (Whyte, 1980; Gehl, 1987; Wooley, 2003; Forsyth and Mussachio, 2005 cited in Song, 2012, p.1). Therefore, urban green space (UGS) has become a great part of urban open space, and it includes all spaces which are covered with natural or maintained with vegetation -publicly or privately owned- and publicly accessible. These areas are opposed to building and paved areas in the city. The urban green space includes side-road plantation, community parks, forested land and other green structures inside the urban milieu. A diversity of urban green open space types can enhance and create a well-functioning system of open spaces within the city- see Appendix (2) and (3). Thereby, establishes a more productive system in providing services to the community or the city needs. Green infrastructures reduce heat islands and improve the microclimate (Haq, 2011). Planners have an increasing awareness that people value green space for non-market characteristics (Hague & Siegel, 2002 cited in Balram & Dragićević, 2005, p.149).

There are two main open space planning approaches which have been identified in the literature; the demand and supply approach (Maruani & Amit-Cohen, 2007). In addition to, many other models and approaches have been developed such as; Ethical approach, Utilitarian

approach, Development approach and Economic approach, each of them has adhered to distinct urban plans and contexts (NYS, 2007; Maruani & Amit-Cohen, 2007; Baycan-Levent, Vreeker & Nijkamp, 2009). These approaches evaluate open green space from different points of view. The demand approach depicts urban green open space as a mean to fulfil the population's needs and demands for recreation and other amenities that enhance environmental quality in the city. In this regard, open space should satisfy the preferences and relate to the values of the target population. This approach particularly supports parks, gardens and other green open spaces proximity to urban areas, their accessibility and distributions (Maruani & Amit-Cohen, 2007). While the supply approach concentrates on conserving of green open spaces and focus on the protection of ecologically sensitive areas. This approach has gained importance from the side of ecologists, conservationists and ethical approach's supporters (ibid.). However, this approach has adopted by utilitarian approach supporters to supply different quantities and types of environmental services and goods to users of open spaces – see Appendix (4).

Despite that, there is no specific rule that proposes a minimum size for green spaces concerning a given number of inhabitants. There are many other sustainability indicators of urban development that include parameters about urban green open spaces, which reflect citizens' satisfaction and perception of their living built environment (Chiesura, 2004). There are various standards and measurements to quantify the area of urban green spaces for each person, and the availability of open and green area within the neighbourhood, town and city. No universal agreement exists regarding the applicability of these standards to a different context. Therefore, a huge amount of references is available introducing different standards which are specifically related to certain contexts. For example, ministry of planning and housing in Iraq recommends the area of 8m²/ resident of green open space within neighbourhood and 5m² within the city, while in Hong Kong 1m²/ resident and the share of each resident in Vienna city's green area is 120m². The World Health Organisation (WHO) (2010) has set a minimum target of 9 m² and an ideal value of 50 m² of urban green space per inhabitant at the city level. For example, other references like the United Nations Environment Programme (UNEP) determine the minimum area from 12m²- 16m² for each person at the city level. The green open area per person depends on the context and the availability of the land.

6.4.7. Social Sustainability (Resident Satisfaction)

Dempsey, Bramley, Power, & Brown (2011) point out that social sustainability is being widely accepted as one of the essential dimension in achieving sustainable urban development. There is no consensus among the researchers regarding the criteria that should be used in social sustainability research. There is a widespread agreement that the social components of sustainability play a great role in promoting sustainability. Furthermore, there have been many attempts to operationalise the social sustainability to evaluate urban planning outcomes and the degree of their sustainability (Bramley & Power, 2009).

Yiftachel and Hedgcock (1993 cited in Bramley, Brown, Dempsey, Power & Watkins, 2010, p. 106) define urban social sustainability as *“the continuing ability of a city to function as a long-term, viable setting for human interaction, communication and cultural*

development". Within the definition the emphasis has put on the need for a city to function as an interactive unit, this implies the notion of the sustainable urban form and social sustainability. Urban form elements provide more opportunities for social interaction- such as viable streets, public spaces and walking- which helps to promote social capital, a sense of community and resident involvement in the social life of urban neighbourhood (Talent, 1999).

Many factors influence the level of residential satisfaction with their residential area. Some of these factors are related to socioeconomic status, and others related to physical characteristics of urban form. Bramley, Brown, Dempsey, Power and Watkins (2010, p.105) confirm that the "*Urban forms cannot be considered 'sustainable' in the full sense if they are not acceptable to people as places to live, work and interact*". The level of neighbourhood satisfaction is claimed to be influenced by both social and physical attributes of the residential built environment (Mohit, Ibrahim & Rashid, 2010). Many personal and experimental factors affect the degree of the satisfaction of the residents such as; previous neighbourhood experience, the individual's educational and aspiration level, sense of community, the degree of social interaction and the person's socioeconomic status (Butterworth, 2000). Therefore, the degree and the level of satisfaction of the resident is an important indicator in evaluating the quality of life of urban built environment (Pacione, 2003; Mohit, Ibrahim & Rashid, 2010), and in turn, affects the individual's quality of life. Resident satisfaction can be an important measure of liveability by examining the individual interpretation of the quality of life of a neighbourhood. Also, resident satisfaction with an urban neighbourhood determines the level of community stability, as a more resident satisfied with their residential neighbourhood is less likely to move out to another one (Bramley and Power, 2009). Moreover, it provides measures of how certain aspects of the urban form (e.g. density, accessibility) impacts the social acceptability of the urban form (Arundel, 2011). Furthermore, it provides important inputs to the policy-makers to know the degree of success of policies for achieving sustainable development (Rani & Shumsuddin, 2013).

Bramley and Power (2009) claim that the resident satisfaction overlaps with other two outcomes of social sustainability namely; the sense of community (the degree in which people feel pride and attached to their neighbourhoods) and social connections (the degree in which people feel stronger relations).

Urban form configurations can affect the liveability of the neighbourhood; therefore, satisfaction can help to better determine the acceptable urban form. There is a strong relationship between key aspects of urban form such as density, type of housing, accessibility and social sustainability outcomes (Bramley & Power, 2009). Quality of life reinforces through establishing a good relationship between residential, retail, education and health facilities. This relationship fulfils better social interactions, a sense of community and neighbourhood satisfaction within the built environment (Barton, 2000 cited in Rani & Shumsuddin, 2013, p. 1161).

The degree of acceptability of the level of residents' satisfaction is a relative issue in term of social sustainability. Hence, the degree of resident satisfaction with the built environment remains a contextual matter depending on cultural and environmental aspects.

6.5. Approaches for Measuring Urban Form and Structure

Spatial structure of any city is the accumulation and a result of many; events, policies and preferences along to the history of the city. Hence investing and analysing the city is required, but at the same time, it is complex and challenging (Johnson, 2007). Cities are growing and evolving, at any point of time, the character of urban form and structure is different and need to be measured and mapped through using methods and techniques developed by the scholars (Bertaud, 2013). The structure of the city can be understood by analysing its components and characteristics. Conzen (1960) considers land use, building structure, plot pattern are the most important elements which the structure of an urban settlement can be investigated through. The early attempt for assessing of urban form has been done by (Lynch, 1984) through listing five dimensions of performance measured solely by reference to spatial form for evaluating the goodness of urban form which are vitality, sense, fit, access and control. Also, Scheer and Scheer (2002) have listed eight broadly accepted components or elements of sustainable urban form, namely; compactness and density of urban form, balancing land use, preservation of existing built form, open space availability, parcel size, size of the building, a mix of the building type. To delimit the area of the urban design Shirvani (1985) identifies elements of urban form and structure as land use, massing, open space, building form, circulation and parking, pedestrian walkway, signage and activity support. Therefore, the components of urban form and structure can range from very small localised scale such as fenestration, façades and building materials, to a broader scale such as housing type, street type and their spatial arrangement or layout, urban blocks, neighbourhood and city (Knaap, Song, Ewing & Clifton, 2005; Dempsey et al, 2010).

Urban form and structure understood through a mixture of physical and non-physical elements. Land use, building type, urban block, plot size, layout and street network, these elements are considered to be classified as physical elements, and manifest in housing, schools and other facilities and infrastructure, and reflected on the characteristics of the urban fabric of the city. While non-physical elements are the urban activities generated through the interaction between physical urban elements and their inhabitants, creating a certain socio-economic and environmental condition (Lee, 2012).

Understanding of the spatial organisation of the urban area can provide planners with strategies to implement and improve municipal developments (Bertaud, 2013), and at the same time provide important inputs to urban planners and decision-makers. In general, measuring and evaluating urban form and structure can help to:

- Take decision regarding course of actions for future development,
- Identify strategies that essential and integral to the existing development, and
- Monitor and evaluate the existing structure and its consistency with the development objectives and policies that shape the city structure (Bertaud, 2001; Bertaud 2004 cited in Kotharkare, Bahadure & Sarda, 2014, p4249)

The scholars developed different measures of urban form and structure. These measures are analysed in different ways depending on the trends that measured and diagnosed, therefore, these measures and indicators are related to the various characteristics of the city such as; compactness, accessibility, sprawling, spatial structure and social sustainability. Thus, the urban form can be investigated and assessed based on the analysis of the data

related to the above aspects (Johnson, 2007). The following matrix summarises various approaches used to measure the sustainability of urban form and structure as mentioned or applied by different scholars- see Table 6-3.

Table 6-3: A summary of applied indicators for measuring urban form and structure

Scholars	Trends Measured	Indicators/ variables
Conzen,1960	Morphology	Land use, building structure, plot pattern & street pattern
Board of the city of Redwood ,2011	Elements of urban form	Physical structure & infrastructure, street designs, circulation system, a massing of buildings & accessibility
Galster <i>et al.</i> 2001	Urban sprawl index	Density, continuity, concentration, clustering, centrality, nuclearity, mixed use, proximity
Bourne,1982	Spatial structure	Physical pattern, land use activities, population density, transportation, degree of compactness, size or shape of the city & phases of development
Ewing, Pendall & Chen, 2000	Sprawl indices for four components	Residential density, neighbourhood mix of homes, jobs and services, accessibility of the street network
Burton, 2000	Social equity	Density, a mix of uses, intensification.
Bertaud, 2013	Spatial structure of the city	Spatial distribution of the population, pattern of trips made by people from residence to locations for work, school, shopping, social activity, etc.
Alford & Whiteman, 2009	Transport energy use & greenhouse gas emissions	Degree of compactness, layout of the settlement & stages of urban development
Song & Knaap,2004	Development patterns	Street design and circulation system, density, land use mix, accessibility, pedestrian access
Fulton et al, 2001	Trend in urban form & land consumption	Actual measurement of urbanized land, density
Krizek,2003	Neighbourhood accessibility & transport behaviour	accessibility, housing density, land use mix, street design, small plots, proximity of land use, distinct neighbourhood Centre, narrow streets, lanes of pedestrian, on-street parking, sidewalk, tree lining, shallow setback, porches
Knaap, Song, Ewing & Clifton,2005	Measures of urban sprawl	Measurement of density, measures of shape, accessibility, transport networks, neighbourhood design, landscape
Dempsey et al,2010	Elements of urban form	Housing type, density, land use, layout , transportation social relationship
Shirvani,1985	Element of urban design	Land use, massing, open space, building form, circulation & parking, walkway, signage & activity support
DETR,2000	Urban design in planning system	Character, continuity, enclosure, quality of public realm, ease of movement, legibility, adaptability & diversity
Hess et al.,1999	Site design & pedestrian travel	Using block size, length and completeness of sidewalks
Krier,1984	Elements of urban form	Street, urban block, squares, public spaces
Bently & Butina-	Urban design issues	Physical layout of the city, density, street layout,

Watson (1990)		transportation, employment
Tsai, Y., 2005	Quantifying compact vs. sprawl	Population size, density, degree of equal distribution (Gini coefficient), degree of clustering (Moran coefficient)
Scheer & Scheer, 2002	Managing intermediate size city	Compactness, density of buildings, preservation of existing built form, balancing land use, open space, parcel size, size of building & mix type of buildings
Panerai, Castex, Depaule & Samuels, 2004	Urban design issues	Physical layout & design of the urban settlement, density, street layout, transportation,
Bramley & Krik, 2005	planning & urban form	Shape, size, intensity of settlement, spatial organisation of land use
Handy, 2006	Transportation, land use & physical activity	Land use pattern, transportation system, design
Mead, Dodson & Ellway, 2006	Key relationship & policy imperative	Design of buildings & streets, land use & transportation
Kotharkar, Bahadure & Sarda, 2014	Measuring urban compactness	Gross population density, average built-up area, average land consumption per capita, population density by distance from CBD, land use balance, land use area at levels of building, neighbourhood and city, density, average trip length, road network density, congestion index, street shape performance,
Saya, Yamagata & Nakamichi, 2014	Measuring compactness	Occupancy rate, household size, city size
Chen, Jia & Lau, 2008	Compactness vs. urbanisation	Urban population growth, urban build-up area, rate of urbanisation, land consumption rate, availability of; health, education, commercial, road efficiency, efficiency of public transport,
Gong, Chen, Liu & Wang, 2014	Intensity change of urban development	Urban road Area m ² per capita, residential area m ² per capita, green Area per capita m ² , residential land ratio, residential built-up area m ²
Ibrahim, 2008	High density & mixed use	Open space ratio, residential area ratio, plot size, grain, connectivity of streets, sidewalk lanes
Arifwido & Perera, 2011	Quality of life & compactness	Gross district density, distance to the CBD, urban facilities area
Holden & Norland, 2005	Compactness & energy consumption	Land use characteristics, urban density, residential area, urban service area, building type,
Jim, 2004	Relationship of green space & compactness	Green area, built-up area
OECD, 2012	Compactness assessment	Gross density, net density, floor space ratio, proximity to services, urban growth rate, built-up area, share of persons of green area, percentage of peoples living within 500 m,
Sim & Mesev, 2011	Sprawl & compactness	City size, density, shape, open space
Burton, 2001	Justice & compactness	Population density, built-up area, housing density, persons per household, residential area, ratio of residential to non-residential, rate of new housing building, change in housing building, change in density, ratio of residential to non-residential,

		spread of facilities horizontally, incidence of mixed retail/residential and commercial/residential development
Dempsey et al, 201	Spatial structure	Gross density (city), gross density neighbourhood, net residential density neighbourhood, net residential density, floor Area ratio, coverage area ratio,
Zhu, 2012	High density & low income family	Housing stories, plot ratio, site coverage area,
Shoup, 2008	Gradual density zoning	Plot size, block size, land assembly,
Pont & Haupt, 2009	Relationship of space & density & form	Land use intensity, coverage area, building heights,
Chan, Tang & Wong, 2002	Density control & quality of life	Building density, plot area, population density, floor area ratio, built-up area
Roberts, 2007	Urban density changes	Urban land use density, urban mass density, population density,
Alexander, Reed & Murphy, 1988	Density & urban form	Street width, space between buildings, plot size, plot form, back yard depth, set back from street, depth of site, block configuration, block size,
Shi, Sun, Zhu, Li & Mei, 2012	Growth type & density distribution	Urban growth density, growth type,
Kim & Sohn, 2002	Density & street configuration	Land density, buildings type, street configuration,
Islam, 2007	Relationship of density & sprawl	Physical density, plot characteristics, land use pattern, building density, building heights, plot sizes, built-up area
Forsyth, 2003	Measuring density of residential & building intensity	Parcel density, block density, net neighbourhood residential dwelling density, net neighbourhood density, gross neighbourhood density,
Petersen & Wilson, 2011	Residential density types	Plot size, building height, street width, parking, plot frontage, setback & gardens
Churchman, 2009	Disentangling density	Parcel density, street density, gross residential density, neighbourhood density, gross living area density, residential destiny, population density, community density
Ibrahim & Shaw, 2009	Compactness & high density	Land use area at levels of buildings & neighbourhoods
Crevero, 1996	Density & transit	Single-family detached house, low rise family housing, high rise residential buildings, commercial and other land uses
Sperry, Burris & Dumbaugh, 2012	Transit & mixed use	Land uses, vehicle Miles travelled, travel mode analysis
Talen, 2008	Design & diversity	Mixing of different housing type, building densities, household sizes, plot sizes, tenure types, mixture of social and income
Fainstein, 2004	Diversity	Building diversity a mix of high and low rise types, streetscapes, mix of uses
Frey, 2005	Spatial structure	Desirable urban features, mixing of different housing type, building densities, household sizes, tenure types, mixture of social and income
Dempsey et al, 2011	Spatial Structure	Bus stop location, proximity to services, bus route

		coverage, frequency of services, location off-street parking, on-street parking, location of route of pedestrians, location of routes of cycling, speed restrictions, access to daily need (percentages of population),
Tsitoura, Tsoutsos & Daras,2014	Measuring efficiency	Comfort conditions
Koohsari, Kaczynski, Corti & Karakiewicz,2013	Accessibility to POS	Proximity, distance, size,
Koohsari et al,2015	POS & physical activity & design	Proximity, typological of POS, quality, number of POS
Malek, Maraipan & Abrahaman,2015	Relationship between POS & social sustainability	Active activities, passive activities, lot size area, accessibility, green coverage, design and management
Rasidi, Jamirsah & Said,2012	Public open space& urban design effects	Green quality, green setting, accessibility to POS, dynamic features, social preferences, green space design character
Arundel, 2011	Urban form & social sustainability	Street orientation, human scale, space of opportunity, automobile dominance, spatial diversity, aesthetic values
Rani & Shamsuddin,2013	Urban form & residents satisfaction	Density, housing type, layout, land use, Transport and accessibility
Ngesan & Karim,2012	Commercial activity & urban quality	Commercial activities towards quality of life
Zenker & Rutter, 2104	Social satisfaction & Place attachment	Variety of shopping opportunity, tranquillity, open spaces availability, job chances, cultural activities
Ibem & Amole, 2013	Quality of life & housing	Housing unit characteristics, location of housing, housing services, Socio-economic environment of housing
Delmelle, Haslauer & Prinz,2013	Social satisfaction & neighbourhood	Housing characteristics, commuting & transportation
Kyu-in & Dong-woo, 2011	Satisfaction & residential quality	Tenure, owner-occupied dwelling, dwellings type, type of architectural design
Bramley & Power,2009	Urban form & social sustainability	Gross density, house type, density of cars, density of dwellings, density of household

Source: Own construct

6.6. Categorisation of the Indicators based on the selected Sustainable Criteria

Based on the above table, a set of indicators are derived with the reference to the extensive reviewed literature to measure and assess urban form and structure of the city at the neighbourhood and city level. The set of these indicators are categorised in relation to compactness, density, mixed use, accessibility, diversity, green space and social satisfaction criteria. Some of these indicators are related to measuring urban form at both levels of the neighbourhood and the city, while others are concerned to measure each level independently - see Table 6-4.

Table 6-4: Categorisation of the indicators according to the sustainable criteria

NO.	Key Characteristics	Scholars	Indicators for measurement & assessment
1	Compactness	Conzen (1960); Galster et al (2001); Boume (1982); Ewing, Pendall & Chen (2000); Alord & Whiteman (2009); Song & Knaap (2004); Knaap, Song, Ewing & Clifton (2005); Tsai (2005); Scheer & Scheer (2002); Bramley & Krik(2005); Kotharkar, Bahadure & Sarda (2014); Saya, Yamagat & Nakamichi (2014); Chen, Jia & Lau (2008); Gong, Chen, Liu & Wang (2014); Arifwidodo & Perea (2011); Holden & Norland (2005); Jim (2004); OECD (2012); Sim & Mesev (2011); Burton (2001); Dempsey et al (2010); Shi, Sun, Zhu, Li & Me (2012); Islam (2007); Ibrahim & Shaw, (2009); Shirvani (1985); Handy (2006);	Gross residential density
2			Average built-up area
3			Land use consumption per capita
4			Percentages of land use pattern
5			Average land absorption
6			Gross parcel area
7			Gross coverage area
8			Built area density
9			Open space area
10			Undeveloped area
11			Setbacks
12			Building attached type
13			Net residential density
14			Street network density
15			Rate of urban growth
16			Sprawl rate
17			Land use balance
18			Degree of compactness
19			Housing pattern (low & High rise)
20			Grain
21	Density distribution	Galstare et al (2001); Ewing, Pendall & Chen (2000); Bertaud (2013); Song & Knaap (2004); Fulton et al (2001); Krizek (2003); Knaap, Song, Ewing & Clifton (2005); Dempsey et al (2010); Bently & Butina-Watson, (1990); Kotharkar, Bhadure & Sarda (2014); Saya, Yamagata & Nakamichi (2014); Chen, Jia & Lau (2008); Gong, Chen, Liu & Wang (2014); Ibrahim (2008); Arifwidodo & Perea (2011); Holden & Norland (2005); Jim (2004); OECD (2012); Burton (2001); Zhu (2012); Shoup (2008); Pont & Haupt (2009); Chan, Tang & Wong (2002); Roberts (2007); Alexander, Reed & Murphy (1988); Islam (2007); Peterson & Wilson (2011); Churchman (2009); Crevero (1996); Talen (2008); Frey (2005);	Density distribution
22			Population by distance to the centre
23			Block size
24			Block configuration
25			Plot sizes
26			Plot area
27			Building type
28			Building heights
29			Floor area ratio (FAR)
30			Net residential Density
31			Dwelling density
32			Setbacks from street
33			Household size
34			Occupancy rate
35			Urban road per capita
36			Plot area ratio
37	Accessibility	Board of City of Redwood (2011); Ewing, Pental & Chen (2000); Song & Knaap (2004); Krizek (2003); DETR (2000); Hesse et al (1999); Krier (1984); Mead, Dodson & Ellway (2006); Kotharkar, Bhadure	Average trip length
38			Efficiency of line
39			Link-node ratio
40			Average street length
41			Segment connectivity
42			Network connectivity

43		& Sarda (2014); Dempsey et al (2010); Crevero (1996); Sprperry, Burris & Dumbaugh (2012); Dempsey et al (2011); Kim & Sohn (2002); Koohsari, Kaczynski, Corti & Karakiewicz (2013); Malek, Maraipan & Abrahaman (2015); Turzi (2003); Gautam (1992)	Sidewalks
44			Street length
45			Turning radius
46			Number of intersection
47			Public transport accessibility
48			Bus stop location
49			Neighbourhood centre
50			Location of on-street parking
51			Location of off-street parking
52			Street width
53	Block size		
54	Diversity	Holden & Norland (2005); Burton (2001); Talen (2008); Fainstein (2004); Frey (2005); Arundel (2011); DETR (2000); Scheer & Scheer (2002);	Types of housings
55			Types of plots
56			Types of blocks
57			Household sizes
58			Tenure types
59	Land use mix (LUM)		
60	Mixed use	Galster et al (2001); Burton (2000); Song & Knaap (2004); Krizek (2003); Talen (2008);	Mixed use percentages
61			Types of mixture (commercial, industrial...etc.)
62			Horizontal & vertical mixes
63	Public Open Space	Shirvani (1985); DETR (2000); Krier (1984); Scheer & Scheer (2002); Gong, Chen, Liu & Wang (2014); Jim (2004);	Green area per capita
64			Type of open spaces
65			Serviced population
66			Open space ratio
67	Social Satisfaction	Rani & Shamsuddin (2013); Bramley & Power (2009); Zenker & Karim (2012); Ibem & Amole (2013); Delmelle, Haslauer & Prinz (2013); Kyu-in & Dong-Woo (2011)	House features (e.g. height, Built-up area, orientation)
68			Type of housing (low or high rise)
69			Service availability
70			House orientation
71			Sidewalk space
72			House privacy
73			Open space availability
74			House exposure
75			Neighbourhood attachment
76			Elements of neighbourhood (e.g. block sizes, street width, sidewalk)
77			Occupancy rate
78			Tenancy
79			Owner-occupying
80			Proximity of the services
81			Transition space
82	Availability of car parks		

Source: Own construct

6.7. Conclusions

Many approaches have emerged in order to enhance the quality of the urban built environment. Some of these approaches advocate certain policies or strategies as a response to specific urban problems and claim to introduce solutions to urban deficiencies. Moreover, there is a huge overlap in adopting planning strategies between these approaches. Most of these approaches concentrate on neighbourhood level as a basic building block in the city as well as other levels such as city, metropolitan and regional, while others adopting holistic approaches. None of these proposed planning and development approaches can be applied in different contexts and even if in the same context at different periods, because of the continuous changing in the socio-economic aspects of the city. Therefore, it needs to be modified according to the context in which it supposes to be implemented.

Most of the sustainable approaches are emerged and applied in developed countries and related to the context of these countries. Using these approaches as a template in promoting sustainability in an urban area in developing countries is problematic due to the differentiations in social, economic, institutional and environmental aspects. Therefore, after reviewing a huge amount of literature seven criteria of sustainable urban form have been identified. These criteria (compactness, density, mixed use, accessibility, diversity, greening and social sustainability) are outlining the main advocating design concepts of sustainable urban forms which steer physical sustainable urban development.

Many methods and techniques have been developed by scholars to quantify different aspects and characteristics of the urban form depending on measuring and assessing various indicators and variables.

6.8. Illustrated Conceptual Framework

There are many forces pushing city growth such as social, economic, spatial, demographical and political. Inevitably, the growth of the city drives planning institutions to provide housing, roads, land and other infrastructures to respond to the process of growing the city. Thus, the form and structure of the city will change. In case, the spatial planning institutions and other related partners in the city are unable to meet the growing requirements of sustainability, either the informal settlement will increase or resulting in creating inefficient urban forms and structure which accompanied with many urban problems such as overpopulated, sprawling, congestion and lack of open spaces. There is a consensus agreement on the importance of constraining and controlling city growth into a more socially, economically and environmentally sustainable urban form. These goals have emphasised the continued and likely increasing importance of sustainable city form.

The reviewed literature shows there is a linkage between applying the concept of sustainable development and spatial urban planning practices in cities. The integration of sustainability as a concept into spatial urban planning involves two main aspects; *first*, consolidating urban form to pursue more sustainability through continuous adaptation to the new social, economic and physical changes which occurs due to the growth of the city, and *second*, empowering institutions through better urban management and urban governance. These issues have been considered as prerequisites to initiating sustainable physical urban

development and contribute enormously towards bringing sustainability into urban areas of any context.

The spatial/physical dimension of urban sustainability emphasises the need for physical sustainable urban development. There has been widespread agreement on the importance of urban form and structure as an entity in promoting sustainable urban development. At the same time, urban form and structure are considered as a source of urban built environment problems. Urban form and structure is the physical product and outcome of urban planning and urban development process. It manifests on the ground and representing the physical characteristics of the city such as buildings, blocks, streets and land use distribution. The need for more 'sustainability' has further motivated researchers, planners and policy-makers to search for good urban form. Many sustainable development approaches have emerged to deal with city development and advocating certain strategies and policies to promote sustainability in cities. All of these approaches have emerged in developed countries as a response to certain problems. These approaches share many strategies and design concepts, which are essential in applying sustainability to city's form. It is not necessary to apply any of the sustainable forms as an approach; rather, adopting the concepts advocating by these approaches in any urban context is more rational and applicable. Adopting of the approaches as a template to the alien context of developing countries for promoting sustainability, without doubt, causes many deficiencies due to the differentiation in social, economic, environmental and institutional factors, and even the degree of required sustainability is different. Therefore, selecting identified criteria as design concepts which advocated by these approaches is more applicable as long as the concept of sustainable development calls for various approaches to different contexts. Thus, a matrix is drawn to identify the main criteria called by sustainable urban forms to apply them in the context of growing cities - see Table 6-1. These concepts are able to bring a better quality of the environment, guide the city towards more sustainability, and put it on the first step for embracing sustainability.

Enhancing the quality of the built environment through sustainable urban development requires liveable neighbourhoods and streets, integration of activities and arranging of the complex relationships between the buildings and spaces. These imply the degree of minimum residential density, accessibility to different urban amenities, mixed of uses, greening and open spaces and strengthening of social interaction. Thus, the selected criteria for promoting sustainability; compactness, density, diversity, accessibility, mixed use, greening and open space and a degree of residents' satisfaction regarding the built performance will bring a degree of sustainability to the urban context –see Table 6-2. These key design concepts are considered a crucial requirement for promoting and investigating physical sustainability in an urban context. Each of these selected criteria promotes sustainability in an urban context, but they are interrelated and often work most effectively in combination with each other rather than individually.

It is recognized that elements of urban form are inter-related and dependent on each other. The extent to which they are depends on each other is disputable. Scholars have identified various elements that constitute urban form in perspective to different points of view. By reviewing extensive literature, the research comes to conclusion by drawing a matrix to identify elements that considered as main 'principle elements' in shaping and forming urban

city's form. These selected elements are settlement pattern, urban block, street pattern, open spaces, land use and traffic flow of pedestrian and vehicles – see Table 5-2 in Chapter Five. These elements are widely used by the scholars to assess and analyse urban form and structure, and it is believed to be the cornerstone for reorienting urban form and structure to the path of physical sustainability. These elements are at two scales; at the city level and neighbourhood level. There is evidence from the literature that the neighbourhood remains an important milieu and a block unit of cities in achieving sustainability because the city is mere of many neighbourhoods.

The legal framework, regulations, the process of the development and institutions setting-up and involving community remain important principles in achieving and steering sustainability in any context. Ineffective planning institutions and out-of-dated and conflicting regulations cannot produce the creation and the formation of the good urban form. Urban form and structure is the product and outcome of many major actors who have an impact on forming and directing urban development planning and process. A fair and balanced distribution of power and role between these actors are responsible for promoting sustainable urban form and structure in any context.

The conceptual framework has assumed that the concept of sustainable development is an essential means to promote sustainable physical urban development in an urban context. The relationship between the concept of sustainable development, forces of urban growth and urbanisation, the regulatory and institutional structure and elements of urban form is elucidated in a form of the conceptual framework- see the simplified conceptual framework in Figure 6-5 and more detailed conceptual framework in Figure 6-6.

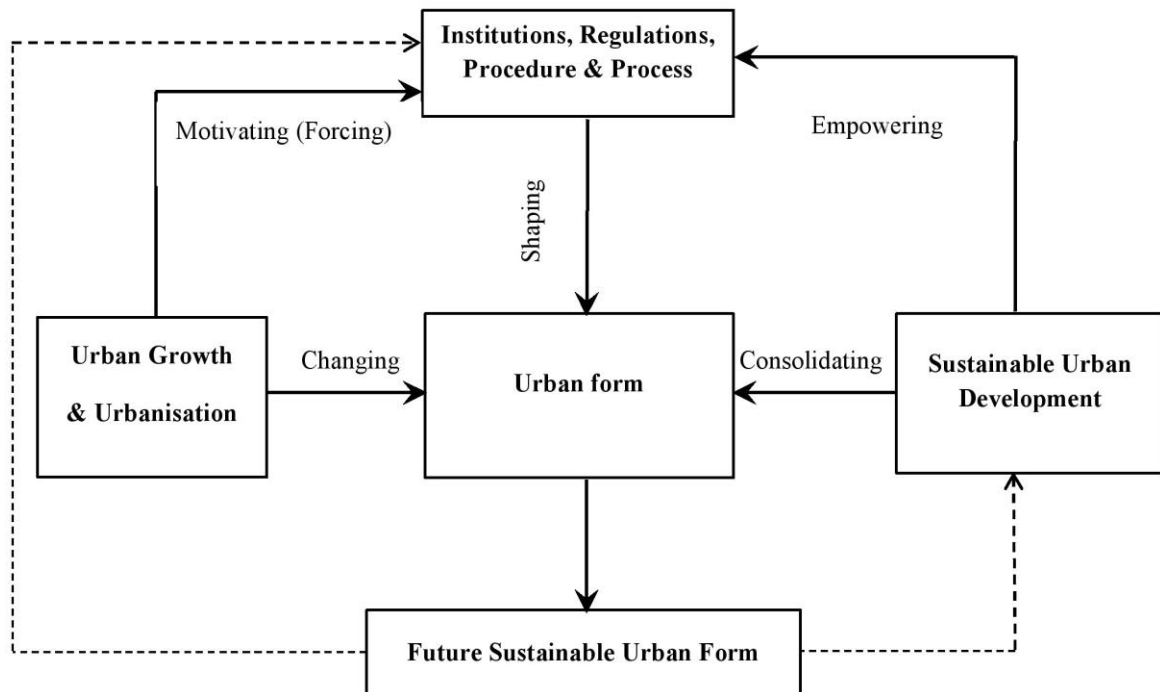


Figure 6-5: Simplified Conceptual Framework
Source: Own Construct

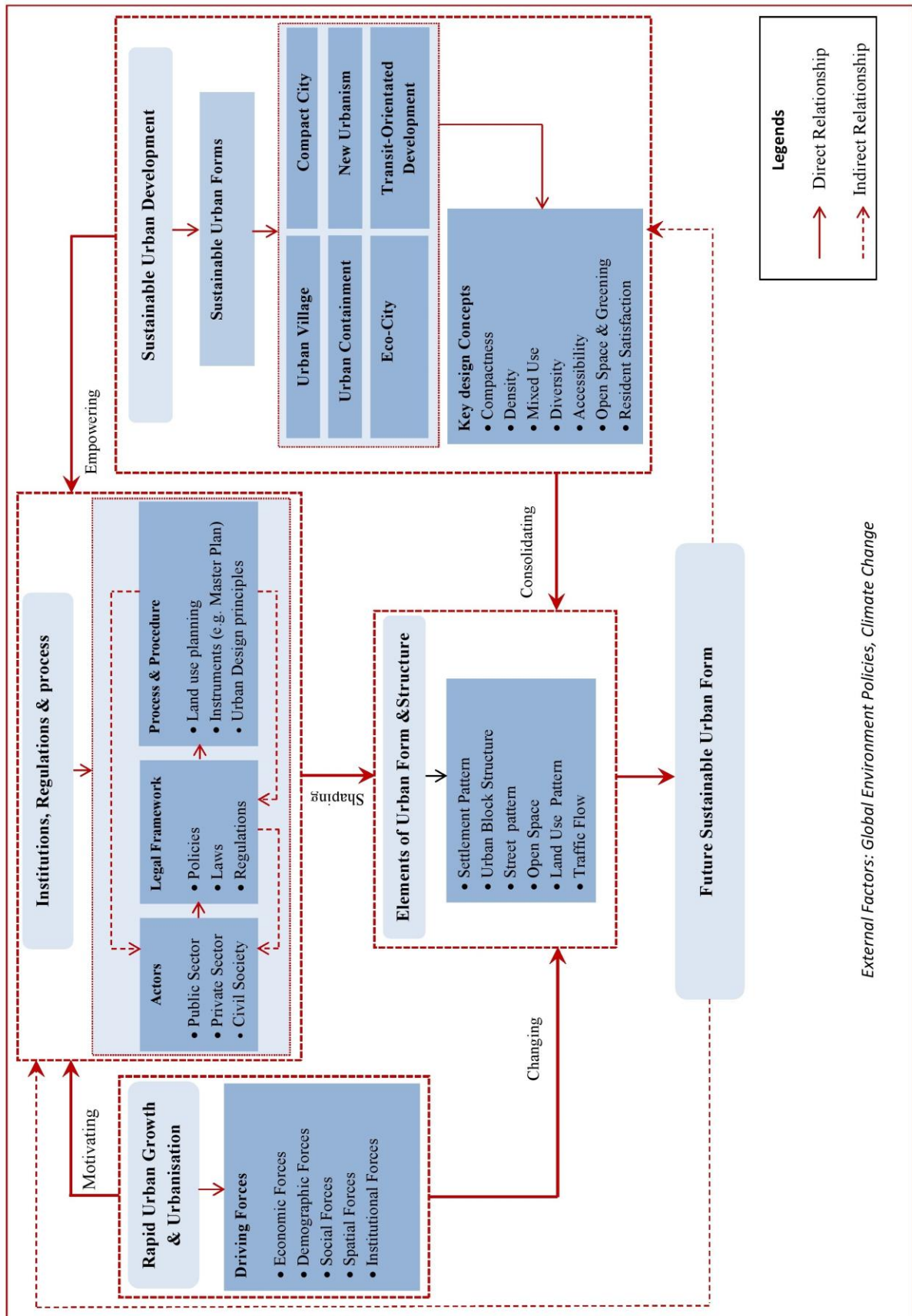


Figure 6-6: Detailed Conceptual Framework

Source: Own construct

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Chapter Seven: Research Methods

7.1. Introduction

This chapter tries to present the research strategy and the rationale for the selection of the case study, in addition to the strategy of the selection of the sub-cases and the units for investigation and their sizes. Also, it presents the used methods in the course of this research and exposes the detailed questions.

7.2. Research strategy and Rationale

The nature of the research problem, namely, the need for examining the urban form characteristics and their validity to enhance built environment, indicates that the approach in carrying out this study is descriptive, explorative and correlational. Duhok city is selected as a case study within which identification and evaluation of urban forms made. According to (Yin, 2003) case study strategy is a useful and advantageous in cases of city and regional planning researches such; studies of plans, neighbourhoods. The exploration of a new concept for future physical urban development in the city of Duhok is supported by the descriptive analysis of the context of the City of Duhok, through investigating urban development pattern, identifying of urban form characteristics and driving forces that influencing the development process, while the correlational approach is to discover the impact of urban form on the sustainability of the built environment.

The urban development process is a complex phenomenon in term of what factors are influencing and shaping its urban form and the process of development, through this approach, the specific context of cause-effect relationships can be applied and investigated. The case study is the best alternative to be able to understand a certain phenomenon in a real-life (Yin, 2003.). Moreover, the case study permits a mixed use of both qualitative and quantitative methods which is necessary to obtain and analyse data for investigating the study (Gillham, 2000; Hancock & Algozzine, 2006).

The starting point for this study is, what constitutes urban physical development, this can be understood through defining urban form as a manifestation of physical urban development in a real-life context. The notion of urban form implies the question of what are the elements that define and shape urban form, and what type of criteria are used to assess these elements from an urban sustainability point of view. This requires systematic approaches in identifying and assigning urban form, therefore, a case study approach is considered and selected as an appropriate research strategy for this study.

The conceptualisation of the research problem helps to breakdown the main question into more detailed questions which assists to identify various formulated variables and clarify them. These variables are essential to link theoretical and operational level. Therefore, it helps to identify the data need to answer the research questions. Consequently, this supports to decide on the research strategy and the type of methods and tools for data collection and analysing these variables - see Figure 7-1. The characters of these variables require qualitative and quantitative data. The qualitative data are here mostly related to the resident's satisfaction and official's perception, interpreting of documents, images, photos and opinions regarding the built environment performance and development process, while quantitative data are mostly related to the spatial characteristics of the urban form. These require to rely on both secondary and primary data as essential resources to obtain data for analysing.

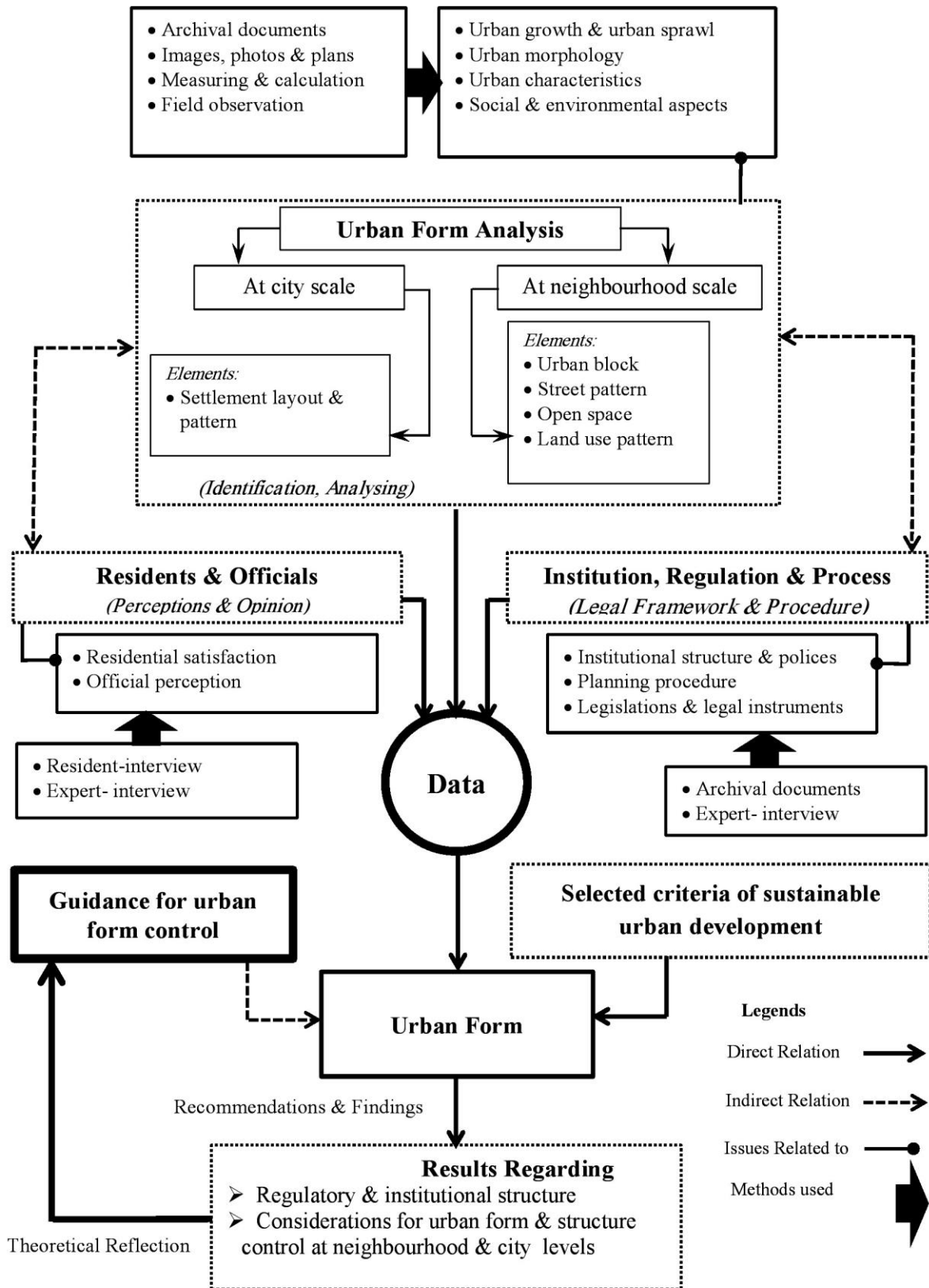


Figure 7-1: Research strategy

Source: Own construct

Therefore, the research uses a combined strategy of the case study and archival study since the urban form cannot be understood without investigating its historical background to identify the factors and circumstance that created it.

7.2.1. Rationale for Selection of the Case-study Area

Case study strategy has been chosen to direct this research. The case-study approach here affords special opportunities and allows the investigation of real-life events within a specific context; moreover, it investigates a contemporary phenomenon (Yin 2003). The case study method also grants the researcher the ability to deal with a wide spectrum of evidence (Kumar, 2012).

The case study can afford the possibility of undertaking single method or multi-methods which give the researcher more space for searching of different methods and techniques for the study as important aspects of case study, namely; in-depth interviewing, obtaining information from secondary records, gathering data through observations, collecting information through focus group and group interview, etc. However, during the time of analysis, the case study has to be considered as a single entity (Kumar, 2012).

There is an agreement among scholars that the choice of research strategy depends mainly on the type of research question(s). Why and how questions give strong indications to use a case study approach (Yin, 2003). Given the main research question stated above in Section 1.6 Chapter One, it is obvious that this research could be located within the ambit of the case study strategy.

As learned from previous Chapters that each city is a unique phenomenon and its urban form is the outcome of many of factors such as, topography, demographic, socio-economic, development initiatives which have their influences on the urban fabric of the city. The character of the city can be expressed through its build features, and every city is considered to be a unique case.

The urban form of a given city at the macro-level (city-level) can consist of many different urban forms at the micro-level (neighbourhood level). It is rare to find out more than one city, even in the same context which holds the same urban form characteristics at the micro-level. Studying the city for the purpose of investigating its urban form at the macro level is not necessary to reflect the clear picture of the urban form on the neighbourhood level, therefore, adopting the strategy of selecting single case study as an entity within the identified boundary, and then selecting neighbourhoods as units (sub-cases) of analysis for more detailed investigation and comparison gives a clear insight on the way that the urban form in the different parts of the city work, and the way that the development initiatives implemented.

Commensurate with this argument, the city of Duhok is selected as a single case study to be investigated at both macro and micro level for the reasons and justifications that have been declared in Section 1.3 in Chapter One.

7.2.2. Identifying Sub-Cases (Units of Analysis)

According to Patton (2002), the units of analysis depend on the prior decision on the focus of the study and he argues that:

“Different units of analysis are not mutually exclusive. However, each unit of analysis implies a different kind of data collection, a different focus for analysis of data, and a different level at which the statement about findings and conclusion

would be made. Neighbourhoods can be units of analysis or communities, cities, states, cultures and even nations in the case of international programmes” (p.228).

To identify the units of analysis is the key factor in selecting and making decisions regarding the consistent units of analysis, and to decide what units are that which something can be said about at the end of the evaluation (ibid.). Therefore, the study tends to select the neighbourhoods as units through filtering them in many criteria in order at the end to identify the appropriate units for investigations.

7.2.2.1. Selection of the Units

The research has taken the scheme of neighbourhoods which produced by the Municipality of Duhok as a base for selecting segments of urban area for investigation. The research adopts the strategy of using the official and public well-known names for the selected neighbourhood's segments.

To select neighbourhoods as units of analysis for detailed investigation has been one of the challenges to this study because the neighbourhoods have not been clearly identified due to:

- 1- Absence of distinctive boundary and characteristics identifying the neighbourhoods.
- 2- Existence of many schemes of neighbourhoods which prepared by the municipality, directorate of Statistics and Land in the city of Duhok which show different boundaries, sizes and even numbers of neighbourhoods.
- 3- Some of the neighbourhoods have more than five times the size and the population of others, which more likely to be considered as districts, not as neighbourhoods.
- 4- Most of the neighbourhoods do not have the centre of services.
- 5- Having regular urban form (planned) and irregular urban form (unplanned) within the same identified boundary of neighbourhoods presents obstacles in front of evaluating and comparing urban forms.

Therefore, within the neighbourhood boundary as major units, another sub-units of analysis have been constituted to ease detailed descriptive account of urban form which represented by plots, urban blocks, streets, building types and open spaces, since the interest of this research is to investigate the sustainability of physical urban development through examining urban form elements at macro and micro levels.

The segments of the urban fabric of the city of Duhok have categorised based on the dominated urban land use into residential and non-residential use, then each of these categories has divided into two sub-categories; regular (planned) form and irregular (unplanned) form. Hence, these criteria guide to identify the units of urban forms from urban fabric with various aspects and situations. Each category represents many characteristics of urban form with different detailed features – see Figure 7-2. Based on, the city of Duhok has divided into 63 urban fragments depending on the type of the urban forms, while the number of the neighbourhoods is officially 48. Under each category the number of the units are:

- 1- Regular residential areas (planned) are 34 units
- 2- Irregular residential areas (unplanned) are 23 units
- 3- Regular non-residential areas (planned) are 6 units

Selecting the units for investigations from the above categories, another set of criteria have been applied which related to the morphological aspects of the urban fabric, in addition to the two other parameters; year of development which has a great impact on the characteristics of

the development and dominated social class⁸. The classification of each category is depended on the following criteria:

- 1- Plots' size, area,
- 2- Pattern of the dominated urban block,
- 3- Street pattern,
- 4- Building type,
- 5- Year of establishing the neighbourhood, and
- 6- Dominated social classes

The selected units are within the juridical boundary of the city of Duhok which is under the authorisation of the municipality of Duhok city- see Figure 7-3.

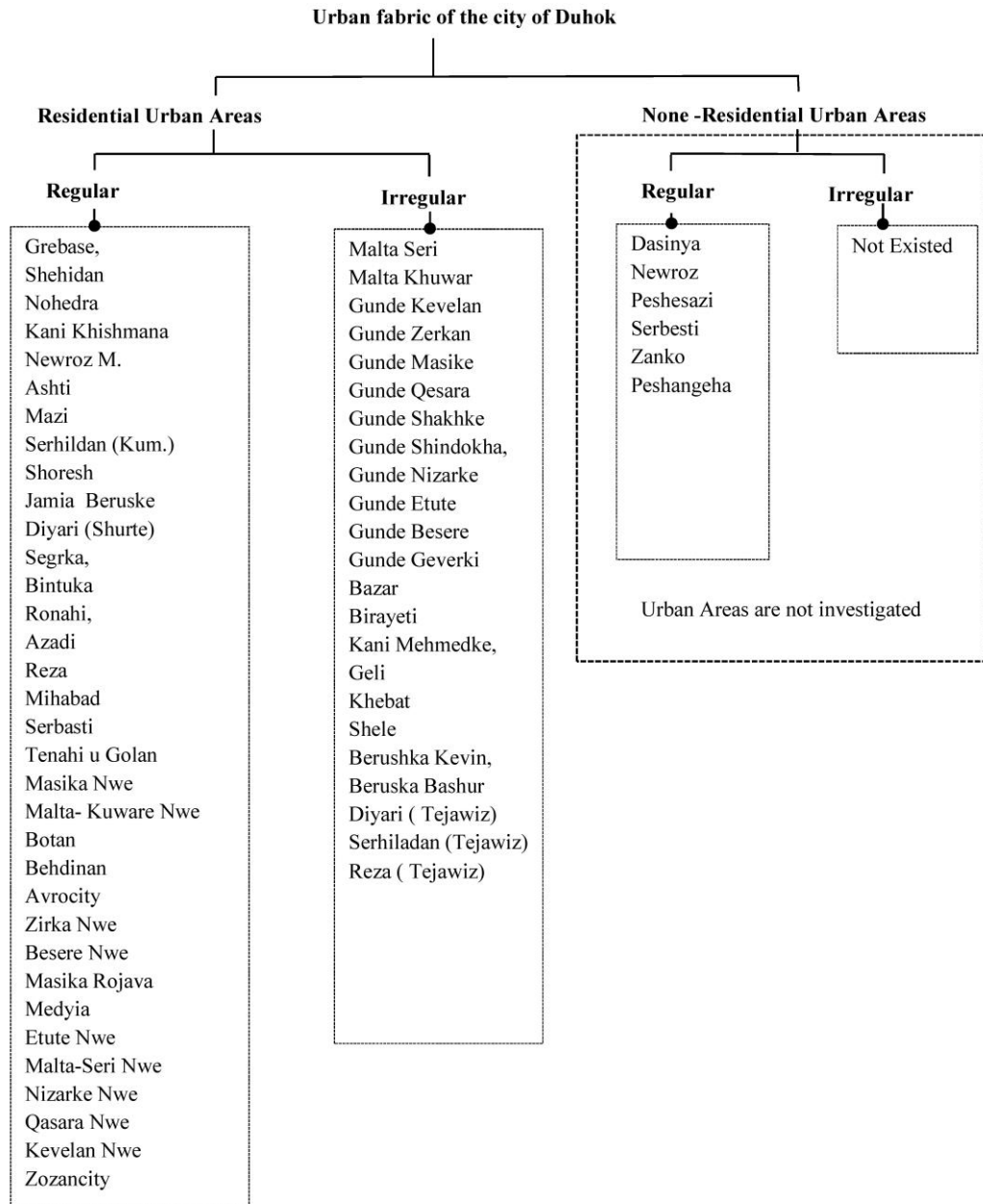


Figure 7-2: Categorisation of the urban fabric (units) in the city of Duhok

Source: Own construct

⁸ -Information regarding dominated social class in the selected areas (unites) have been obtained from the general Directorate of Statistics of Duhok in 2014.

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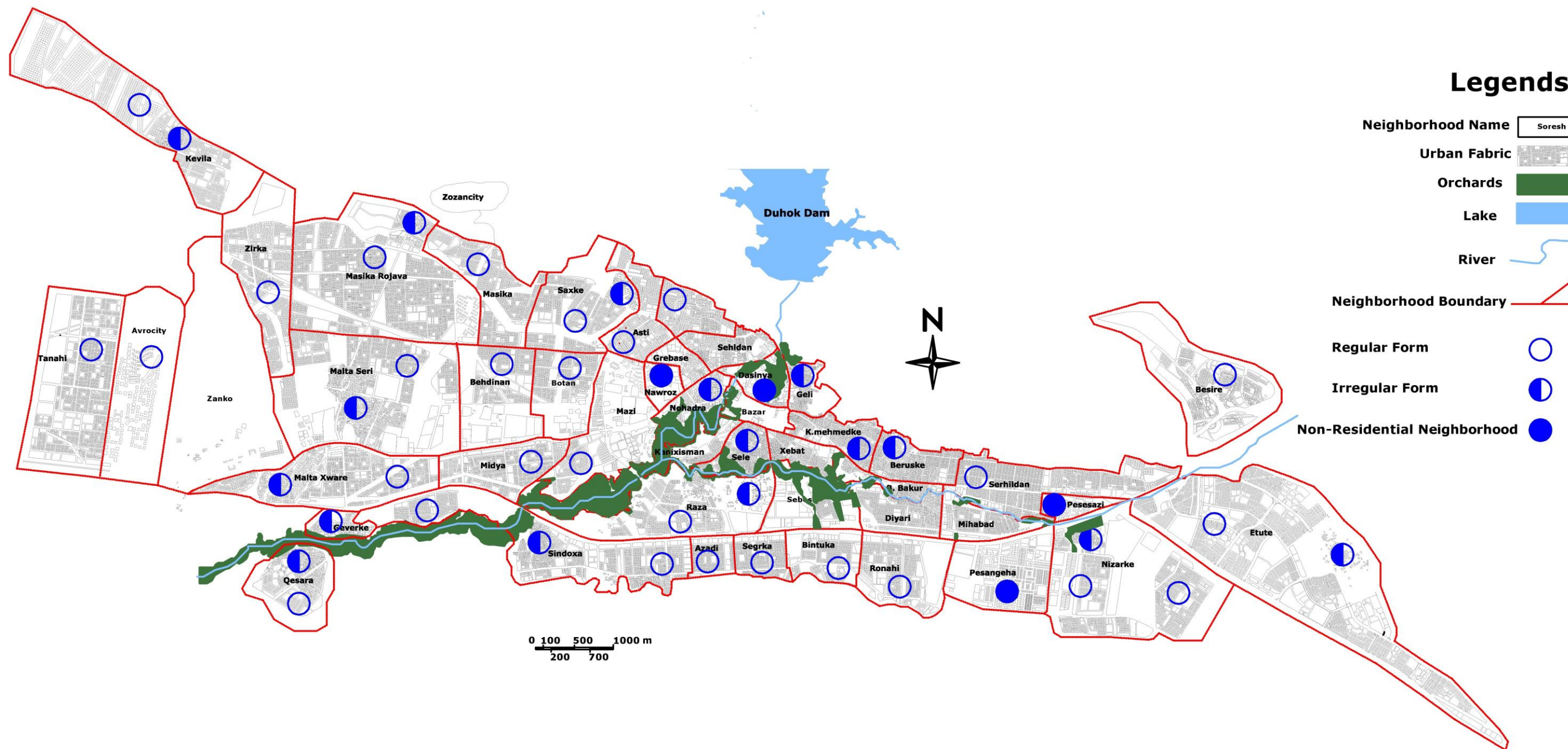


Figure 7-3: Neighbourhoods' boundary and location of the segments in the city of Duhok
 Source: Own construct based on outline plan from Municipality of Duhok in 2014

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The units under the regular-residential category are the urban areas which established, planned and developed in different periods reflecting various characters and features of the physical development and morphology of the city of Duhok. These areas have different characteristics which can easily be identified based on the above criteria - see Table 7-1.

Table 7-1: Regular-residential neighbourhoods in the city of Duhok

No.	Urban Areas (Units)	Dominated plot areas (m ²)	Dominated block formation	Street pattern	Dominated Building Type	Years of develop	Social Class
1	Grebase,	150, 200+ N.F.S	Linear	C+ L.G	1-2 Story, Attached	1965	Poor+ Medium
2	Shehidan	150	Linear	C+ L.G	1-2 Story, Attached	1970	Poor
3	Nohedra	300, 400, 500	Linear	C+ L.G	1-7 Story, Attached	1971	Medium
4	Kani Khishmana	150	Linear	C+ L.G	1-2 story, Attached	1973	Poor
5	Newroz M.	150,200	Linear	C+ L.G	1-2 story, Attached	1973	Medium
6	Ashti	300, 400	Linear	C+ L.G	1-2 Story, Attached	1977	Medium
7	Mazi	Apartments + Houses	Freestanding	C +L.G	Low & High rise Buildings	1977, 2000, 2013	Medium
8	Sheridan (Kum.)	150, 200	Linear	I.G+L.G	1-2 Story, Two attached side	1978, 1980, 2000	Poor
9	Shoresh	300, 400	Linear	Cur.+I.G	1-2 Story, Attached	1979	High + Medium
10	Jamia Beruske	150	Linear	B+L.G	1-2 Story, Attached	1984	Medium
11	Diyari (Shurte)	200	Linear	C+L.G	1-2 Story, Attached	1985	Medium
12	Segrka,	200,300	Linear	B+L.G	1-2 Story, Attached	1986	Medium
13	Bintuka	200,300	Linear	B+L.G	1-2 Story, Attached	1986	Medium
14	Ronahi,	200,300	Linear	B+L.G	1-2 Story, Attached	1986	Medium
15	Azadi	250,300	Linear	B+L.G	1-2 Story, Attached	1986	Medium
16	Reza	200	Linear	B+L.G	1-3 story, Attached	1988	Poor+ Medium
17	Mihabad	200,300	Linear	B+L.G	1-2 Story, Attached	1988	Medium
18	Serbasti	200	Linear	B+L.G	1-2 Story, Attached	1988	Medium
19	Tenahi	200, 250	Linear	B+L.G	1-2 Story, Attached	2000	Poor
20	Masika Nwe	200, 250	Linear+ freestanding	L. G+ I. G	1-3 story +High rise, Attached	2006	Medium High
21	Malta- Kware Nwe	200,250	Linear	B+L.G	1-2 Story, Attached	2006	Medium
22	Botan	200,250	Linear	B+L.G	1-2 Story, Attached	2007	Medium

23	Behdinan	200,250	Linear	B+L.G	1-2 Story, Attached	2007	Medium
24	Avrocity	Apartment+ Villas	Freestanding	B+I.G	High rise building	2008	Medium High
25	Zirka Nwe	200,250, 300	Linear	B+L.G	1-3 story, Attached	2008	Medium
26	Besere Nwe	250	Linear	B+L.G	1-2 Story, Attached	2008	Poor+ Medium
27	Masika Rojava	250+ Apartments	Linear+ Freestanding	B+L.G	1-3 story + High rise, Attached	2008	Medium High
28	Medyia	200,250	Linear	B+L.G	1-2 Story, Attached	2009	Medium
29	Etute Nwe	220, 325, 400	Linear+ freestanding	D+ L. G+ Cur.	1-3 story+ High rise, Attached (New approach)	2010	Medium
30	Malta-Seri Nwe	250, 300	Linear	B+L.G	1-2 Story, Attached	2010	Medium
31	Nizarke Nwe	200+ Apartments	Linear Freestanding	B+L.G	1-2 Story + High rise, Attached	2010	Medium
32	Qasara Nwe	250	Linear	B+L.G	1-3 story, Attached	2011	Medium
33	Kevelan Nwe	200, 300	Linear	B+L.G	1-3 Story, Attached	2012	Medium
34	Zozancity	1000	Linear	B+I. G	Low detached building	2012	High

Note: N.F.S refers to Not Fixed Size, Cur.: Curvilinear, A: Altstadt, B: Bilateral, C: Conjoint, D: Distributer, L.G: Loose Grid, I.G, Iron Grid.

Source: Own construct based on survey and observation

While the listed residential units under the category of irregular-residential are the old urban areas in the city or upgraded informal settlements or villages annexed to the city. Most of the units within this category hold the village's name (Gundê) and known to the people by these names, the villages have remained as unplanned urban forms within the new surrounded urban neighbourhoods. The urban fabric of these villages had grown as an organic urban form without any prior intervention. The characteristics of the irregular urban form (unplanned) are still prevailing on the urban fabrics of these neighbourhoods such as; curved and narrow roads, absence of sidewalks, irregular plots and urban blocks, mixed building types and lack of open spaces and other facilities - see Table 7-2.

Table 7-2: Irregular-residential neighbourhoods in the city of Duhok

No.	Urban Areas (Units)	Dominate plot areas (m ²)	Dominated block formation	Street pattern	Dominated Building Type	Year of developing.	Social Class
1	Malta Seri	N.F.S	Irregular	A+Irrg.	1-2 Story, Attached	-	Poor+ Medium
2	Malta Khuwar	N.F.S	Irregular	A+Irrg.	Low & attached	-	Poor+ Medium

3	Gunde Kevelan	N.F.S	Irregular	A+Irrg.	Low & attached	-	Poor+ Medium
4	Gunde Zekan	N.F.S	Irregular	A+Irrg.	Low& attached	-	Poor+ Medium
5	Gunde Masike	N.F.S	Irregular	C+Irrg.	Low & attached	-	Poor+ Medium
6	Gunde Qesara	N.F.S	Irregular	A+Irrg.	Low & attached	-	Poor+ Medium
7	Gunde Shakhke	N.F.S	Irregular	C+Irrg.	Low & attached	-	Poor+ Medium
8	Gunde Shindokha,	N.F.S	Irregular	C+Irrg.	Low & attached	-	Poor+ Medium
9	Gunde Nizarke	N.F.S	Irregular	C+Irrg.	Low & attached	-	Poor+ Medium
10	Gunde Etute	N.F.S	Irregular	C+Irrg.	Low & attached	-	Poor+ Medium
11	Gunde Besere	N.F.S	Irregular	C+Irrg.	Low & attached	-	Poor+ Medium
12	Gunde Geverki	N.F.S	Irregular	C+Irrg.	Low & attached	-	Poor+ Medium
13	Bazar	N.F.S	Irregular	A+Irrg.	Low & attached	-	Poor
14	Birayeti	N.F.S	Irregular	A+Irrg.	Low & attached	-	Poor
15	Kani Mehmedke,	N.F.S	Irregular	A+C+Irrg.	Low & attached	1972	Poor
16	Geli	N.F.S	Irregular	C+Irrg.	Low & attached	1975	Poor
17	Khebat	N.F.S	Irregular	B+C+Irrg.	Low & attached	1976	Poor+ Medium
18	Shele	N.F.S	Irregular	C+Irrg.	Low & attached	1980	Poor
19	Berushka Kevin,	N.F.S	Irregular	C+Irrg.	Low & attached	1980	Poor
20	Beruska Bashur	N.F.S	Irregular	C+Irrg.	Low & attached	1983	Poor
21	Diyari (Tejawiz)	N.F.S	Irregular	C+Irrg.	Low & attached	1984	Poor
22	Serhiladan (Tejawiz)	N.F.S	Irregular	C+Irrg.	Low & attached	2000	Poor
23	Reza (Tejawiz)	N.F.S	Irregular	C+Irrg.	Low & attached	2002	Poor

Note: N.F.S refers to not a fixed size, Reg.: Regular, Irrg.: Irregular, A: Altstadt, B: Bilateral, C: Conjoint, D; Distributer

Source: Own construct based on survey and observation

The units under the regular-none-residential category are the urban areas which dominated mostly by other land uses such as; university campus, car services (Peshesazi), health services, government offices, big depots, wholesales and small industrial enterprises. These areas are planned and developed in different stages of city development. Moreover, these areas are characterised by their ironic grid networks or curvilinear streets, attached and low or rise buildings. This research does not deal with these urban areas; therefore, it is not included in any investigations - see Table 7-3.

Table 7-3: Regular- none dominated residential neighbourhoods in the city of Duhok

No.	Urban Neighbourhoods	Dominated plot areas (m ²)	Dominated block formation	Street pattern	Dominated Building Type	Year of developing.	Social Class
1	Dasinya	N.F.S	Freestanding	D+Cur.	Medium rise & Detached (dominated by administration buildings and recreational areas)	1972	Medium
2	Newroz	N.F.S 200,300, 400	Linear	B+L.G+ Cur.	Low & attached (dominated by institutional services)	1980 + 1973	Medium
3	Peshesazi	100,200	Linear	B+L.G	Low & attached	1985	Poor+ Medium
4	Serbesti	N.F.S , 200, 240	Linear + Square Grid	L. G+ I.G	Low & attached (dominated by health services)	1985 + 1988	Medium
5	Zanko	N.F.S	Freestanding	D+ Cur.	Medium-high building + Detached (dominated by educational services)	1998	Medium
6	Peshangeha	200,400, 800	Linear	B+L.G	Medium + Low buildings & attached (dominated by big depots, car services, small light industrial projects)	2003	Medium

Note: N.F.S refers to a Not fixed size, Cur.: Curvilinear, A: Altstadt, B: Bilateral, C: Conjoint, D: Distributer, L.G: Loose Grid, I.G, Iron Grid.

Source: Own construct based on survey and observation

Based on the above categorisation, classification and exposed criteria, several urban segments have been selected as units for more detailed investigation. From the category of regular- residential urban areas six units have been filtered namely; Şehidan (Mehela Şehîdan), Aşti (Jamia Grê basê), Serhildan (Jamia Beruşkê), Sêgirka, Masika Rojava (Masîka Nwî) and Êtûtê (Êtûta Nwî). These units carry different characteristics which developed in different periods and have different design approaches.

From the category of irregular (unplanned) urban areas only two cases have been selected namely; Kanîmehmedkê and Geverkê, most of the irregular areas showing many shared characteristics like; the not fixed size of plots, irregular, loose grid and curvilinear pattern of streets, low and attached buildings and lack of services.

7.2.2.2. *The Size of the Units*

As mentioned earlier that large ranges of sizes have existed between neighbourhoods, some of the neighbourhoods have five times the size and the population of others (e.g. Berushaka Bashur and Serhiladan neighbourhoods or Geverke and Êtûtê neighbourhoods). Therefore, for the selection area for micro-examination at the neighbourhood level, the study has undertaken the strategy of (five minutes to walk or 500m distance). As a determination and delimitation for the area of the selected urban areas (units) for scrutiny, this is theoretically accepted distance from the centre of services of the neighbourhood to the far point on the perimeter of

the neighbourhood (Frey, 2005). This research uses a 500m x 500m square segment – *five-minute walk x five-minute walk*- the area of 25 hectares. In term of practically, a circle with a radius of about 283 m is used instead of square segments. The area of the circle with a radius of 283meter yields to the same area under the scrutiny of a square segment (500m x 500m) with more tuned edges. This strategy gives the reasonable areas for the investigation for all selected urban segments (units), and the opportunity for encompassing numbers of urban blocks, plots and streets within this identified circumference of the circle that is enough to know something about them. As well as, this strategy affords enough area for the investigation to know the degree of the sustainability of the neighbourhoods, and reduces the time and sources for investigating the whole selected neighbourhoods.

Practically, to determine the centre of selected units for investigation, the unit's centre is approximately designated, and then the circle with a radius of 283m has drawn from that centre of the units⁹ to indicate the required area for investigation. The research is not restricted to the area inside the circle; rather there is some sort of flexibility and compromising in limiting the area of the units. In case of large urban areas, the circle's perimeter passes through several urban blocks, some of these urban blocks will be included in investigation and others will be excluded depending on the percentage of the block areas that have been cut by circle's perimeter. Therefore, the area of units for investigation might exceed the circle's area. For example, the area that is outlined by the blue line - see Figure 7-4- for indicating the area of the Aştî neighbourhood in the city of Duhok shows the process of including and excluding of urban blocks within the identified areas of the urban neighbourhoods. The area within the boundary of blue line here is measured about 25.44 hectares. As seen, some urban blocks are remaining outside the circle area (in blue colour) and outside the red shadow area which will be excluded. This strategy can be true and applicable to those urban units which have large sizes. Nevertheless, there are some units have less area of 25 hectares, especially in irregular urban units and other small size neighbourhoods. In such case, the whole area within and outside the circle perimeter is going to be included for examination as in case of Geverke.

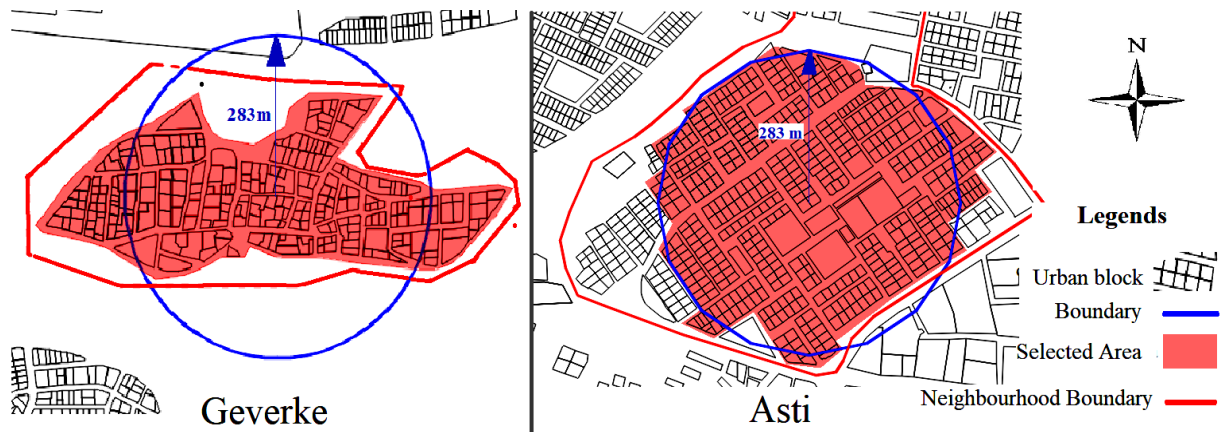


Figure 7-4: The process of selecting urban segments (units) for investigation in Aştî and Geverkê neighbourhoods in Duhok city

Source: Own construct based on the neighbourhoods layout plan (Duhok Master Plan, 2009)

⁹ – Centres of the neighbourhoods cannot not be precisely indicated due to the irregular shapes of neighbourhoods, therefore, the fixation of the centres depends on the approximate location of the centre of gravity of the neighbourhoods.

7.3. Qualitative and Quantitative Approaches

This research adopts a mixed-method approach implying both qualitative and quantitative research techniques and methods. The qualitative approach tends to explore attitudes, behaviours and experiences through conducting methods such as interview or focus group discussions. It attempts to get an in-depth opinion from informants, which are very important to know (Dawson, 2007). Quantitative approach originates statistics through the use of large-scale survey research, using methods such as questionnaires or structured interviews, calculation and measuring (Dawson, 2007; Kumar, 2012).

Although some researchers like Lincoln & Guba (1985) construe the two approaches to be incompatible, Patton (2002) argues that skilled researchers can successfully combine both approaches. The multi-strategy research approach enables the researchers to investigate a particular area from a variety point of views and perspectives, concentrating on different issues and collecting different types of data and analysing them through using different techniques and methods (Henn, Weinstein & Foard, 2006). Qualitative and quantitative are both having their strengths and weaknesses - neither is better than the other- they are just different approaches (Dawson, 2007). Both approaches have the same epistemological basis and therefore considered as complementary to one another, in this research the separation between the two approaches is considered shallow and is not deep.

7.4. Research Supplementary and Detailed Questions

In order to have a clearer understanding of the nature of the posed questions, the research tries to breakdown the main question into supplementary and detailed questions - see Table 7-4. The questions can easily be answered, and directly gives indications to the relation of the variables to the primary and secondary data collection and analysis.

These supplementary questions and detailed questions are embedded in the theoretical and empirical investigations and help to formulate the variables. These variables are essential elements to link the theoretical conceptual level with the practical level. Hence, the variables within the detailed questions can easily indicate the type of data needed to answer the questions.

Table 7-4: Supplementary and detailed research questions

Key Research Question I: What are the driving forces of rapid urban growth from the physical development point of view?	
Supplementary Questions	Detailed Questions
1.1. What are the main factors of rapid urban growth and sprawl?	<ul style="list-style-type: none"> ➤ What are the socio-economic and demographic factors affecting urban growth? ➤ What are the spatial factors affecting urban growth in the urban context? ➤ What are the legal-institutional factors affecting urban growth in the urban context?

<p>1.2. How does the urban sprawl effect on the sustainability of urban context?</p>	<ul style="list-style-type: none"> ➤ How urban sprawl defined in an urban context? ➤ What are the different approaches to interpreting urban sprawl? ➤ What are the forces that encouraging urban sprawl? ➤ What are the main characteristics of urban sprawl in the city of Duhok? ➤ What are the main traits of urban sprawl and their effect on the urban built environment in the city of Duhok? ➤ What kinds of strategies have undertaken to curb urban sprawl in the city of Duhok?
<p>1.3. What challenges does urban growth management face in the city of Duhok?</p>	<ul style="list-style-type: none"> ➤ What kind of strategies has been used by the municipality of Duhok to control illegal urban development within and behind the statutory city border? ➤ To what extend do landowners have affected the physical urban growth direction in the city of Duhok? ➤ What planning strategies have been adopted to eliminate the extra loading on infrastructure in the city centre of Duhok? ➤ What are the policies and strategies that promoted by planning institutions to control and constrain urban growth in the city of Duhok? And how effective they were? ➤ To what extend the density has balanced in the city of Duhok? <i>In term of population and built-up area.</i> ➤ What are the geographical constraints on the direction of the physical urban growth? ➤ How the land for investment is provided, what are principles and grantees? ➤ To what extent do the planning institutions co-operate and co-ordinate to manage urban growth in the city of Duhok?
<p>1.4. To what extend does rapid urban growth affect the sustainability of physical urban development in the city of Duhok?</p>	<ul style="list-style-type: none"> ➤ Did the municipality successes in exploiting non-agriculture land (rocky lands) for new development in the city of Duhok? ➤ To what extent do the planning institutions succeed in conserving natural and artificial assets in Duhok (<i>e.g. Duhok Dam Project Channel, natural green fringes, rivers</i>)? ➤ What is the rate of urban growth (population growth to land consumption) in Duhok? ➤ What is the rate of yearly agriculture land consumption? ➤ What is the rate of open and green space to other land use activities? ➤ To what extend does fast urban growth has affected the accessibility in the city of Duhok? ➤ What is the rate of yearly shortage in housing?

1.5. What are the current trends of physical urban development in the city of Duhok?

- What are the main morphological stages of Duhok city that shaped and modelled the city's urban form?
- What is the prevailed spatial pattern of urban growth in the city of Duhok?
- What is the percentage of single-home and multi-story apartment?
- How much land yearly dedicated to different uses?
- What are the directions of CBD growing in the city of Duhok and the transformed neighbourhoods?
- Which neighbourhoods in the city of Duhok associate with the sustainable planning approach?
- To what extent does the process of granting free land parcel to public servants by the Kurdistan Regional Government (KRG) has encouraged fast growing of the city of Duhok?
- What are the current considerations on compactness and density in case of new developments in the city of Duhok?
- To what extent does urban containment development adopted by planning institutions as a strategy to control excessive urban growth and promote compactness in the context of Duhok?
- What are the negative impacts of granting free land parcels to a certain group within certain areas?
- Is there any kind of cooperation between the planning agencies in Duhok city and the companies that import taxi cars to limit the number of private cars and mitigate traffic congestion in the future?
- What is the pattern of current urban growth in the city of Duhok?
- How did population density distribute in the city?
- To what extent does the land consumption rate consider in the development process?
- What is the yearly land consumption rate?
- What is the source of population growth in the city?
- What is the share of each city inhabitant from the land and open green spaces?
- What is the rate of single-family and multi-family houses?
- What is the rate of residents who work inside the neighbourhood, inside the city centre and outside the city?
- How long does the family stay in the neighbourhood?
- What is the rate of families who have moved to the neighbourhood from inside and outside the city of Duhok?
- Where do most residents perform their daily shopping?
- How do the residents normally travel to the city centre and other parts of the city?
- What is the rate of car ownership between residents?
- What is the frequency rate of the residents to the city centre?
- When you go for shopping in the city centre? Which type of shopping do the residents perform?
- Where do the residents perform their daily shopping?
- How do the residents normally travel to the city centre?
- What type of green open space do the residents prefer?

Research Question II: How did the concept of sustainable development interpret in an urban context?

Supplementary Questions	Detailed Questions
<p>2.1. What does the concept of sustainable urban development mean in the context of Duhok?</p>	<ul style="list-style-type: none"> ➤ How the concept of sustainable development has defined? ➤ What are the main principles of sustainable development related to physical urban development? ➤ How can the concept of sustainable urban development be understood in the context of Duhok? ➤ What are the spatial dimensions of urban sustainability? ➤ How can the physical dimension of urban sustainability be translated into the urban context? ➤ What are the critical objectives and requirements for achieving sustainable development in the urban context? ➤ What are the criteria of a sustainable city? ➤ What is a sustainable neighbourhood? And how is defined?
<p>2.2. What are the goals of sustainable development? And how can be achieved to bring more physical development in the urban context of Kurdistan?</p>	<ul style="list-style-type: none"> ➤ What are the goals & objectives of sustainable development that ensure in bringing sustainability in Duhok? ➤ What are the spatial issues that urban planning should undertake to promote physical urban sustainability? ➤ What are the sustainable urban issues that rose by Agenda 21 to ensure sustainable development? ➤ To what extend sustainable approaches and theories have been contributed to enhance the quality of life in new neighbourhoods in the city of Duhok? ➤ What planning approaches dominated the planning of new developments in the city of Duhok? ➤ What would be considered as the accepted planning approach for new neighbourhoods in Duhok? ➤ What we should learn from the existing urban form when designing new developments and suburbs? ➤ How is a sustainable city defined and envisaged? ➤ To what extend does sustainable city contribute to sustainable urban development? ➤ What are the spatial criteria of a sustainable city? ➤ How can the principle of the sustainable neighbourhood be promoted in the context of Duhok? ➤ How does built environment performance contribute to consolidating urban sustainability? ➤ What are the characteristics of good urban governance in order to achieve sustainable urban development in the city of Duhok?
<p>2.3. What are the prerequisites for promoting more sustainable urban development in the context of Kurdistan cities?</p>	<ul style="list-style-type: none"> ➤ ➤ What is the effective planning process in bringing sustainable physical urban development? ➤ What are the appropriate strategies to control and constrain rapid urban growth in the city of Duhok? ➤ To what extent infrastructure (streets, water, sewage...etc.) are adequate in the city? ➤ To what extent the cities in Kurdistan are self-sufficient? ➤ To what extent a political situation is stable and the planning decisions are independent?

<p>2.4. What are the key factors challenging sustainable physical urban development in the context of Duhok?</p>	<ul style="list-style-type: none"> ➤ What are the challenges that hinder urban development planning and process in the context of the city of Duhok in order to achieve urban sustainability? ➤ What are the opportunities that urban context going to gain in achieving urban sustainability? ➤ To what extent do officials and people aware of the environmental issues in the city? ➤ To what extent does the management system in cities flexible and self-modifying? ➤ To what extent existing regulations and legislations are updated and conform to new urban development trends in the city? ➤ To what extent does population growth affect the rapid urban growth of the city of Duhok?
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Research Question III: What are the elements that shape/define urban form? And how can the concept of the sustainable urban form be understood?

Supplementary Questions	Detailed Questions
<p>3.1. How can the urban form be defined and understood in different spatial levels in the urban context?</p>	<ul style="list-style-type: none"> ➤ What are the different definitions of urban form? ➤ What are the natural determinations of urban form in the city of Duhok? ➤ How can urban form, urban morphology and urban structure be understood? ➤ What are the areas of intervention of urban form, structure and morphology? ➤ What are the urban form elements that considered at the city level? ➤ What are the principal elements of urban form that define urban physical development? ➤ How can the elements of the urban form be defined and selected at the neighbourhood and city level for case study investigation? ➤ What indicators are used to measure and asses the sustainability of urban elements?
<p>3.2. How can urban form contribute to physical urban sustainability?</p>	<ul style="list-style-type: none"> ➤ What are the sustainable approaches to urban form? ➤ Which of the sustainable approaches of development are considered to be more appropriate to deliver sustainability in growing cities such as in the context of Duhok? ➤ What are the essential physical characteristics for the urban form to enhance the sustainability of the built environment? ➤ What are the main physical dimensions of urban form that affecting the sustainability of urban context? ➤ How the concept of the sustainable neighbourhood be defined?
<p>3.3. What are the criteria that promote physical sustainable urban form?</p>	<ul style="list-style-type: none"> ➤ What are the design concepts that selected for promoting and evaluating physical urban development in Duhok? ➤ What are the appropriate strategies and principles for promoting urban sustainability at the neighbourhood level in the city of Duhok? ➤ What are the criteria of determining size, population, density and other characteristics of the neighbourhood in Duhok? (<i>e.g. Persons/Hectare, FAR and BAR, percentages of land used for different activities</i>) ➤ What are the planning guidelines and criteria to diverse different

	<p>land parcels and different types of residential buildings densities in the neighbourhoods?</p> <ul style="list-style-type: none"> ➤ To what extent there is the substantial correspondence between local planning policies and development patterns? ➤ From the view of experts, what are specific considerations on urban form in designing and planning a new development area?
<p>3.4. To what extent do the elements of urban form and structure impact the sustainability of the city?</p>	<ul style="list-style-type: none"> ➤ What are the types of urban blocks that dominated in the context of Duhok? ➤ What are the spatial characteristics of urban blocks at the neighbourhood level in Duhok? ➤ What are the development guidelines and criteria that are used to form the development that taking place in new neighbourhoods? ➤ To what extent do the urban block and street pattern has according to the natural relief of the city of Duhok? ➤ To what extend the entrance, height and setback of buildings were considered at the neighbourhood level? ➤ What is the rate of the house’s privacy in regards to dominating neighbour’s house over other houses in term of Stories, Height, Balcony and Fence? ➤ To what extend do urban blocks promote accessibility at the neighbourhood and city level? ➤ To what extent does the hierarchy of the street network is promoted to carry out the required traffic? ➤ To what extent do the size and width of streets in the neighbourhoods offer easy movements? ➤ What is the frequency rate of travelling to the city centre in a week? And why? ➤ To what extent does the flow of pedestrians and vehicles consider at the neighbourhood level in Duhok? ➤ To what extend do commercial strip development policies contributed to generate congestion in the context of Duhok? ➤ What are the owning number of cars and taxis the city of Duhok? ➤ What are the spatial solutions in dealing with the main arterial transit road (100m width)? ➤ What is the impact the new traffic plan on the flow of pedestrian and vehicle in the city centre? ➤ To what extend the municipality has offered car parks in old and new developed areas? ➤ Where do the residents park their cars? ➤ To what extent does sidewalk streets offer ease movement of the pedestrian in the residential areas and other streets? ➤ What strategies are suggested to address the problem of occupying sidewalks by citizens? ➤ What is the degree of safety in residential streets? <i>In term of car speed, road humps, road signals.</i> ➤ In general, what are the strategies that promoted by the municipality for increasing mobility and accessibility in Duhok? ➤ To what extent do the current characteristics of the urban block and street patterns comply with sustainability (<i>in term of the number of the house in the block, the size of the block, size of streets, number of intersections, sidewalk</i>)? And why? ➤ To what extend the mixed use (in vertically and horizontally) has promoted in neighbourhoods? ➤ What is the rate of open space and green spaces in the

	<p>neighbourhood and city?</p> <ul style="list-style-type: none"> ➤ Why some of the public open spaces have transformed into other use (e.g. to residential and commercial)? ➤ What conflicts do you experience concerning the change of use of public spaces? ➤ Where do the residents spend their leisure time, in the neighbourhood, city centre or others?
<p>Research Question IV: How does the institutional set-up and regulations affect the creation and transformation of urban form?</p>	
Supplementary Questions	Detailed Questions
<p>4.1. How do the actors participate in taking planning decisions?</p>	<ul style="list-style-type: none"> ➤ Who are the main and leading partners? ➤ How the actors participate in taking decisions regarding approving new development initiatives? ➤ What are the responsibilities of the city council in the city of Duhok? ➤ What are the qualifications of city council members and how do they elect? ➤ Do stakeholders have any role in preparing and approving master-plan and other developing plans in Duhok?
<p>4.2. What is the procedure of applying for new urban development initiatives in the context of the city of Duhok?</p>	<ul style="list-style-type: none"> ➤ What is the process of applying and approving new development initiatives? ➤ What is the procedure of land acquisition for new development initiatives? ➤ To what extent do development initiatives responding to their surroundings? ➤ How does the construction's plan approve for residential and other projects? ➤ How is the flow of planning decisions? Top-down or bottom-up.
<p>4.3. What is the process of preparation & approving urban legal instruments and other development plans in the context of Duhok?</p>	<ul style="list-style-type: none"> ➤ What are the legal instruments that used in controlling & directing urban development? ➤ How these instruments prepared and used? ➤ To what extent do the planning authority are stacked to these instruments? ➤ How the differentiation between the documents & real life will solve? ➤ To what extent does the current development Plan-Master plan- has succeeded to direct and control urban growth and create a liveable city in the context of Duhok? ➤ What are the main development plans? And how they implemented by the authorities?

4.4. To what extent do the planning authorities able to promote the regulations and standards related to sustainable urban development in the context of the city of Duhok?

- What are the current institutional arrangements related to urban planning in term of bylaws, laws, policies, initiatives and legal instruments used to control the creation and transformation of urban form?
- How do the planning agencies coordinate, cooperate and communicate with other institutions?
- How urban planning control guidelines and standards have been enforced? And what the obstacles they face?
- To what extent do the official members of planning institutions can undertake the responsibility of designing and managing physical development in the city of Duhok?
- To what extent does the municipality bound to the regulations and legislation?
- To what extent do the Iraqi urban standards for housing have been applied in term of (street width, setback & height of buildings & plot divisions... etc...) in Duhok?
- To what extent does municipality policies, legislations and regulations are effective in arranging and controlling urban form in regards to height, setback and building area ratio, accessibility and availability of urban services and infrastructure?
- To what extent does the municipality and planning institution have been succeeded to create a good urban form in the city of Duhok?
- To what extent do the residents satisfied with the applicability of municipality regulations in arranging their built environment?
- What are the impacts of the current regulations related to commercial strip on residences and streets satisfaction? *The impact on value, height & congestion.*
- To what extent the municipality of Duhok has been able to enforce and apply the regulations in the fairway?
- To what extent do the residents satisfy with the mobility in the city of Duhok?
- To what extent do the officials - planners, architects, engineers who engaged in planning and operating urban development assess the functioning of current urban form in the city of Duhok?

<p>4.5. To what extent land use zoning, divisions and sub-divisions have succeeded to produce sustainable urban form in the city of Duhok?</p>	<ul style="list-style-type: none"> ➤ What are the strategies or planning guidelines that encourage and regulate mixed land uses within the neighbourhood and the city in Duhok? ➤ What are the criteria for selecting the size of the urban block at the neighbourhood level? ➤ What are the strategies that used to join and divide plots? ➤ What criteria are used for selecting streets for commercial uses? ➤ To what extent transforming residential plots to commercial use on main streets are successful? And what are the criteria for transforming? ➤ What are the impacts of the commercial strip on residences and streets? <i>The impact on value, height & congestion.</i> ➤ To what extent do the local authorities promote the concept of de-centralised concentration for distribution of local services at neighbourhood and city level? ➤ What are the criteria and determinations of plot selection for different uses? (e.g. residential, commercial, recreational) ➤ To what extent does the land use pattern consider in urban spatial planning in Duhok? ➤ What are the criteria and factors that determine the services and their proximity at the neighbourhood level in the city of Duhok? ➤ How is proximity measured in term of distance and time? ➤ What are the current planning and development control guidelines and standards for neighbourhoods in the city of Duhok? (Enquire for these guidelines, Building Codes, Regulations...)
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Research Question V: What is the impact of urban form and structure elements on the residents' satisfaction?

Supplementary Questions	Detailed Questions
<p>5.1. What are the factors that impact the house and neighbourhood satisfaction?</p>	<ul style="list-style-type: none"> ➤ Which type of residential buildings do the residents prefer? (<i>Low or high type</i>). ➤ What are the most preferred neighbourhoods that the residents wish to move? ➤ What type of residential do the residents prefer? <i>in term of exposure and attachment to other houses</i>). ➤ Do you have plans to move from your present neighbourhood to another? Why? ➤ Which neighbourhood in Duhok city would residents prefer to move to? Why? ➤ To what extent the residents are stick to their neighbourhood?
<p>5.2. In what way do the elements of urban form influence the house and neighbourhood satisfaction?</p>	<ul style="list-style-type: none"> ➤ Which elements of the house that the residents most satisfied with? (<i>in term of plot size, building height, indoor garden, building orientation</i>) ➤ Which elements of the neighbourhood that the residents most satisfied with? (<i>in term of block size, number of houses in blocks, easy access, population density, availability of local services, proximity to services, street width, sidewalk, greenness and social contacts</i>). ➤ To what extent do the residents satisfy with the population density in the neighbourhood? ➤ To what extent do the residents satisfied with the availability of green open space rate in the neighbourhood?

<p>5.3. To what extent do the identified factors improve the sustainability of the houses and the neighbourhood?</p>	<ul style="list-style-type: none"> ➤ Does improving accessibility to the services increase the residents' satisfaction? ➤ Do improve house elements such as; plot size, building setbacks, unifying building height, open space) increase the level of residents' satisfaction? ➤ Does improving proximity to services in the neighbourhood improve the level of satisfaction? ➤ Does socioeconomic status affect the level of satisfaction?
<p>5.4. How do residents recognise and evaluate the performance of urban form in the context of Duhok?</p>	<ul style="list-style-type: none"> ➤ What are the residents' suggestions to improve their neighbourhood in term of physical development? ➤ What are the most seen problems in the neighbourhood in term of physical development? ➤ What are the most seen problems in the city of Duhok in term of physical development? ➤ If there is a plan for improving your neighbourhood in term of spatial development, what do you prefer to suggest?

Source: Own construct

7.5. Data collection and analysis methods

The data collection is gathered from the various sources encompassing two main phases. In the first phase, the study is entailed city-wide identification and classification of the city physical development by the types and characteristics of urban forms. Identification and classification of neighbourhoods are carried out during this phase. In the second phase, the study has entailed interviews with the residents to know their view concerning the quality of the built environment at the neighbourhood and city level. Including the interviews with officials from the municipality and planning institutions as an entry to the case study at both micro and macro levels and as a way of triangulating the gathered information from different sources.

The detailed questions give a clue to the source of information that required for answering the questions. This strategy helps the researcher to easily guess the required techniques and methods for answering the questions and identify the source of data; also, it helps to classify the collected data in accordance to their relevance to the certain subjects and titles. The summary of the used methods is presented in Table 7-5.

Table 7-5: Summary of issues & methods used in the research

Research Target Themes	Main Issues	Literature review	Analysis of Documents	Field Observation	Participant Observation	Residents Interviews	Official Interviews	Analysis of Images & Photographs	Measurements & Calculations
Urban Form Analysis	Identifying elements of urban form	○	●	●				○	
	Criteria & concepts of sustainable urban form	●	○						
	Spatial growth of the city & development trends	●	●		○		○	●	●
	Urban form characteristics	○	○	●	●	●	●	○	●
	Urban morphology of the city	○	●	○				●	○
	Socio-economic & environmental aspects	○	○	○		●			
Institutions, Regulations & Process	Institutional structure & policies	○	●		●		●		
	Planning procedure	○	●		●		●		
	Legislation & legal Instruments	○	●		○		○		
Residents' & Officials' Perception & Opinion	Residents Satisfaction	○				●			
	Officials Perception & Opinion	○			●		○		

Note: (●) refers that the method is essential, (○) refers that the method is supplementary

Source: Own construct

7.5.1. Primary and Secondary Data Sources

This study has relied on both secondary and primary data. Secondary data sources which are used in the study are represented by; urban and building regulations and standards, plans, aerial images, photos, maps, archival documents, statistics, official documents and reports and studies. The primary data are mainly used to investigate the characteristics of urban form through observation, survey, measuring and calculations. As well as, the primary data is used to know the degree of residential satisfaction regarding the urban form performance through a semi-structured interview. Also interviewing with experts who engage in planning, designing and managing the development initiatives in the planning institutions in different levels in order to understand the development planning process and identify the obstacles that hinder it. A focus group discussion has also conducted for officials from the planning institutions at different levels and other related institutions and academics to capture their idea about the performance of existing urban form, and the same time to indicate the relevancy of identified criteria and their applicability in the context of Duhok.

7.5.2. Field Observation and Photographic Registration

Observation is one of the methods of qualitative research for collecting primary data. It is considered to be a purposeful, systematic and selective way of watching and listening to an interaction or phenomenon as takes place (Kumar, 2012). Moreover, observation can provide a large amount of rich and valid data (Rugge & Petre, 2007). According to Yin (2003), observation enriches the research and provides the researcher with an insight perception that is not being able to obtain it in any other methods. Observation has been a part of the research methods in investigating studies related to spatial planning studies. Field observation has been supported and strengthened by conducting other methods such as semi-structured interview, photographic registration, calculations and measurement to consolidate the obtained inferences. Field observation is supported by the fact that the researcher has information on understanding the spatial arrangements and functions in the study area- see Section 1.3 in Chapter One.

The field observation has coincided with the study of the history of the city development and the urban morphology of the city. This helps in understanding the changes and modes of urban growth and urbanisation in the city. Furthermore, the directions of the current and future spatial expansion of the city are studied. In addition to the researcher's familiarity with the area of study- as one of the city's residents- a purposeful walking around the city has done through looking at different types of buildings, neighbourhoods, land uses, transport system, open spaces and green areas. This process has helped the researcher to experience the on-going development process in the city and the quality of the built environment, and to recognise the apparent conflicts and problems in the physical development of the city. This has been done through taking writing notes, comments, photographs and visual notes.

The field observation in the second phase- with more careful observation- is also used as a primary method to study the main elements of the selected urban units in the city such as; urban block structure, street pattern, open space and land use characteristics. The observed variables of urban block structure include; urban block characteristics, building characteristics and plot characteristics, each of these main variables includes other secondary variables registered through special forms prepared for these purposes—see Appendixes 5, 6, 7, 8, 9, and 10.

7.5.3. Analysis of Plans and Drawings

The plans and drawings are gathered from different sources like Duhok municipality, Directorate of Constructive Planning in Duhok, Directorate of Land Registration, Information Centre and Knowledge in Duhok and Directorate of Statistics in Duhok. Plans and drawings are considered to be essential inputs and source in the analysis. All the indications of the urban block, plot, building, land use, street and open space variables such as; block configuration, block size and area, building setback, plot area, plot layout and size, plot configuration, floor area ratio (FAR), built-up area ratio (BAR), street length and width, street configuration and building density and others are obtained from the available plans. In addition, the plans and the maps are used for delimitation and delineation the area of investigation of urban neighbourhoods.

A Comparison of variables such as trends in transforming and changing plot sizes, block configurations, floor area ratio, built-up area ratio and others are explored by comparing plans, drawings and maps of the same units in different periods. Different map scales are used for these purposes.

7.5.4. Aerial Images

Aerial images have been another helpful source of analysing urban form by determining the area of neighbourhoods, blocks and plots, as well as, the aerial images beside maps are the best sources for indicating the development directions and the natural and artificial constraints of city urban growth. Aerial images can provide a basis for establishing trends of spatial growth, infill development and housing densification processes. Time series aerial images can provide a base to analyse settlement spatial urban growth trends periodically and on time-space development.

7.5.5. Structured and Semi-Structured interview

According to (Yin, 2003, p. 92), interviews are an essential source of the case study approach. Most of the studies that are related to human affairs are depended on the opinion of specific interviewees, so well-informed respondents providing in-deep information about the situation.

This method perhaps the most common type of interview used in the qualitative approach. In this type of interview, the researchers tend to know certain information which easily is compared and contrasted with information gained by other respondents (Dawson, 2007). The samples that need, generally small samples, with very detailed information about the subject, are usually very long and customised to suit individual respondents, and all the respondents have to be asked the same questions in order to build a clear idea about certain issues (Tayie, 2005; Dawson, 2007). One of the advantages of this technique is flexibility in questioning the respondents so that new information might be raised (Dawson, 2007).

7.5.5.1. In-depth Expert Interview

Semi-structured interviews are conducted with experts and officials who have a direct impact on shaping urban form and approving new development initiatives. The interviewees are directors, managers, engineers and architects in urban planning institutions from the Directorates of Constructive Planning, Municipality, Environment, Tourism, Agricultural and Land Registration who are the most influential leading role in taking decisions. The questions that are posed have been divided into several themes and are open-ended questions. The aim

behind such questions is to provide enough area and space for respondents to answer the asked questions and at the same time to know different opinions. The information, which gathered from this group of experts, has focused on the relationship between the prevailing spatial planning practices and sustainable planning considerations of urban form with respect to density, accessibility, proximity, compactness, city transformation, urban growth and sprawl. The interviews with officials have provided a basis for triangulation of gathered information from other sources, as well as, this has provided the ground to figure out on policy issues, perceptions of the institutions they represent, as well as, the issues of planning and management of physical urban development and changes occurring in urban form.

The interviews with experts are carried out between 17th March 2014 and 22th October 2014 included (10) interviews. The interview with experts focused on a sample of individuals with different institutions and decision-making role and power, based on their involvement in designing, managing, approving and implementing physical urban development initiatives in the city of Duhok. The directed questions are distributed into three main themes namely; spatial planning and practices, planning process and management and city growth, urbanisation and sprawl. Then the answers are documented and compared to extract the final conclusions of the interviewees-see Appendixes 11 and 12.

7.5.5.2. Residents Interview

The semi-structured interview has carried out between 10th July 2014 to 25th November 2014 face to face with 484 residents tends to gain information regarding the degree of residents' satisfaction with their built environment and the performance of municipality in the city of Duhok. All the interviews carried out by the researcher without the intervention of other parts to ensure the credibility and consistency of the answers. The sample carries a confidence interval of 95% with a margin of error (4.4). The sample size has calculated according to the following formula (Rumsey, 2001):

$$\text{Sample size} = (Z\text{-score})^2 * \text{StdDev} * (1 - \text{StdDev}) / (\text{margin of error})^2$$

The interviewees are from the urban segments (sub-cases) that have been selected for investigations in the city of Duhok. The asked questions are revolved around the satisfaction of the residents about the urban features which have a direct impact on the sustainability of the physical development and related to the urban form elements. Some of the posed questions are concerned with socio-economic situation of the residents, and other questions are related to the building characteristics, while the last three questions are opened-ended, and they are regarding the residents' suggestions and envisaging the future urban development in the city of Duhok- see Appendix (13).

A stratified sample procedure is used for the survey. The population of the samples is based on the city's population classification according to the age, gender and neighbourhoods – see Table 7-6. The reason behind such a strategy is to ensure that all class ages of community in the neighbourhoods have participated in reflecting their opinions regarding their living place.

Table 7-6: Sample size of population for residents' satisfaction in the neighbourhoods

No.	Neighbourhood	Total population of The neighbourhood	Population of the Segment (persons)	Target Population	Sample Size of Population (persons)
1	Aşti	6530	3019	1811	45
2	Êtutê	6549	2023	1214	30
3	Geverkê	2918	1426	855	21
4	Kanimehmedkê	12341	6412	3847	96
5	Masika Rojava	6472	5442	3265	82
6	Segirka	5664	4408	2645	66
7	Şehidan	3696	3712	2227	56
8	Serhildan	29519	5897	3538	88
Total		73689	32338	19403	484

Source: Own construct

According to the Directorate of statistics in Duhok, the percentage of the male gender is 51% and female is 49%. The classes of ages in Duhok city above 14 years are distributed as 36% from the 15-24 years¹⁰, 45% from 25-44 years, 16% from 45-64 years and 3% above 65 years old. Based on this classification of the gender and the age of the population, samples have been designed and each stratum is set to be not less than 10 persons - see Table 7-7.

Table 7-7: Design of the population sample

No.	Units (Sub-Cases)	Age				Gender		Total Sample Size of Population (persons)
		36%	45%	16%	3%	Male 51%	Female 49%	
		15-24 Yrs.	25-44 yrs.	45-64 Yrs.	65+ yrs.			
1	Aşti	16	20	7	1	23	22	45
2	Êtutê	10	14	5	1	15	15	30
3	Geverke	8	9	3	1	11	10	21
4	Kanimehmedkê	35	43	15	3	49	47	96
5	Masika Rojava	30	37	13	2	42	40	82
6	Sêgirka	24	30	11	2	34	32	66
7	Şehidan	20	25	9	2	29	27	56
8	Serhildan	32	40	14	3	45	43	88
Sub-Total		174	218	77	15	247	237	484
Gross Total		484				484		484

Source: Own construct

¹⁰ - The researcher interviewed individuals who are more than 16 years old, in order to ensure that they have enough knowledge about the built environments.

From each house, only one member has been asked to answer the questions in order to cover many houses and different members of different families. The directed questions have been divided into main themes, general information, socio-economic, residents' preferences, interaction with urban form and residents' perceptions of urban form and structure. The posed questions are those which their answers could not be obtained elsewhere. These questions are crucial to be known to have a clear idea about the way that the people interact with urban form and their preferences, satisfaction and perceptions.

- i. General background (of the member of the house) revolved around the identity of the interviewee his/her name, qualification, occupation, age and sex,
- ii. Socio-economic aspects (of the family) includes family size, family income, the ownership of the house, the number of the family members, the duration of staying in the house and neighbourhood and the place where they come from,
- iii. The questions of residents' preferences revolved around the character of the future intended owning the house. These mainly are about the physical characteristics of the houses such as the type of the housing exposure (attachments), the privacy in term of dominating of the balconies, heights and fence over the neighbour house. The housing type (low or high-rise) that the residents' favour and prefer to live in.
- iv. Interaction with urban form, are related to the reason for going to the city centre, the using mode, the place of parking, using the sidewalks adjacent to the house, and the type of the green open spaces they normally attend and where they spend their leisure time,
- v. The questions of the residents' perceptions of urban form elements are of two groups; one is related to the character of their own houses and the other are related to the neighbourhood's characters. These characters are mainly concerned with the physical aspects of urban form and structure,
- vi. Municipality's performance and the effectiveness of the regulation, the related questions are revolved around the degree that the residents satisfied with the performance of municipality of Duhok and the effectiveness and applicability of the regulations and legislation and enforcing them,
- vii. The last group of open-ended questions related to the perceptions of urban form aiming to obtain the interviewees' options regarding the recognised problems in the city and the neighbourhood and the future envisaging of the city.

7.5.6. Focus Group Discussion

Focus group becomes a popular tool for producing data through interaction between a group of selected participants. Such assembling aims to discuss and comment on certain issues related to the topic of the research (Tayie, 2005; Dawson, 2007). The selection of the participants based on expert sampling as purposive sampling techniques (Yin, 2001). The purpose behind selecting this number of participants is to have those who provide the most relevant data and aware of the city problems and deficiencies in the context of Duhok. The sample of the group is architects, civil engineers, academics, managers, planners and policymakers who engage in urban planning issues in the city - see Appendix 14.

The main aim of the workshop is to identify the existing spatial problems at neighbourhood and city level in the city of Duhok and the relevancy of the agreed criteria in

Chapter Six to the context. Moreover, exposing the constraints that face planning and development process in the city of Duhok.

The workshop held on 22 of November 2015 in the cultural centre of the University of Duhok- see Figures 7-5 showing a part of the events. At the beginning of the workshop, the researcher introduced a brief presentation about the urban form and structure and its relation to sustainability and how it affects the physical development of the city. The presentation aims to guide and direct the discussion to comply with research objectives and goals – see workshop schedule in Appendix (15). The researcher participated as one of the groups' members without taking the role of a moderator or rapporteur within the workshop.



Figure 7-5: A part of the events of the workshop which held on 22 November 2015 in the cultural centre in the University of Duhok

7.5.7. Calculations and Measurements

In the course of this research, various methods of calculations and measurements have been used to help the researcher to obtain required results by using computer software like (AutoCAD, ArcView 10 and Excel). The calculations and measurements are mainly related to the physical dimensions of different variables by using different mathematical and statistical formulas. For example, one of the simple methods for determining land consumption is to determine whether the rate of growth in the urban area exceeds the rate of growth in population. Many researchers have used this measurement to know the degree that the city or a region is sprawling or not (Ewing, Pendal & Chen, 2002; Fulton et al, 2001 cited in Lee, 2005, p.49, Glaster et al., 2001). Then the increase of land areas in other years compared with the increase in a population increase rate. One of the most common measures of urbanisation is the rate at which the new urban land is added to the urban areas over time, which can quantify the amount of the converted land from rural to urban.

To measure the proximity of the urban services to the residential area a 'catchment area' is applied. The coverage area is used based on the recommended area by Iraqi Housing or UN-Habitat or other scholars. Different services have different catchment area which depends on the type of services and the population using these services - see Table 7-8.

Table 7-8: Calculating and measuring variables

Variable	Description	Features to be measured	Formula
Built-up Area Ratio (BAR)	The ratio of build area to plot	Total area of floors	Floor area m ² / site area m ² x 100
		Site area	
Floor Area Ratio (FAR)	The ratio of floor area to the site area	Build area	Build area m ² / Site area m ² x 100
		Site area	
Building Block Coverage	Area of Ground Floor Footprint of Buildings (GFFB) divided by the block area measured to curb	Area of GFFB	Area of GFFB m ² / Block Area m ²
		Block area to the curbstone	
Block Density	Number of Dwelling Unit or Residential Population divided by block area measured to curb	Number of Dwellings or Population	Number of Dwellings or Residence/ Total Area m ²
		Total Area of Block to Curb	
Part Block Density (Parcel Approximation)	Number of Dwelling Units or Residential Population divided by the clear subset of the block area	Number of DU or RP	Number of Dwellings of residences/ Clear Area of Block m ²
		Clear area of Block to curb	
Parcel Density	Number of Dwelling Unit or Residential Population divided by Parcel area (all uses)	Number of Dwellings or Population	Number of Dwellings or Residence/ Total Area m ²
		Total Site Area of Parcel	
Sidewalk to Street Ratio	The ratio of Street Width to Sidewalk	Street Width	Street Width m / Sidewalk Width m
		Sidewalk Width	
Coverage Ratio (Neighbourhood)	The ratio of Building footprint to Site Area	Building Footprint (each Building)	Area of Buildings footprint m ² / Total Area of neighbourhood m ²
		Site Area of Each Plot	
Intersection Density	An Approximation of network connectivity	Total numbers of intersections divided by	Total N. of Intersections/ Total km ² network buffer
		Total number square kilometres of within 1 km ² network buffer	

Source: Based on (Dempsey et al, 2010 and Design Centre for American Urban landscape, 2003) Modified by the researcher to adapt to the study's requirements

7.6. Validity

For intensifying the credibility of the case study, different sources of information are used as stated above. All the collected data are well-documented during the phases of conducting the fieldwork. There are several control instruments which have been taken into account during the process of conducting fieldwork, as an attempt to increase the quality of the results of the research, and are illustrated as follows:

According to Smith (1991, p.106 cited in Kumar, 2012, p. 178) “*validity is defined as the degree to which the researcher has measured what he has set out to measure*”. Validity refers to the degree to which an empirical measure precisely reflects the real meaning of the concept under considerations (Babbie, 1989 cited in Kumar, 2012, p. 178). Broadly, validity is the concept of appropriateness and accuracy which applied to a research process and output. The internal validity is mostly concerned with casual or explanatory case studies, in which the researcher tends to understand the phenomenon. Therefore, the challenges that arise of how to ensure the appropriateness of the conclusions and explanations derived from various sources of information (Yin, 2003). Internal validity emphasises that the researcher has employed accepted strategies and methods to document the accuracy of the undertaken study (Creswell, 2007).

The internal validity of the gathered information and data has been ensured through comparing data collected by using different techniques and methods. The coherence of different research methods used in research justifies by Mason (2002, p.33) to;

1. Explore different parts of the phenomenon.
2. Answer the same research in different ways and angles.
3. Answer different research questions through different methods.
4. Analyse something in greater and lesser depth.
5. Enhance the quality of data, and
6. Examine different analysis, explanations of theories against each other.

This approach has been strengthened by the researcher’s knowledge.

For the sake of the accuracy and appropriateness of the output of this research, two main strategies have been adopted to ensure the authenticity of the used data. The first strategy is concerned with the sources of data collection on the same issues. Therefore, the study has tended to use different sources of information for one issue and afterwards are consolidated and triangulated to test convergence or divergence. In some case, especially the statistical data has shown large divergences. This information is mostly related to the yearly land dedicated to different uses, density and population, in such cases, an extra effort has done to find more reliable information through investigating the available data in various urban planning institutions in the city, and then document the data that the most institutions are accepted and agreed about. The second strategy, at the end of each question the researcher tends to get feedback from informants to ensure the researcher’s interpretations and conclusions, to confirm that the written information reflecting the informants’ perspectives and opinions.

The familiarity of the researcher with the local knowledge of the study area and witnessing most of the stages of the urban development of the city has assisted to exclude the dubious data and information in the course of collecting data and analysing them during the desktop work.

According to (Graziano & Raulin, 2004 cited in Marczyk, DeMatteo & Festinger, 2005, p.175) external validity refers to the degree to which research out-put generalise to other conditions, participants, times, and places. External validity tends to draw a boundary to which the findings of the research can be generalised beyond the particular case study, and assures that the process and output of the study can be generalised beyond the case under consideration. Yin (2003) argues that the out-put of the case study can be generalised because case study approach relies on concepts, models and theoretical generalisation. Moreover, the logic in the case study approach is theoretical rather than statistical. The generalisation of the out-put and findings from one case into other case study is conditional and can be only transferred in case the context that affecting the actions in those other cases are replicable and controlled.

To verify the external validity, the research has adopted the strategy of examining one case study (Duhok City) targeting the cities in Kurdistan region and Iraq at the macro-level and eight sub-cases at the micro-level to be representative of the context which offer an ability to generalise the research findings.

The general out-puts of this research are conceptual strategies and can be applied to similar contexts. The cities in the Kurdistan region are sharing many characteristics and challenges that influencing their development processes and patterns. Therefore, the out-put drawn from Duhok City case study can be generalised and transferred to other cities in the Kurdistan region and Iraq or other comparable contexts.

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Chapter Eight: Institutional Set-up and Regulatory Framework in the Context of Duhok

8.1. Introduction

This chapter presents the institutional arrangement to urban development planning in the context of the Kurdistan region. Reviewing and analysing the responsibilities of urban planning institutions and their cooperation and coordination at different levels of regional and local levels, as well as reviewing the most related regulations that shaped urban form and structure of the city of Duhok.

8.2. Institutional arrangement of Urban Development and Planning

8.2.1. Planning Hierarchy and Legal Framework

In abroad, Kurdistan Regional Government (KRG) is composed of three main and independent authorities or entities: the legislative authority enacts and amends laws; the judicial authority applies the enacted laws, and the executive authority enforcing laws, regulations, policies and guidelines.

Urban development planning and management in the Kurdistan Region government structure has a multi-Ministerial related organisational composing of many ministries and boards. Physical urban development is mainly the task and the responsibility of the Ministry of Municipalities and Tourism, represented by the General Directorates of Constructive planning and Municipalities. The responsibility of urban management is partially shared by the Ministry of Transportation and Communication, Ministry of Agriculture, Ministry of Electricity, Ministry of Justice and Environmental Protection and Improvement Board in Kurdistan Regional Government (KRG), these competent authorities are represented by general directorates at province level and directorates at the local level (District level) - see Figures 8-1 and 8-2.

The degree of intervention and availability for making the decision by the Ministry of Transportation, Agriculture, Ministry of Electricity, Ministry of Justice and Environmental Protection and Improvement Board is depended on the level of planning. The decision is higher at the level of provincial than the level of local level, and mainly covers issues of supplying the public services (e.g. Electricity, Roads, Sewerage, Land Registration). The environment issues and natural aspects (i.e. national parks, natural assets and ecosystem) have related to the urban development and planning, are mainly the responsibility of the Environment Protection and Improvement Board in KRG (Environment Protection and Improvement Board, 2012).

According to the legislation no.12 of 2010 of the Kurdistan Regional Government (KRG), the Ministry of Municipality and Tourism has the responsibility of managing and achieving physical urban development initiatives through seven General Directorates at the provincial level and many directorates at local levels- see Figure 8-2. The main responsibilities of the Ministry are articulated according to the article no. 2 of the above legislation– see Box 8-1.

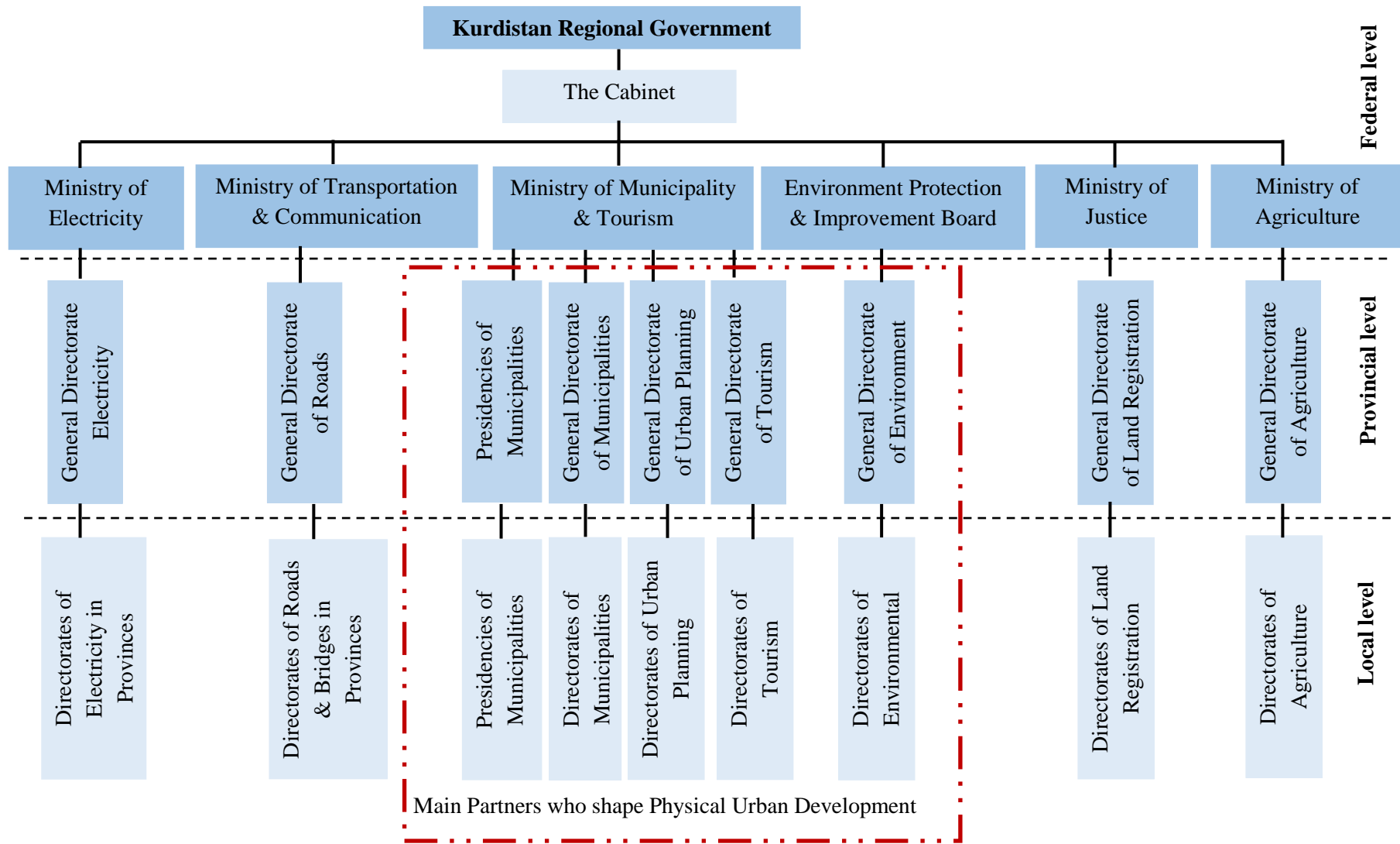


Figure 8-1: Urban development planning within the hierarchy of urban planning system in the Kurdistan Region
 Source: Own construct based on document analysis form Ministry of Municipalities and Tourism, 2015

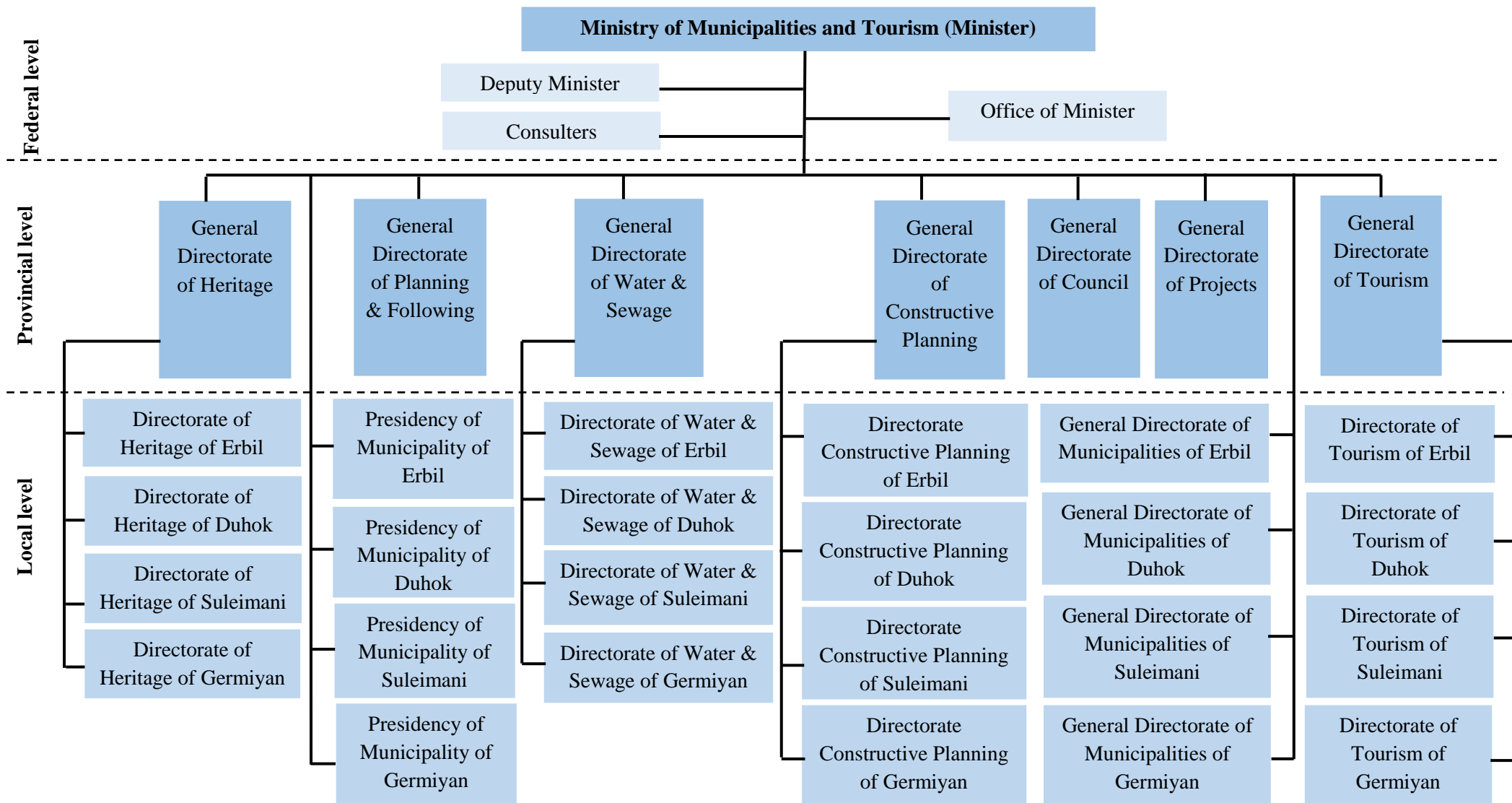


Figure 8-2: Institutions involved in urban development schemes in the Kurdistan Region
 Source: Own construct based on document analysis form Ministry of Municipalities and Tourism, 2015

Article 2, Legislation 12 of 2010

- Provisioning of all municipality and touristic services to secure citizens' need through offering drinking water, discharge and filter sewage water and rain water, constructing bridges, roads, tunnels within the boundary of municipalities' borders and other small towns and villages, as well as upgrading and enhancing the facilities in term of quality and quantity, offering parks and entertainments in touristic places.
- Planning, managing and implementing the duties that are responsible of creating local economic development via effective policies in land use utilisation, urban planning, as well as planning and following the touristic movement within the general development plan of tourism.
- Setting up suitable circumstance to preserve clean and healthy environment as well as enhancing green areas and treating solid wastes within the cities and towns.
- Working to attract capitals and encouraging investments in coordination with the Invest Board of Kurdistan within the available articles and regulations.

Box 8-1: Responsibilities of the Ministry of Municipality and Tourism

Source: Own construct based on Document analysis from the Municipality of Duhok, 2015

All the development plans relevant to the provinces develop by local governments with the assistance and approval of the regional and federal authorities, through establishing statutory planning provision with little intervention from the public side. Most of the changes on urban form negotiate and coordinate with the consent of the federal planning institutions representing by the Ministry of Municipality and Tourism in Kurdistan Region (MMT-KRG).

According to the resolution no.16, law no. 6, Article 10 of 1993 of Ministry cabinet of the Kurdistan Regional Government the municipalities are classified according to the number of the population based on the last conducted census¹¹ as following:

- 1- The Municipality of the capital of the region holds the special rank,
- 2- Municipality of the capital of the province holds excellent rank has thirteenth members of the city council.
- 3- Municipalities of cities having more than 75000 population hold the first rank,
- 4- Municipalities of towns having more than 15000 population rate as the second rank
- 5- Municipalities of towns having more than 5000 population rate as the third rank,
- 6- Municipalities of towns having less than 5000 population rate as the fourth rank.

8.2.2. Legal Instruments of Urban Development and Planning

Kurdistan Regional Governments prepares and adopts different plans¹² for controlling and managing physical urban development such as strategic plan, development plan and master plan for legal purposes - see Box 8-2.

The highest and the most general one are at the national level. The National Development Plan (NDP) sets out the fundamental and generic framework for the whole state. The Regional Development Strategy follows the state plan (NDP) such as Kurdistan Regional Development Plan (KRDP) of 2014; this in turns follows the Province Strategic Plan which guides the region and the governorate development plan. These plans prepare through involving different relevant bodies and entities in the ministries, academics and representatives of the concerned

¹¹ - Following the general census the ranks of the municipalities have to be updated.

¹² - Relatively these plans are new in the context of Kurdistan Region, the strategic and development plan for first time prepared after 2011, while in Iraq is back to 1970s.

unions and experts from international organisations. These plans are followed by a more detailed plan which is the Master-Plan of the different aspects of development (e.g. Master plan for Cities, Master Plan of Tourism Development). In general, the Master Plan for cities controls the physical development and its extension and improves the existing structures and built environment. The lowest plan level is the detailed zoning and design plan, these plans concerned to manifest exactly the use, size and kind of buildings on plots.

Examples of Plan Categories in Kurdistan Region

- Kurdistan Regional Government Development Plan
- Provinces Strategic Plan for Development and Improvement
- Master-plan of Cities
- Other Plans: Sub districts master-plan, Master-plan of Transportation, Master-plan for Sewages, Master-plan for solid waste management and others.

Box 8-2: Categories of Development Plan

Source: Own construct based on document analysis form Ministry of Planning in KRG, 2015

After 2003 and decentralization process, the legal framework of urban planning law in Kurdistan gives sufficient space for municipalities to prepare and adjust the technical planning process in coordination with the political decision-makers at the local level with the final approval of the general directorate of constructive planning and the Ministry of Municipality and Tourism in Kurdistan Regional Government. The municipality has to arrange the public participation sessions for local discussions and general public hearings that is mainly the officials from the local government bodies invited with limited civil contributions. In reality, the municipalities are not able to fulfil this task efficiently for many reasons;

- Shortage of qualified and experienced staff
- Lack of coordination and information exchange between the related bodies and organizations,
- Lack of effective planning culture within the local and regional government, and
- Behaviour and attitude constraints

The institutional mechanisms require and in shortage need to perform at a higher level to plan and achieve workable and applicable urban strategies which able to solve the urban development schemes in the context.

8.2.2.1. Master-Plan

The most important instrument of urban planning in Iraq is the master-plan as principle document for physical urban development planning. Preparing the master-plan in most cases has not associated with any detailed plans, simply was addressing only zoning for development of cities and towns. The elaborate master-plan should address social, economic and institutional development needs and requirements (UN-Habitat, 2003).

Iraq started to prepare the development plans for the biggest sectors in Iraq and master-plans for big cities and other towns in the 1950s. Most of the new master plans for all Iraqi cities were prepared at the beginning of the 1980s. These plans have not been subjected to rigorous revisions during the following years of wars and failed to respond to the new changes in socio-economic trends. In general, urban planning in Iraq has proportionate to the master

plan or zoning, while there is limited inclusion of socio-economic development requirement. These plans are mostly obsolete and no more reflecting the needs and requirements of today urban sector (ibid.).

The process of preparing and approving the master-plan as one of the main legal instruments of urban development is outlined in Figure 8-3.

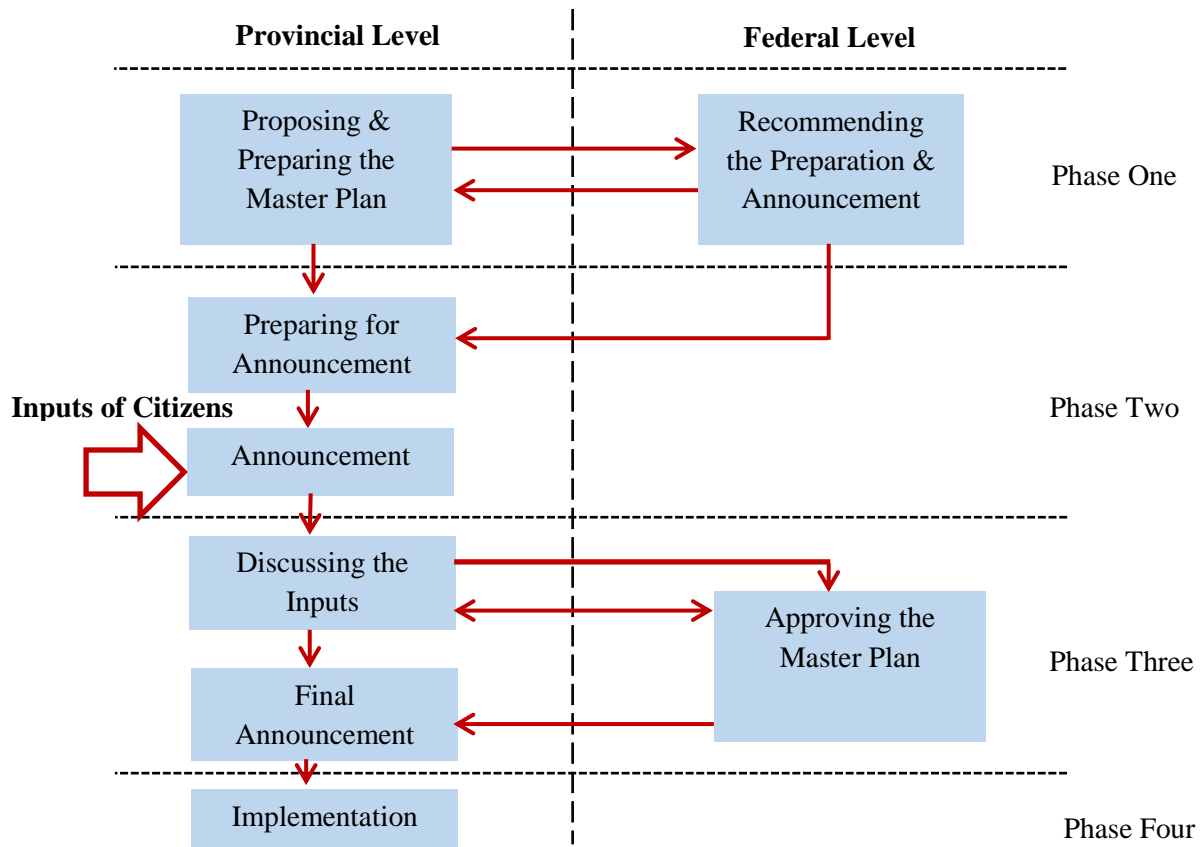


Figure 8-3: Stages of preparation and approving the Master-Plan in Kurdistan Region
 Source: Own construct based on document analysis form the Municipality of Duhok, 2014

Master plan has four main phases; this is applicable for a municipality with excellent rank as Presidency of Municipality of Duhok- as below:

Phase One: This phase needs up-to-dated maps for different aspects such as; current population and future expectation of growth, socio-economic trends and environmental profiles for the city. This work can be achieved by involving relevant institutions with the assistance of local or international expertise. This task undertakes by institutions at the local level after the year of 2003 with enjoying more authorities. General Directorate of Constructive Planning is the main partner with the assistance of General Directorate of Municipalities and Presidency of Municipality. Then the proposal discusses with the Ministry of Municipality and Tourism of Kurdistan Region at the federal level.

Phase Two: In this phase based on the Law of Municipalities the Ministry recommends announcing the proposal plan, this phase takes a long time for discussing the details of the proposed plan between related institutions at the local and federal level. The Ministry sends it back to the General Directorate of Constructive Planning with a written report, which

forwards to the Presidency of Municipality for announcing for one month to receive any appeal or recommendations from the citizens, NGOs and civil society organisations.

Phase Three: In this phase, the proposed master plan is well-discussed interactively based on the recommendations and suggestions received at federal and local levels. Then the proposed plan is prepared for publishing with approval of the Minister of Municipalities and Tourism and other different partners for using it as a legal document for urban development.

Phase Four: The plan will be sent to the Directorate of Constructive Planning and presidency of Municipality of the city for implementation and considering it as the main reference.

During the history of the city of Duhok, four master plans have been prepared; the first one was in 1973, the second one was in 1982 with its revisions in 1984, 1986, these plans were prepared by the Ministry of Municipalities in Iraq. These two master plans did not reflect the real development trends, urban growth and the future of the city of Duhok as the capital of the province, and was not able to create a sustainable built environment. Despite the critics towards the two last master plans, they had presented good examples in preserving natural assets and respecting city reliefs. Also, the master plan of 1973 has relatively created the best example of community planning in the city in term of land allocation and distributing of the facilities inside the community representing by Asti neighbourhood in 1977. These plans were more centralised with little intervention from the municipality, while no participation from the local community. City council who legally represents community wishes had no contribution in making decisions in preparing these plans. These master plans have obsoleted and followed by the third master plan in 1994.

The third master was not in the quality of the previous master plans, because it is prepared in the time where the Kurdistan Region was under two blockages; one from the united nation as the region is part of Iraq and the other was by the regime of Iraq. The third master plan was prepared in 1994 by the Directorate of Constructive planning in the city of Duhok under the authorisation of the Ministry of Municipalities and Tourism in Kurdistan Regional Government. The master plan was very simple and has not been accompanied by studies and detailed plans. The local staffs prepared this master plan. Mainly, the staffs were from the Directorate of Constructive Planning in the city of Duhok and the Municipality of Duhok with other planning institutions and related authorities in the city under the approval of the General Directorates of Municipalities in the ministry. The master plan has created unsustainable environment due to the lack of experiences, capabilities and competencies of the local staffs, and produced unsatisfactory results, and it could be considered as a main responsible in directing spatial planning improperly towards deficiencies and deteriorating urban environment in the city. Some of these deficiencies can be listed below;

- 1- Destroying the Irrigation Project Duhok Dam in the west direction of the city which cannot be compensated by millions of dollars. The project was one of the strategic agricultural projects in the city of Duhok, which was able to produce vegetation, fruits and grains, and offering thousands of job opportunities.
- 2- The master plan was not able to preserve natural assets of the city such green valleys of Şivcerdan, Hişkerou, Gely and many to name, which are ecological corridors and green fingers connecting the mountain to the Valley (Duhok River).
- 3- The master plan has encouraged low residential density by promoting single-house.

- 4- Underestimating of Iraqi residential standards and planning regulations in planning and designing the neighbourhoods and districts.
- 5- Street networks have faced in recent years many deficiencies like congestion and overflow of traffic, through neglecting future promotion of public transportation initiatives. Moreover, failure in designing and planning street width in view of engineering transportation due to increasing private-car dependency.
- 6- Failure in planning and designing urban blocks in term of a type, length, width, number of plots and direction and considering city reliefs.
- 7- Transforming of residential buildings and plots to commercial uses after the developments have been taken place which generated many deficiencies.
- 8- Depending mainly on the old city centre and encouraging commercial street strips, instead of promoting the decentralised concentration of commercial activities.
- 9- Deficiencies in distributing public services concerning density population.

During the 1990s, urban planning has practically absent in Iraq and Kurdistan Region as a whole, municipalities were lacking modern and updated urban plans. Also, the lack of required professionals and institutional capacity building. Inefficient and limited experience at the regional and local levels affected the type and quality of prepared plans, which constrained to provide the right direction of pursuing sustainable urban development in the city of Duhok. Therefore, the municipality has suggested preparing another plan with foreign knowledge and local. In 2007 a consultation company from Germany (Vössing) invited by the Duhok local government to plan and develop the forth master-plan for the city of Duhok and other small towns like Sêmêl, Akrê and Amêdî in Duhok Province.

Most obviously, the company have borrowed ideas of spatial planning from the Germany experience which were peculiar to the local planning institutions at the province level. Local consultants from institutions of urban planning and other relevant government institutions in the city of Duhok were invited to participate with Vössing team in a joint committee for negotiation to ensure that the local experiences and perspectives have contributed in shaping the ideas in planning and developing the master-plan. Unfortunately, most of the members of the joint committee of the local consultants were not specialised, and carry limited experience or not concerned to the urban planning field. The members were not able to emerge from the underlying traditional processes¹³. Therefore, the master-plan has come with negative impacts on developing and directing the urban development in the city of Duhok. However, the master-plan of the city Duhok is underestimated the pace of rapid urban growth and informal development overwhelmed the assumptions and projections of the plan. Preparing the master-plan was a result of a political decision rather than a rigorous planning decision. Indeed, the city was facing a problem of demanding more housing for the growing population of the city, but the decision of preparing master-plan was not a response to the problems facing the local community (e.g. high density, lack of accessibility, lack of open spaces, poor built environment performance). Moreover, the strategies, policies and regulations have not been succeeded in giving clear and distinctive characteristics to the physical urban development pattern in the city at macro-level and neighbourhoods in micro-level.

¹³ - The researcher had the opportunity to participate in two of those meetings with the German team in 2007 and 2009 as a representative -senior architect-from the University of Duhok

The master-plan has been prepared for the period of twenty-five years for a long-term period and divided into five-year plans based on forecasting of urban growth trends in the city of Duhok. The Master-Plan has represented the overall vision of the city of Duhok for future development until 2032. According to the attached report to the master plan, envisioning the future was based on analysing the information from the primary and secondary data to meet the needs for the future urban development¹⁴. The main planning objectives of the master-plan of the Duhok were;

- 1- High-quality, diversified and complete living environment;
- 2- Structuring, efficient transportation networks;
- 3- A prestigious, convivial and inhabited centre;
- 4- Dynamic, accessible and diversified employment areas;
- 5- High-quality architecture and urban landscapes, and
- 6- Healthy environment

In general, some of the advantages and disadvantages of this plan can be listed below:

- 1- The master plan has taught the local staff the process of planning and preparing future master plans.
- 2- The master plan has been able to some extent to control and direct the future urban growth of the city.
- 3- The plan has been able to indicate the future needs of the city from the infrastructure and public transportation routes.
- 4- The plan has encouraged high residential building in the city, through infill development strategy in many pockets in the city.
- 5- Presenting many strategies and regulations for improving the future local built environment.
- 6- Suggestions on expanding the sub-centres of Beruşkê and Masîkê neighbourhoods, to mitigate the load on the main city centre.
- 7- Indicating the schedule of development, the phases of implementation and management the master plan, through determining the amount of suggested future developments in every five years.
- 8- The master plan has envisaged the future development of the townships surrounding the city of Duhok namely; Sêmêl, Domîz, Misurîk and Xanikê.

Despite those advantages and many others, there are many deficiencies some of them are related directly to the master plan and others related to the incapability of the planning institutions to manage the process of implementing the plan.

- 1- The master plan has concentrated on future developments, despite existing of many deficiencies and problems inside the city.
- 2- The master plan has used the fertile agricultural land for future development (14000 hectares) which is twice more than the current size of the city of Duhok.
- 3- The master plan has failed to give a real picture to the exact future development and the growth rate of the population.
- 4- The master plan has not been associated with detailed plans, which resulted in producing malfunction urban form at micro-scale in the city of Duhok.

¹⁴- Invalidity of the data and uncertainty in envisioning future lead the master-plan failing to response to the urban growth trends in the city.

- 5- Some of the idea and planning strategies mentioned in the associated report with the master plan are alien to the context of the city of Duhok.
- 6- The municipality was unable to control and manage the implementation of master plan due to the out-dated of the regulations, lack of qualified staffs and funds on one hand, and political intervention on other hands.

Since the final approval of the master plan, none of the mentioned objectives and the goals of the master has been achieved. The last four years from the life of the master plan were accompanied by the financial crisis and the tense of the political situation in Kurdistan Region.

The master plan needs to be reviewed in an increment of five years, for updating and considering new trends in urban development. Ten years have passed over since the fourth master plan endorsement and implementation without assessing the achievements of applying the master plan. According to the officials from the municipality of Duhok, more than two over thirds of the devoted land to the future developments has been consumed in the span of fewer years. There is no substantial correspondence between what the master plan stated and what the patterns of development are in real life. Most of the implemented developments have not associated with providing basic infrastructures and public utilities. The municipality of Duhok has not staked to the proposed schedule of development; rather, the pace of development was highly affected by the politician intervention and pressure of housing affordability and less by the planning institutions decisions.

8.2.2.2. Construction Permission

At present, the attribution of granting constructing permission is divided among different urban planning institutions (Directorate of Constructive Planning, Municipality, Land Registration, Environment Protection and Improvement Board, Investment Board, Directorate of Water and Sewage and Directorate of Electricity) – see Figures 8-4 and 8-5. Furthermore, a non-objection certificate is required in certain cases depending on the characteristics of the plots and the type of development.

The figures show a series of steps to obtain construction permission for residential and non-residential buildings. These steps are consuming time through moving between many partners for getting final approval, and at the same time, this process becomes a routine rather having adequate investigations and following up the projects and planning requirements. Also, these steps created weak chains in the process of approving final permission which is subject to the corruption and inconsistency in taking decision regarding the quality of the submitted plans and documents and their adherence to the regulations.

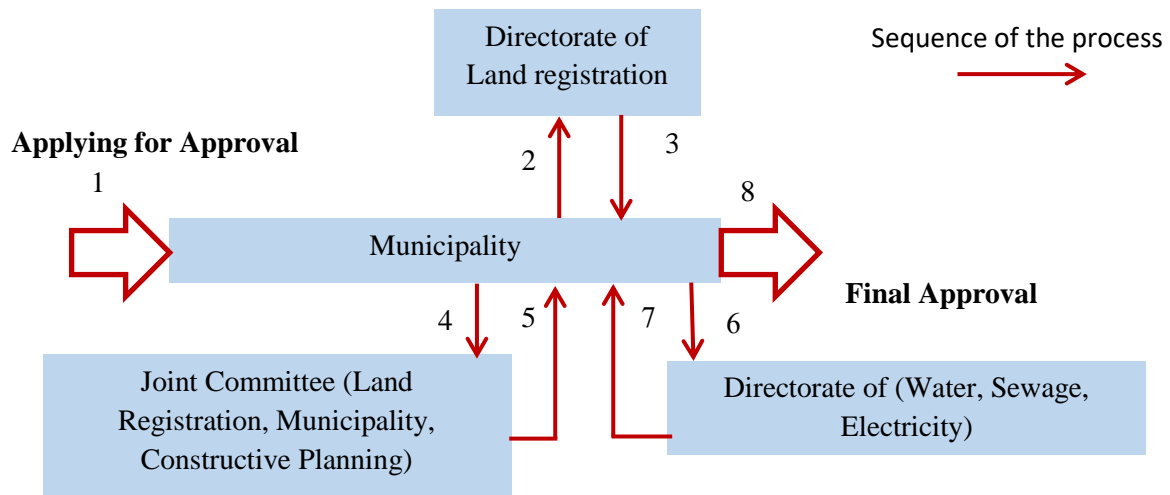


Figure 8-4: Approving of construction permission for residential units
 Source: Own construct based on document analysis form the Municipality of Duhok, 2015

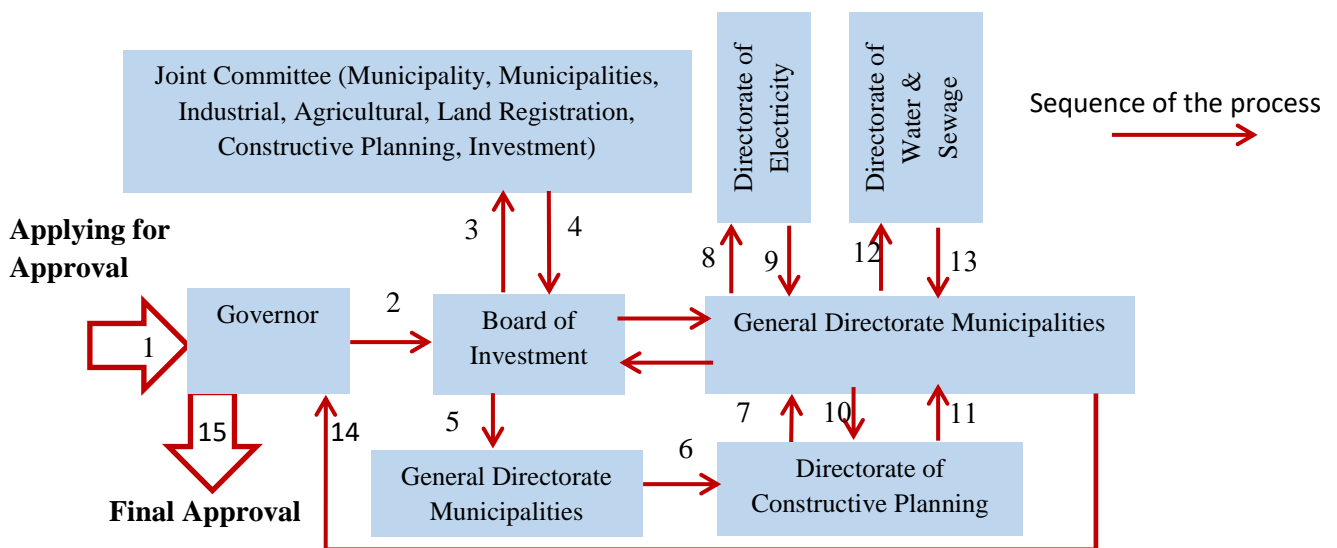


Figure 8-5: The process of approval of construction permission for investment projects
 Source: Own construct based on document analysis form the Board of Investment Duhok, 2015

8.2.2.3. Amendments to the Master Plan

Any amendment to the master-plan of the city of Duhok should be approved by the majority of city council members (twelve members plus municipality president) through voting and the final approval of Governor of the province of Duhok. The developers firstly; should submit the proposal for the amendment - these may be investors or ordinary citizen-who has an interest in a certain project proposal. The proposal will be submitted in case of the existence of any conflict with the master-plan or the proposal adds an important aspect to the master-plan, *secondly*; the technical and design department within the municipality after

negotiation with other departments transfers the request to the city council members for voting for approval. According to Resolution no. 829 of 2013 of the Ministry of Municipalities and Tourism in Kurdistan Region based on Article no. 25 of law 6 of the year 1993, the municipalities can amend changes in the approved master-plan of the cities in Kurdistan Region according to the following steps:

- 1- Technical departments in cooperation and coordination with other relevant departments in the municipalities should satisfy that the new amendments on the master-plan are essential to serve the public welfare in the city. The amendments can be introduced to the city council by the president of the municipality in the form of a report for discussion with the members of the city council.
- 2- Establishing a committee for consultation with the membership of General Directorate of Municipalities in the province, Directorate of Constructive Planning, Directorate of the relevant municipality and other concerned partnerships. The committee has to present their opinions in a written report to the city the council about the changes on the master-plan.
- 3- The decision of the city council has to be announced in the local newspaper for (30) days for receiving comments from the community. In case of an appeal against the decision by the public, the committee, in turn, will be entitled to study the comments carefully and then answer it. After doing the amendments suggested in the comments, it should be announced again for another (30) days for the final approval.
- 4- The city council should suggest and decide the new amendments in view of the presented reports from the consultation committee. The amendments have to be approved by the Minister of the Municipality and Tourism in (KRG).

Based on Resolution no. 1900 of 2013 of the Ministry of Municipalities and Tourism in Kurdistan Region, the amendments should be done only for the sake of those projects that will be executed for the public interests, such as changing green open space areas to other facilities (e.g. clinic centre, fire station, police station, primary school, kindergarten and electricity mobile station). The municipality should carefully indicate the buffer zone of each service. Applying for amendments must be for urgent issues and necessary to serve the public welfare. Any other amendments regardless of the mentioned facilities are not accepted by the Ministry of Municipality and Tourism. This resolution is enacted after many proposals have been approved which were against the public interests and have defected the urban form of the city and distorted the main characteristics and changed the land use pattern. Many open green spaces in the city have changed to residential or other uses for the interest of certain individuals. According to the officials from the Municipality and Directorate of Constructive planning in Duhok, these violations of the law were the result of pressures from the political parties or elites supported by these parties. The resolution was the responses to many claims against the municipality performance and ad hoc developments.

In case of new sub-divisions, corrections, unifications and adding residual lands to residential plots according to Resolution no. 9324 of 2007, the following required steps are essential to get the final approval for any amendments on the detailed plan:

- 1- Applicants have to submit their proposals to the municipality, and then the inspection will be undertaken by the municipality to ensure the issues related to any sub-division, correction and unification of the plots.

- 2- The departments of surveying and planning in the municipality prepare a report for that purpose.
- 3- The report submits to the Directorate of Constructive Planning to obtain approval.
- 4- After getting approval from the Directorate of Constructive Planning, the report submits to the city council by the department of planning and designing in the municipality for discussion and approval.
- 5- By getting approval from the city council, the proposal sends to the Governor for final approval.
- 6- Then, the request sends to the department of Estate in the municipality and to the Directorate of Land Registration in the capital of the province for fixing new amendments.

These steps are enough to get the acceptance and approval of related institutions and to ensure that amendments meet the spatial, institutional, socio-economic and environmental requirements, but in real life, inefficient and incompatible practices in the city of Duhok displaying things opposite to what has been documented in the papers and plans.

The proposals for master plan amendments have not participated in consolidating and improving spatial issues, rather, has brought many deficiencies because of lack of sound formal analysis of development impact assessment and other regulatory articles which are easily subject to the corruption, inconsistency and lack of transparency.

A full review of master-plan should take place every five years by reviewing the city's zoning and subdivision regulations for any required change. The absence of periodical amendments of the master-plan has punctured its ability to comply with the needs of the community and new trends of socio-economic and demographic aspects.

8.2.3. The Impact of Regulations and Legislations on Built Form

This section reviews the main laws, legislations and regulations that affected on shaping current urban form and structure in the city of Duhok. During the last decades, many legislations and regulations have been issued by the Ministry of Municipality and Tourism, Ministry of Local Government and other related urban planning institutions in Iraq and Kurdistan Region to control and regulate the physical urban development in the cities of Kurdistan Region.

8.2.3.1. Divisions and Subdivisions

The regulations of sub-divisions characterise and shape the urban form of a neighbourhood at micro-level. Sub-divisions are the article of dividing the land into small pieces that are easier to sell or to develop and plan, or may be used for another purpose such as commercial, industrial and entertainment development.

According to the Resolution no.850 on 1979 of the Revolutionary Command Council in Iraq, a minimum area of the new subdivisions of the land for residential uses in the capital cities are 120 m², and 100 m² for townships in the districts and sub-districts¹⁵. The effective measurements according to Article no. 25346 on 2010 of Ministry of Municipalities and Tourism in Kurdistan Region which based on resolution no. 943 on 1979 and Resolution no. 940 on 1987 of the Revolutionary Command Council in Iraq, the area of plot sub-divisions for

¹⁵ -This regulation became invalid according to Resolution no. 943 on 1979 of the Revolutionary Command Council in Iraq.

residence in the centre of the capital of the province, district centre and sub-district centres¹⁶ are indicated in Table 8-1.

Table 8-1: Residential plot sub-divisions within and outside of the cities and township

Location	Area (m ²)
Province Capital	200
District Centre	250
Sub-Districts (Township)	300

Source: Own construct based on document analysis form the Municipality of Duhok, 2014

The Resolutions, which encourage unified subdivisions of land, are considered the main sources of the dull characters and non-diversity of the neighbourhoods in term of land subdivisions, type of urban block, supplied services and social segregation in the city of Duhok. The Government used to subdivide the land for unified sizes of plots for new development initiatives and then distributing them in trivial cost to support public servants. These are many areas in the city of are known by (e.g. Lawyers, Polices, Academies, Doctors, Gypsies, Nomads, Millionaires and so on) which gives raise for social segregation in the city of Duhok, even though the process of selling and buying land is highly affected by these characteristics. In addition, these regulations are the main sources of sprawling urban area through encouraging single residential houses and accelerating spatial expansion of the city of Duhok

Resolution no. 1359 on 1996 has determined the minimum depth of the residential plots for single attached houses to 20 m and the width (front elevation) to 10 m, 12.5 m and 15 m for the parcels with areas of 200 m², 250 m² and 300 m² respectively.

Maximum allowable area for new subdivisions within the municipalities' boundary for a single residential plot is 800 m². It is possible to subdivide the plot of 800 m² with less area to two or more land pieces for residential uses, which conditioned to a minimum width of 8 m and area at least 30% of the total land.

According to Resolution no. 1488 on 1985 issued by the Ministry of Local Government in Iraq, permissible construction areas for residence in agricultural land within the boundary of the municipalities should correspond to the following measurements- see Table 8-2.

Table 8-2: Allowable construction areas of residential purposes in agricultural land inside the cities

Agricultural Area (acre)	Allowable Construction Area (m ²)
More than 3	240
More than 2	180
More than 1	120
Less than 1	100

Source: Own construct based on document analysis form the Municipality of Duhok, 2014

¹⁶ - According to the Kurdistan Regional Constitutions, all urban settlement which has population more than 5000 inhabitants should have one unit of municipalities. This reveals that urban settlements which have less population will not be under the control of urban planning institutions such as villages in rural areas.

8.2.3.2. Change of Land Use

The minimum area of sub-divisions of a commercial area in the old core of the city is 100 m² with at least 6 m width facing the street. While the minimum area of new subdivision for commercial uses on the commercial strips and axes in the city is 200 m² with at least 8 m width facing the street and a minimum depth of 15 m. In the case of subdivision for commercial uses in the residential area, the minimum allowable area for commercial uses is 200 m² with a depth of 10 m. If the house is blocked from the street view, then an alley of 3 m width should be left as private access- see Figure 8-6. These regulations have affected the way that urban form transformed from the residential to commercial uses, through encouraging commercial strips.

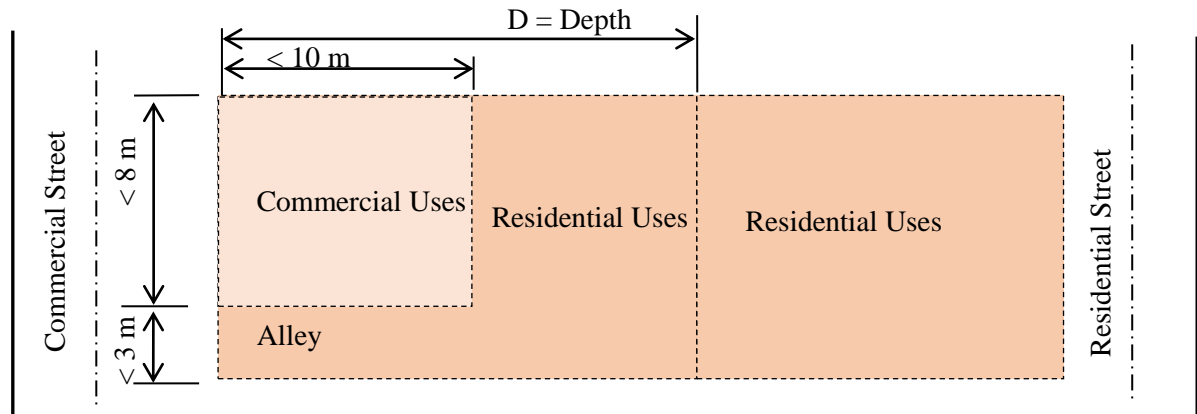


Figure 8-6: Subdivisions of residential plot for commercial purpose

Source: Own construct based on document analysis from the Municipality of Duhok, 2015

Based on Resolution no. 940 on 1987 of the Revolutionary Command Council in Iraq, minimum sub-divisions of land for commercial uses are indicated according to the morphological stages of the city- see Table 8-3. This resolution lacks adequate clarifications regarding the characteristics of the morphological areas referred to because the municipalities even did not properly identify these zones.

Table 8-3: Allowable sub-divisions of land for commercial purposes inside the cities

Developed Area	Plot Area (m ²)
First Developed Area (Old City Core)	100
Second Developed Area	200
Third Developed Area	300
Fourth Developed Area	600

Source: Own construct based on document analysis from the Municipality of Duhok, 2014

According to the new urban design guidelines for the city centre which promoted by the Governorate of Duhok. It is not allowed to renovate or reconstruct any commercial buildings with an area less than 100 m², the owners are imposed to sell their buildings to the owners of adjacent buildings because their plots have fewer areas than 100m² as recommended. This regulation counters legal support, many of the owners of the commercial buildings with less than 100 m² area refuse to sell, and at the same time the owners of adjacent commercial buildings with more than 100 m² refuse to buy, or there is speculation at prices where both

parties taking the opportunity to increase or reduce the price. Promulgation of such regulations indicates the lack of knowledge in issuing regulations in the field of urban planning which result in conflicts. The new recommended instructions issued by the General Directorate of Constructive Planning for creating new commercial axes - see Box 8-3.

- 1- Temporal transforming of the residential streets to commercial with regards to the actual need for commercial activities in each period.
- 2- Priority to be given to the streets which has already transformed to commercial as a response to create extra commercial activities in the area.
- 3- Creating new commercial strip should be avoided in area which has already a planned commercial centre according to the detailed plans.
- 4- Avoiding mixing between the commercial and residential activities horizontally, commercial areas on the streets determined to depth of 20 m.
- 5- Municipality has to render a decision of city council concerning commercial strips.
- 6- Municipality has to coordinate with other technical institutions such as Traffic Office prior to creating any new commercial strips in the city, and
- 7- Preventing to create new commercial axes and strips in area of institutions, orchards and agricultural areas.

Box 8-3: Instructions for creating new commercial strips

Source: Own construct based on document analysis from the Municipality of Duhok, 2014

The transformed residential uses to commercial uses are supported by the decision of city council members through the voting. The decision lacks deliberately investigating social and spatial impacts of the transformation of the urban form – see Figure 8-7.

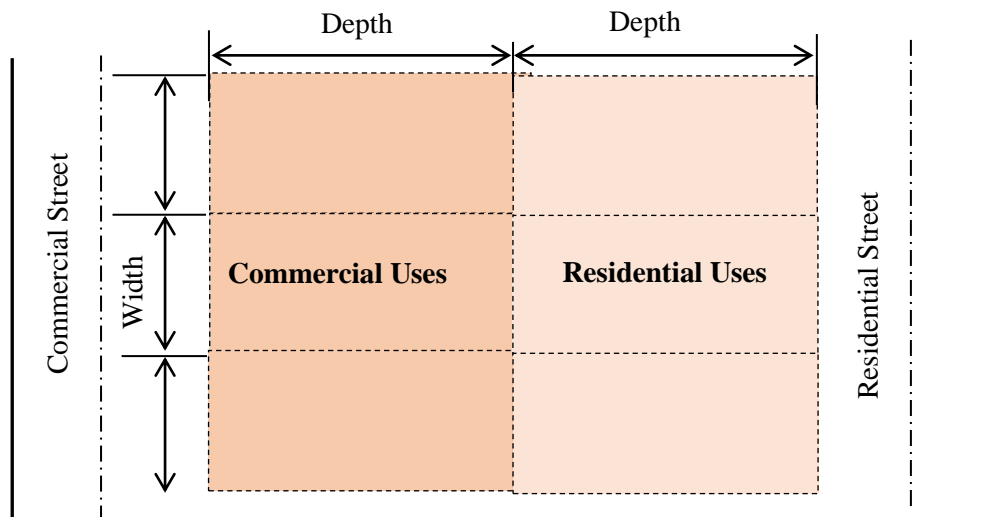


Figure 8-7: Residential and commercial strips in linear blocks

Source: Own construct based on document analysis from the Municipality of Duhok, 2015

8.2.3.3. Plot Corrections and unifications

Based on the Resolution no.9324 on 2007 of the Ministry of Municipality and Tourism in Kurdistan Region, corrections¹⁷ of plots for residential, commercial and any other uses would

¹⁷ - Correction is the process of correcting the dimensions and areas of the plots in real life and in the documents of the Municipality, Land Registration and other related urban planning institutions.

be done either by correcting areas or dimensions of the land parcel. Correction of the dimensions and the areas of the plots are applicable for the errors resulting in fixing the dimension of the plots or blocks.

Residuals are the pieces of land parcels that have leftover due to errors done by the Municipality in fixing layouts of plots or urban blocks. The remaining land if exceeds 120 m² considers as a uniform plot. These residuals can be dealt with as follows:

- 1- Adding to the pavements or other open areas,
- 2- Selling to the citizens in an auction if the area exceeds 120 m²,
- 3- If the residual area is less than 120 m² and adhered to a certain residential plot, then the owner of the adjacent plot has the legal right to buy the residual.
- 4- In case the residual is located between two residential plots or more and the area is less than 120 m², the owners of the plots have the legal right to buy the residual evenly.
- 5- The residual would not be sold to the owners of informal houses in irregular urban blocks before registering and upgrading the informal areas.
- 6- The Municipality has the right to keep the residual if it is going to serve the public interest.

In most cases, these regulations have served certain individuals more than public interests. For example, in KRO Street opposite to Şilan Hospital, in Karwan Streets and in Berûşkê Street and many to name, in these streets, the residuals would have served the public while they have been sold to powerful individuals.

Unification of two or more piece of land for residence is allowable if the total area of the re-joining plots is less than 800 m² in regardless of the dimensions. Unification of plots for commercial uses, the allowable depth of the unified plots should not exceed 20 m length; these regulations are effective for the commercial streets which have linear residential blocks of 40 m depth- see Figure 8-8. These regulations apply to the developed areas of the second morphological stage and afterwards.

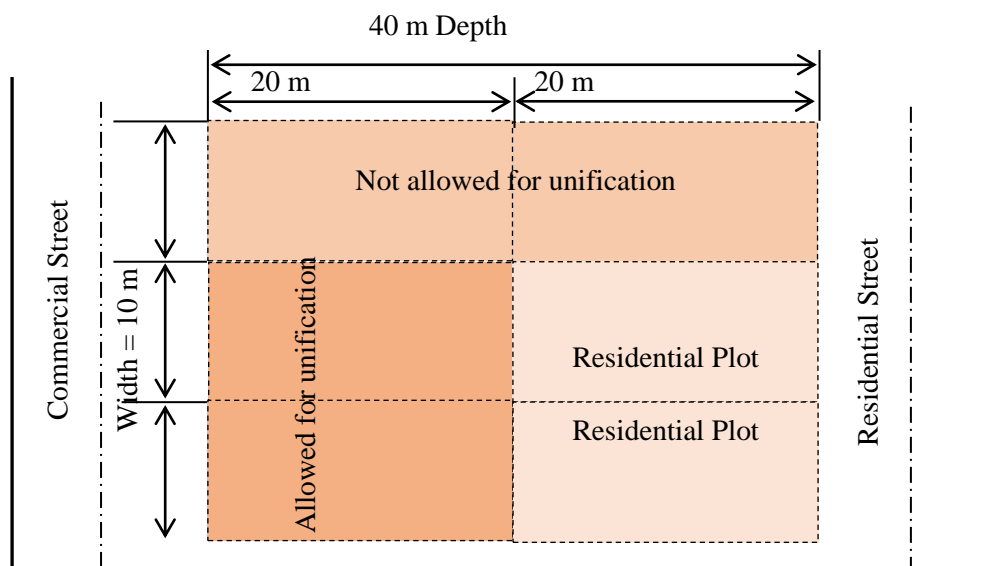


Figure 8-8: Unification of residential and commercial plots

Source: Own construct based on document analysis from the Municipality of Duhok, 2015

8.2.3.4. Building Setback

Regulations regarding setbacks are not precisely studied and controlled by the municipality. There are two types of applicable regulations. One is concerned to the residential setbacks line that is determined to the size of the plots and the other is concerned to the commercial building setbacks which are determined to the width of the streets. Resolution no. 1359 on 1996 defines the minimum setbacks for residential plots of 200 m² areas as 1.5 m, setback for plots with areas of 250 m² is 2.0 m and for plots of an area of 300 m² is 2.5 m - see Figure 8-9. In practical, the Municipality of Duhok is not able to enforce the regulations of setback which is relevant to residential buildings, in most cases as the fieldwork investigated, the setbacks are ranging between 1.00 m and 5 m and used by the owners as an eternal garden house or as a private car park. Residential plots in the first and second morphological stages of the city's development have direct openings on streets without setbacks.

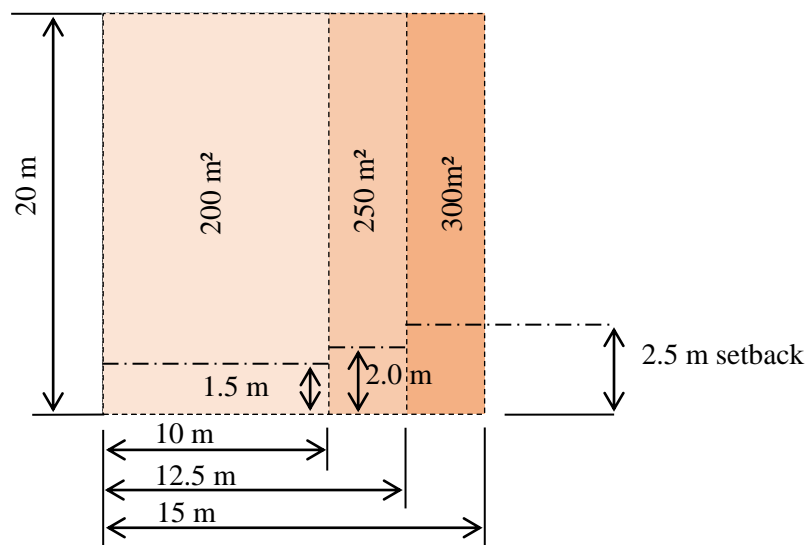


Figure 8-9: Setbacks of residential plots based on their areas

Source: Own construct based on document analysis from the Municipality of Duhok, 2015

In case of residential plots of more than 300 m² till 800 m² within the boundary of municipalities' jurisdictions, the minimum setback is 4 m in front which faces main streets, and half of this length (2 m) for the sub-ways. These measures can be applied for the corner plots in residential areas - see Figure 8-10.

Referring to Article no. 416 on 2000 of General Directorate of Constructive Planning in Kurdistan Region which based on Article no. 8147 on 1989 of Presidency Office in Iraq, commercial plots those are located on the main streets (30 m width and more) should have 5 m setback from the property line and 3 m on sub-way or back streets. In addition, setback of 2.5 m and 1.5 m setback for streets of 20 m and 15 m width- see Figure 8-11. The areas of setbacks in commercial streets should be added to widen sidewalks.

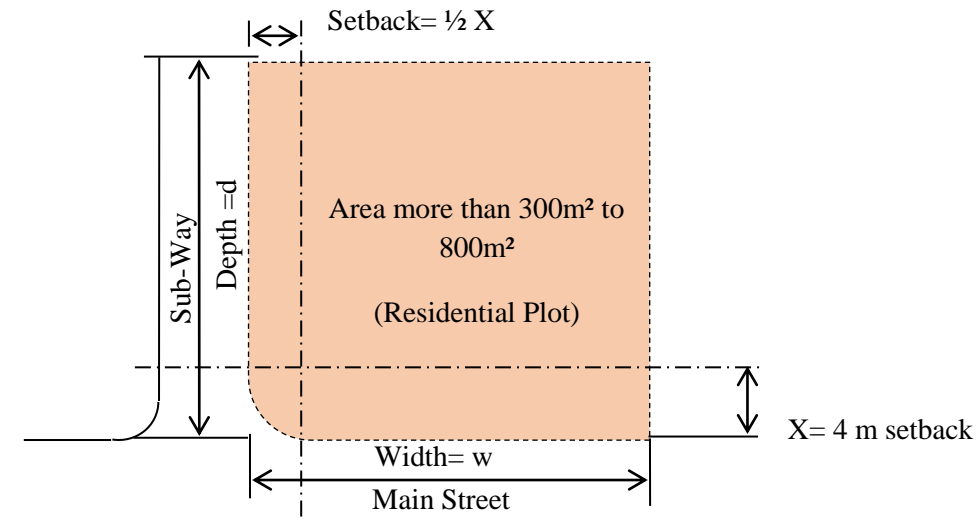


Figure 8-10: Setbacks of corner residential plots with area more than 300 m²
 Source: Own construct based on document analysis from the Municipality of Duhok, 2015

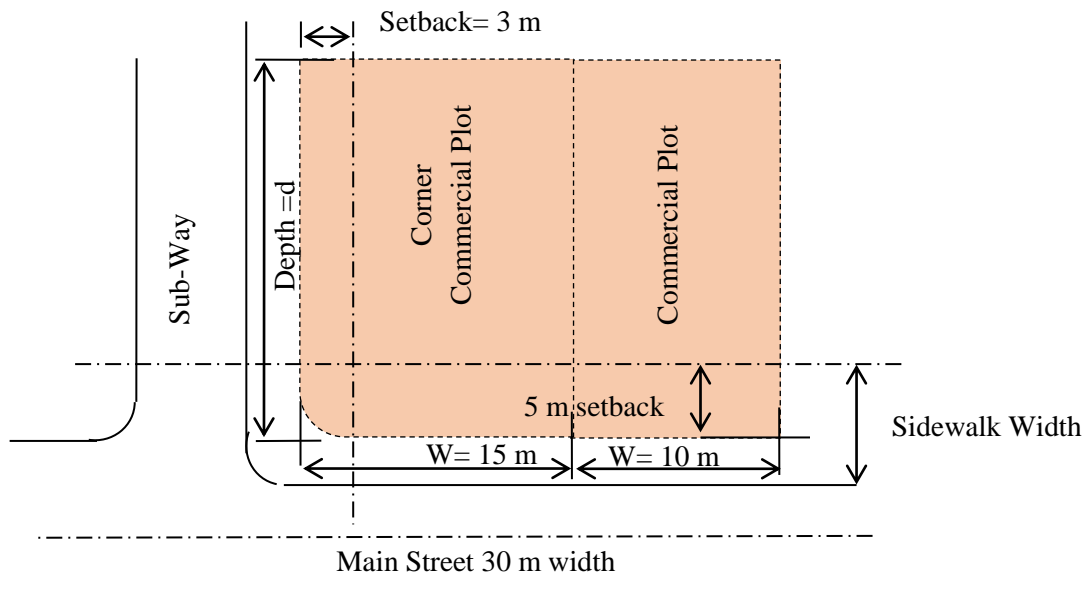


Figure 8-11: Setbacks of commercial plots at main streets
 Source: Own construct based on document analysis from the Municipality of Duhok, 2015

Setbacks for commercial buildings at the main streets are 1.5 m, 2 m, 2.5 m for the streets of 12m, 15 m, 20 m respectively in regardless of the plots area and their dimensions. In case of the commercial buildings, the setbacks here consider as a public space, but in practice, they are not used in favour of the public interest, because the building owners have occupied the setback for displaying their goods or as an extension to their plots.

Cancelling building setbacks in other sides of the residential plots has generated a type of residential buildings that are attached in three sides. This, in turn, has led to losing the privacy of the residential units and obstructing natural air ventilation and sunlight. Also, it is reduced the amount of open green spaces in residential plots and increased built-up area.

8.2.3.5. Building Height

The numbers of allowable stories for single attached houses low-residential building is two or three stories with staircase house, while the numbers of stories for high residential buildings are not mentioned in details in any regulations, which mainly are depended on related bylaws or the decisions of the city council. Article no. 629 in 2014 issued by the Environment Protection and Improvement Board in Kurdistan Region, states that the commercial plot which has the area less than 1000 m² are not allowed to build more than five stories. Initially, most of the commercial plots in the old core of the city of Duhok and other newly developed areas are not conforming to this regulation. This regulation has not been studied and discussed with the related authorities with the Municipality and the Directorate of Constructive Planning due to the lack of coordination between related planning institutions.

The permissible height of the ground floor for the commercial buildings is 4.5 m and for other floors is 3.20m with a projection width of half of the setback- see Figure 8-12. For the residential buildings –single attached and detached- there is any sound regulation to restrict the high, but the applicable height is between 3.00m to 4.00m.

In practical, these regulations are not applied carefully and have not been properly implemented, as there are many cases of abuse and non-compliance, which in turn led to losing the privacy of many buildings and distorting of the streetscape scenes.

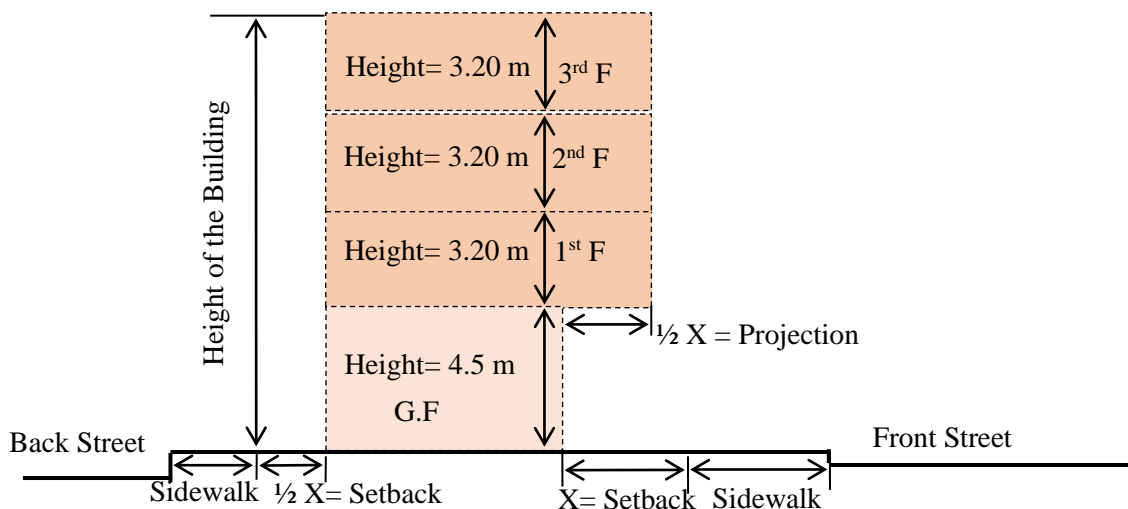


Figure 8-12: Setback and projection measurement for Commercial Buildings

Source: Own construct based on document analysis from the Municipality of Duhok, 2015

8.2.3.6. Built-up Area

The allowable built-up area in case of commercial buildings for each floor is 75% of the total area of the plot. The minimum area of each retail (small units) on the ground floor is 10 m² in case the commercial buildings are on commercial strips. The minimum area of each apartment is 45 m² for commercial uses and offices, while the area for residential apartments is 75 m² for each apartment. The allowable built-up area for residential plots is 65% and open spaces are 35%. The percentage of open space is divided into two divisions, 17% percentage as green open spaces and 18% percentages as tilled open area.

Article no.9115 in 2012 which issued by the General Directorate of Constructive Planning in Kurdistan Region based on Article no. 12/883 of 2012 of the Environment Protection and Improvement Board in Kurdistan Regional, refers to the minimum allowable green area for neighbourhoods within the municipality border as 25% -30% from the total area of the neighbourhood. In the case of commercial plots, the regulations, instructions and detailed plans do not show how to translate these open spaces in real life, and the purpose of leaving such area- see Table 8-4.

Table 8-4: Minimum allowable area of open spaces for the commercial uses

Area of Commercial Uses	Area Ratio of Open Space
Less than 30 m ²	Determinable in time of releasing construction permission
31-50 m ²	10%
51-75 m ²	15%
76-100 m ²	20%
More than 101 m ²	25%

Source: Own construct based on document analysis from the Municipality of Duhok, 2014

The Municipality was not able to apply these regulations and enforce them at the ground because of the noncompliance and obedience by the plot owners. The owners are used to prepare two sets of drawings, one set which is according to the regulations for getting the construction permission and the other for implementations, such practices reflect poor monitoring and following-up the implementation of new projects, and incapability in enforcing the regulations. Therefore, most cases of the executed plans do not match the plans which have been submitted to the Municipality for getting construction permission.

8.2.3.7. Land Usage

The rate of utilisation of land for constructing entertainment and commercial activities in agricultural lands located within the boundary of the municipality in the cities are shown in Table 8-5.

Table 8-5: Allowable activities for Agricultural land inside the cities

Allowed Activities	Type of Activities	Plot Area (m ²)	The Rate of Allowed Areas
Hotels & Motels	Green open Space	2000-5000	10-20%
Restaurants & Tea Shops	Entertainment & Green Space	1000-2000	20-40%
Playing Yards & Zoos	Entertainment & Open Space	2000-10000	15-30%
Swimming Pools	Entertainment & Open Space	3000-5000	25-35%
Different Nursery	Green open Space	1000-3000	3-5%

Source: Own construct based on document analysis from the Municipality of Duhok, 2014

According to Article no. 50 of law no.6 of 1993 and its amendments, the agricultural lands within the municipality buffer zone can be sub-divided with the permission of the Ministry of Agriculture and the Ministry of Municipality and Tourism in Kurdistan Region for residence and recreational uses. Agricultural lands have classified to five categories of buffers

depending on the proximity to the city centre and the rank of the municipality as shown in Figure 8-13. There is a lack of accurate and precise details regarding the criteria, regulations and the way that Municipality controls constructions in these zones. Most of the agricultural land in the villages near to the city of Duhok before the process of the land acquisition have been divided and sold in the land market, which increased the informal development in these villages, and later on jointed to the city and became a part of the newly developed areas.

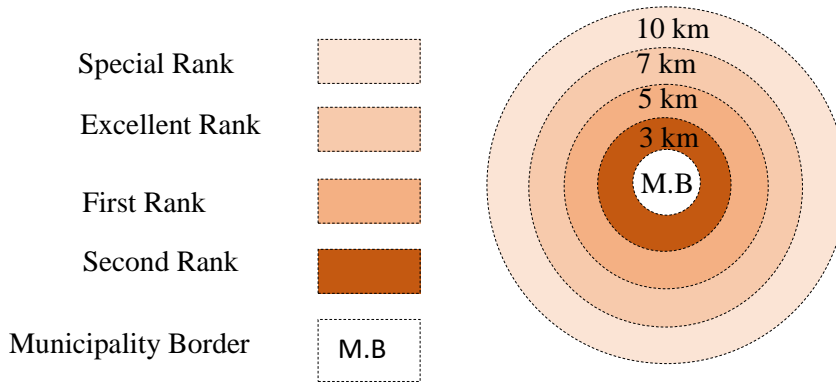


Figure 8-13: Classification of land utilisation for residential purposes within buffer zones of the municipality's boundary

Source: Own construct based on document analysis from the Municipality of Duhok, 2014

According to Resolution no. 5 of 2007 of the Cabinet Council of Kurdistan Regional Government based on Resolution no. 80 of 1970 and Resolution no. 53 of 1976 of the Revolutionary Command Council in Iraq, in case of new extensions of the city according to approved master-plan in expense to agricultural land, the occupied agricultural land that registered in the name of the Ministry of Financial have to be transacted as a property to the Ministry of Municipality and Tourism. Moreover, any other agricultural land that the individuals keep the right on should be dealt with according to the regulations. The municipality should grant 3% of the area of the procuracy land to individuals who has an (agricultural agreement with the Ministry of Financial) and granting 12% to the individuals who have the right of disposition on the land. Individuals who have the land as their property should be award 20% of the procuracy land. The regulations state that exploiting fertile agricultural land for urban issues should be avoided as much as possible, orchards, groves and fruit gardens will preserve as green spaces inside the city without showing the mechanisms and the alternatives that should be applied to avoid extra land depletion. According to the officials in the General Directorate of Agriculture in the city of Duhok, they do not have any sort of appeals against the municipality decisions in case of invading any new agricultural land for city growth.

8.2.3.8. Street Network

Streets and pedestrian movement have not received adequate attention from the side of urban planning authorities in Kurdistan and Iraq. Most of the regulations relating to the street width, street median and sidewalks are inefficient. There are three types of street's width in the city:

- 1- Residential streets with width 7.5m and 10.0 m
- 2- The collector streets 12.0m, 15.0 and 20.0m
- 3- The arterial streets 25.0m, 30.0m, 35.0m and 40.0m

The regulations do not indicate the amount of traffic flow for each type of streets, also the number of lanes, junctions and segments. These regulations do not consider population density, pedestrian right of the way, type of streetscape, providing of on-street and off-street parking in the residential and commercial streets. Therefore, the streets in the city suffer from congestion, over speed, disconnected and improper design in term of traffic engineering with a poor streetscape.

8.3. Urban Planning Governance and Management

By the end of the previous regime in Iraq, Kurdistan Region enjoys more authorities as stepping in applying the concept of de-centralisation. The new orders offer the local governments many authorities in taking decisions in issues relevant to spatial planning. Accordingly, the Ministry of Municipality and Tourism has endowed the municipalities and directorate of Constructive Planning at the local level with more authorities. The issues of urban governance and management remain hostage to the inherited concepts of strict centralisation. Generally, the spatial planning institutions and authorities lack sound legal framework, clear distribution of responsibilities and tasks, efficient regulations and laws.

According to the Ministerial Order no. 1900 in 2013 based on Orders no. 15, 4898 and 8998 in 2010 of Ministry of Municipality and Tourism in Kurdistan Region indicated the authorities and responsibilities of the three main bodies of urban planning institutions namely; General Directorate of Constructive Planning and its Directorates, General Directorates of Municipalities and Presidencies of Municipalities in the Capitals of Provinces in Kurdistan Region— see Boxes 8-4, 8-5, 8-6 and 8-7.

First: Responsibilities of the General Directorate of the Municipalities in the Provinces

- Supervising of different tasks related to the Municipalities of cities and towns in the province except the Presidency of the Municipality in the capital of the province. All the proposals, applications and transections of the municipalities have to be through the General Directorate of Municipalities in the province with their comments and suggestions prior to be sent to the Directorate of Constructive Planning in the Province.
- To participate in a joint committee for the purpose of allocating investment projects with the General Directorate of Investment- except projects related to the Presidency of Municipalities- and recommending on the proposed projects for Districts, Sub-Districts.
- Participating in a committee with other related institutions for the purpose of supervising the process of preparing master plans for cities and towns.
- To participate in a committee for granting construction permission for different development projects within all Municipalities in the Province.
- To give opinions in case of changing residential streets to mixed use (residential and commercial) in all the municipalities in Districts, Sub-Districts and residential compounds, following the proposal of the joint committee in which the General Directorate of Municipalities is a member, with the approval of city council after expiration of announcement date for appealing, under the authorisation of the Directorate of Constructive Planning.

Box 8-4: Responsibilities of the General Directorate of the Municipalities in the Province

Source: Own construct based on document analysis from the Municipality of Duhok, 2015

Second: Responsibilities of the Directorates of Constructive Planning in the Provinces

- To give planning opinions and follow the development projects of those have been designated by the Municipalities in the province within the master-plan jurisdiction. The development projects should comply with laws and regulations regarding the land use and allocation of the projects. In case the location of the assigned project has no specified drawing, the Directorate is obliged to work on preparing the plan for the area and later on giving opinion on the land use and the location of the project.
- Providing planning opinion on issues relevant to corrections, unifications of the plots and residual lands in accordance to the Article no. 1148 on 2009 of the Ministry of Municipality and Tourism in Kurdistan region. All the matters that can be solved by the joint committee do not need to be referred back to the Ministry.
- Presenting opinions regarding allocation of lands for NGOs projects and other civic society organisations.
- Indicating ideas regarding land acquisition within the boundary of the master-plan after getting approval from the General Directorate of Constructive Planning with the authorisation of the legal department in the Ministry of Municipalities and Tourism and the Ministry Cabinet.
- Recommending on new detailed and amended sector plans and approved master-plans which proposed by the concerned institutions for final endorsement.
- Participating in joint committee for providing planning opinions regarding allocating of investment projects in the province.
- Participating in joint committee for preparing new master-plans for the cities and towns in the province.
- Participating in joint committee for granting construction permission within Municipalities borders in the cities.
- Demonstrating opinions in case of changing land use pattern within the sectorial plans – except green open spaces which need approval of the Ministry Cabinet- after getting permission of city council and expiration of the legal announcement period.
- To give opinions in case of changing residential streets to mixed use (residential and commercial), after presenting the proposal of the joint committee in which the Directorate of Constructive planning is a member, with the approval of city council after the termination of announcement period for appealing.
- Participating in surveying tasks for allocating sectorial issues and development initiatives with joint committee from the related institutions, as well as preparing detailed plans.

Box 8-5: Responsibilities of the Directorates of Constructive Planning in the Province

Source: Own construct based on document analysis from the Municipality of Duhok, 2015

Third: Responsibilities of the Presidency of the Municipalities in the Provinces

- To participate in preparing master-plan in cooperation and supervision of Directorate of Constructive Planning in the Province and under the authorisation of General Directorate of Divan and supporting of General Directorate of Constructive Planning.
- Recommending and suggesting on sectorial plans, preparing and amending them in accordance to the approval version. In both cases, the updated version has to be approved by the Directorate of Constructive Planning in the province, and a copy of the approved version to be sent to the General Directorate of Constructive Planning in the Ministry of Municipality.
- Allocating and suggesting locations for different activities within the jurisdiction of the Municipality basing on the approved detailed and sectorial plans and according to the Resolution no.64 on 1990 and law no.25 of 1991, then the proposal to be sent to the Directorate of Constructive Planning in the Province for approval.
- Providing planning opinions and preparing plans for issues related to corrections, unifications of the plots and residuals in cooperation and coordination with planning institutions. Proposals to be sent to the Directorate of Constructive Planning for getting approval.
- Allocating and suggesting locations of important development projects within the banning areas of the master-plan in a cooperation and coordination with the Ministry of Agricultural and the Directorate of Constructive Planning in the province capital. This issue is conditioned to; *firstly*, to prepare required plans for the proposal, *secondly*, getting the approval of General Directorate of Constructive Planning in the Ministry of Municipality and Tourism prior to any action takes place.
- Recommending ideas regarding killing agricultural land for the purpose of development initiatives and compensating land owners, as well as providing opinions on land acquisition according to the regulations.
- Recommending and proposing opinions on changing land use pattern within the approved sectorial plans, this conditioned to the permission of Constructive planning and discussing planning issues related to changing the function of land according to the regulations.
- To give opinions in case of changing residential streets to mixed use (residential and commercial), after proposing it by the joint committee in which the Presidency of Municipality is a member.
- Participating in different tasks of surveying for allocating development initiatives with the joint committee from the concerned institutions.

Box 8-6: Responsibilities of the Presidency of Municipality in the Province

Source: Own construct based on document analysis from the Municipality of Duhok, 2015

Fourth: Responsibilities of General Directorate of Constructive Planning

- Recommending and approving opinions to the Minister on matters relevant to master-plan.
- Recommending and suggesting issues related to the elaboration of cities' master-plan and approving the last version.
- To recommend on issues relevant to amendments on cities' master-plan and approving them.
- Providing planning opinions in case of changing the zones and sectorial issues on the master-plan and approving the changes.
- To give planning opinions on issues related to constructing within the banning areas of road outside the master-plan jurisdiction. In such case, the issues need a new plan to be prepared by an authorised committee from concerned institutions and approving it.
- Supervising and following all technical and planning tasks of the Directorates of Constructive Planning in the provinces of Erbil, Sulaimanyia, Duhok and Germiyan.
- Setting-up, revising and standardisation of technical and planning regulations and generalisation them in cooperation with concerned authorities in the Ministry
- Collecting and archiving all master plans of the cities and towns in Kurdistan region and referencing them in (GIS) system.

Box 8-7: Responsibilities of the General Directorate of Constructive Planning

Source: Own construct based on document analysis from the Municipality of Duhok, 2015

To initiate the process of public participation at different levels of public decision making, the Iraqi government has created city council¹⁸ since the date of first Iraqi National Government in 1936. The role of the city council is clarified within the legal framework of urban development planning. The involvement of stakeholders outside the government bodies was defective during the last decades. Based on the Resolution no.16 law 6 of 1993 of Ministry cabinet of Kurdistan Regional Government, the elected numbers of the city council in each municipality is indicated by Article 18- see Box 8-8.

The number of elected members of city council

- Municipality of Special rank has seventeen members.
- Municipality of excellent rank has thirteen members.
- Municipality of first rank has eleven members.
- Municipality of second rank has nine members.
- Municipality of third rank has seven members.
- Municipality of fourth rank has five members.

Box 8-8: Number of elected members of the city council per municipality in Kurdistan cities

Source: Own construct based on document analysis from the Municipality of Duhok, 2015

¹⁸ - According to Law no. 3 of 2009 of the Ministry cabinet of Kurdistan Regional Government a new council formed and called the Council of the Province which diminished the responsibilities of the city council and conflicts each other in many cases.

Following are the main tasks and responsibilities of the city council according to Article no.25, 26;

- 1- The city council is obliged to announce all the master plans that were prepared by the Directorate of Constructive Planning to the public and other relevant authorities for submitting appeals and proposals for a period of sixty days. For the detailed plans and other revised and amended plans, the announcement period is thirty days.
- 2- All the proposals and appeals should be studied by the city council, if any, through indicating rational reasons. The studies have to be sent to the Directorate of Constructive Planning within one-week period time.
- 3- The decisions of the city council regarding amending, revising and omitting of issues related to master plans or detailed plans, or dividing the city into zones (residential, commercial and industrial uses) are subject to the objection of the administrative authorities for a period of fifteenth days.
- 4- The city council has the right to call the municipality for amending the master plan.
- 5- In case of amending the master plan or detailed plan the city council has to prepare a report regarding the new requirements of the amended master plan and works for the acquisition of the land, pertaining to the master plan within twenty years from the final approval.
- 6- The city council can decide in contrary to the master plan in view of submitting proposals from concerned bodies for the permissions to construct buildings or using of lands for temporary uses.

Based on the Articles of the above Resolution, the additional responsibilities of the city council relating to controlling and supervising physical urban development with the cooperation of concerned authorities are indicated- see Box 8-9.

In broad, city council can;

- Amend and issue resolutions that are relevant to regulations at the local level.
- Decide to suggest and discuss the general issues of spatial planning and states its opinions.
- Study the rules and regulations and agreements and concessions, indicating its opinion thereon.
- Discuss annual reports relevant to municipalities work, giving its opinion thereon.

Many of these mentioned tasks and responsibilities of the city council revolve around technical issues that are related to urban planning and urban design matters which are assignments of urban designers and planners. These tasks need qualified and capable individuals with long experience.

Tasks of the city council

The city council decides with a coordination to related authorities the following tasks and works;

Article 28

- Opening and widening streets according to approval plans.
- Paving, levelling, tiling and greening the streets in the city.
- Deciding methods of using streets, residuals and empty plots owned by the municipality for services such as retails vendors and kiosks in a manner to maintain public welfare with a cooperation of Directorate of Constructive Planning.
- Constructing, maintaining and classifying public gardens and parks.
- Allocating playing yards, entertainment cities with a cooperation of General Directorate of Tourism, and renting them to private or public sectors for long term-renting.
- Executing approval master plan and other detailed plans, and implementing the services and facilities in view of these plans.
- Constructing and maintaining underground streets and overpass.
- Demolishing the useless and ragged buildings and other obstacles that hinder public accessibility.
- Indicating places for selling and raring pets and domestic animals inside the city.
- Constructing retails and shopping centres inside the city according to approved plans.
- Indicating places and locations for selling different animal and agricultural products inside the city.
- Constructing open and closed swimming pools, theatres, cinema, playing yards, hotels, baths, tea and coffee shops, museums, libraries, youth centres and entertainment places.

Article 29

- Driving out all industrial, crafts and other occupations that harm the environment and public health outside the cities, and to find suitable places for allocating them according to approved plans.
- Demolishing buildings and constructions that are contrary to regulations and laws.
- Preventing any constructions that hurt other people or distort streets and parks.

Article 30

- Indicating methods and mechanism for distributing residential parcels among the citizens according to the available land that acquisitioned inside the master plan jurisdiction.

Article 31

- The city council has to determine regulations, bylaws that help to runs above tasks and responsibilities in pervious Articles.

Article 39

- To sell the space over the pavement of streets according to setback regulations as a projection for building first floor and upwards.

Article 47

- In the interest of public the city council has the right to cancel old streets and replace it with a new one according to approved plans.

Box 8-9: Tasks of city council relevant to Physical Urban Development

Source: Own construct based on document analysis from the Municipality of Duhok, 2015

The mentioned responsibilities and authorities are the final and updated tasks of the three main urban planning bodies and entities in the Kurdistan Region and the responsibilities of the city council. These bodies have full responsibility in shaping and formulating physical urban development. A critical review of these responsibilities appears that:

- Absence of clear and distinctive responsibilities of the urban planning bodies.
- Delegated responsibilities are in the shape of sequential steps for achieving daily routine tasks in the institutions.
- Interfering and conflicting in supporting tasks and duties.
- The urban planning bodies are mainly concerned to supervise and execute municipalities' work in the cities, rather than planning and managing the city's issue.
- The Governor's approval does not necessarily mean that the decision meets the technical requirements because there is no efficient board of experts, planners and advisory bodies in the office of the Governor.
- Absence of spatial planning entities within the ministry structure that concerned to assess the impact of the implemented development initiative.
- The responsibilities that endowed to the city council are many and they hold decisions regarding important issues related to the current and future developments.
- The members of the city council need qualifications and professionalism to be able to decide issues concerning spatial planning practices and evaluate the quality of the master plan.
- Many wrongful and unfair planning practices that affected city urban form which was against the citizens' interest took its legitimacy from the weak link of the city council.
- The centralised urban planning governance meant to offer a limited involvement at regional and local levels, which give no space for the stakeholders, civic society organisations and scientific institutions participation in all levels.
- The proposals do not well negotiate with the affected communities or other public partners and planning institutions.
- Forming of the joint committee in most cases delay achieving duties and not leading to performing sound decisions, because, in many cases, the elected members of the joint committee are no qualified to give the opinion on specified issues.
- Distributing of tasks and responsibilities between many entities and bodies resulting in confusing and inconsistency.

In general, the role of the local government is weak in understanding the role of the urban planning system in enhancing social, environmental and economic development at the local level. Relationships between the various planning authorities are lacking coordination and cooperation at different levels of planning, which reflected on the type of physical urban developments that have been implemented during the last years. The relationship between the institutions mainly revolves around the sectorial issues in urban areas such as transport, electricity, water supply, urban wastewater management and drainage, solid waste management, housing and land.

8.4. Conclusions

Physical urban development in Kurdistan Region is the responsibility of the Ministry of Municipality and Tourism at the federal level and the local level through its three main entities namely; Presidencies of Municipalities, General Directorates of Municipalities and General Directorate of Constructive Planning. Initially, the task of issuing regulations, ordinance, laws relevant to the physical urban development (e.g. regulations of buildings, streets, green spaces) is the responsibility of General Directorate of Constructive planning. The issues, which are related to the implementation and supervising of development initiatives, are the responsibility of the General Directorates of Municipalities and Presidencies of Municipality. Cooperation and coordination between the Ministries are through their entities at the local and federal level. At the local level the cooperation is mainly related to the issues concerned to the technical aspects, and in the regional level are mainly related to the planning, design and management issues which are very weak and ineffective.

The master plan is the main legal instrument of managing physical urban development in Kurdistan region. Most of the master plans which are prepared until now do not reflect the wishes and needs of the people in Duhok. The current master plan of the city of Duhok needs regular updating in a short time- every five years- to cope with the rapid urban growth and changing of socio-economic, demographic and political trends. The process of amending master plan is long, and it is not necessarily producing good results. The decision of the city council is essential in the process of amending master plan in the city of Duhok, but the members of the city council are not qualified to undertake such responsibility.

The regulations and legislation about land divisions, sub-divisions, building setbacks and heights are not specific in detail matters relevant to urban block, density, compactness, traffic flow, accessibility, greening and socio-economic aspects. These regulations and legislations are ineffective and inefficient to produce sustainable urban form. The regulations are tied to control rather than direct city urban form towards more sustainability, which failed in both controlling and directing the urban development initiatives.

Managing urban development has been divided between many Ministries, although, planning and supervising of the developments are the main authorities assigned to the Ministry of Municipality and Tourism. General speaking, the responsibilities that have entrusted to different partners are unclear, overlapped and universal. Consequently, scattering the planning responsibility among many institutions have affected the type of physical developments that have been executed. The relationship between urban planning institutions is lacking horizontally and vertically thoroughly collaboration and coordination.

Chapter Nine: Critical Challenges Facing Sustainable Spatial Planning Practices in Duhok

9.1. Introduction

The economic, demographic, social, political and institutional factors are major driving forces affecting the urban built environment that shape and identify the current and the future development of any city. However, each city has its unique conditions and specific driving forces that influence its development trends. The city of Duhok is affected by many driving forces as one of the main cities in the Kurdistan Region.

The context of the city of Duhok is considered unique in the province of the Duhok because of its position and distinct political, economic, geographical and demographic conditions which affected its context. However, it shares many common features that exist in other cities in Kurdistan.

It is essential to determine the driving forces that have contributed and affected the urban environment in the city of Duhok, and their current impacts and future consequence on the physical urban development of the city. The determination of the driving forces is based on; *first*, the discussions in the literature reviewed in previous Chapters, and *second*, the analysing of the context of the city of Duhok and information gathered from conducting interviews with experts and officials in the city of Duhok.

9.2. Factors Influencing Physical Urban Development in the city of Duhok

Based on the field observation and discussions with the concerned bodies and experts through conducting a direct interview, the following are the major driving forces influencing and shaping the physical urban environment. The effects of these factors have reflected on the pattern of urban form and structure of the city of Duhok.

9.2.1. Rapid Urban Growth and Urbanisation

Duhok has displayed the largest growth in the built-up area. The expansion of the urban land between 2007 and 2014 almost equals two and a half times all urban land developed during the history of the city. In 2014, the urban area occupied 5763 hectares of land. The city has transformed from compact towards more disperse at a great pace. The population of the city of Duhok has increased 66.34 times while the spatial area of the city has increased 205.52 times since the first morphological stage. The built-up area of the city Duhok has decreased, while the total area of the city has increased since 1977 - see Figure 9-1 and 9-2.

Granting residential plots and endowing loans to the servants who work in the public sector have contributed to the rapid growth of the city on one hand, and on other hand have encouraged low residential houses (single house) which are the main factor in sprawling the city and consuming the land. The land distribution policy as existed lacks strict regulations and mechanisms which highly affected the land use in the city of Duhok and has not solved the problem of housing affordability.

The process of granting free land parcels has created unstable land market speculation. The private land market has depended mainly on the sales of plots formerly granted to individuals by the government. So buying the land parcel for residential purpose is beyond the ability of the households of medium and low incomes. Absence of integrated and comprehensive policy for land distribution, provision of infrastructure and financial support left thousands of poor

people homeless and increased informal housing inside and in the vicinity of the city of Duhok. Land distribution in such ways has lead municipalities to encounter many difficulties in offering suitable land, delivering services and facilities. According to the officials from the municipality of Duhok, the government has granted 23000 residential land parcels to different public servants from 1998 till 2011. Moreover, the government has also granted 21000 plots to the citizens between 2011 till 2014, the size of the plots ranges from 200m² to 500m².

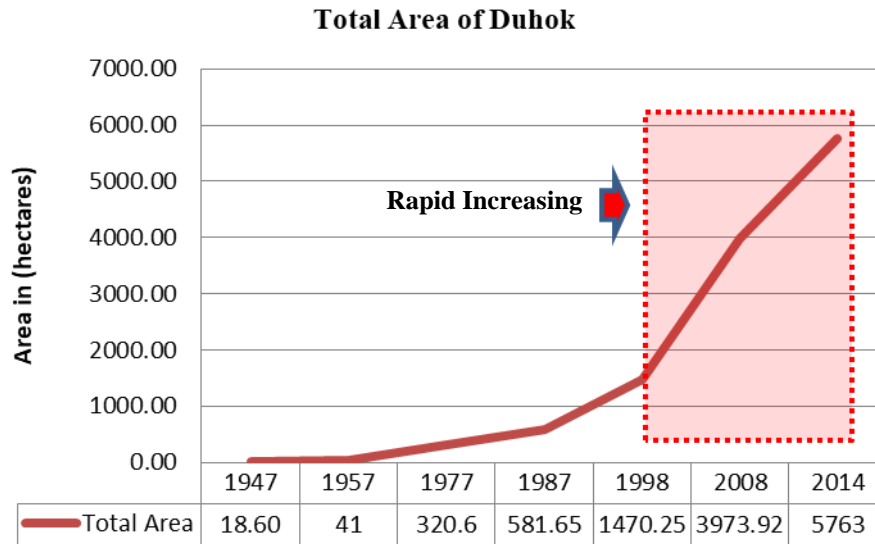


Figure 9-1: Increasing land area of the city of Duhok during last decades

Source: Own construct based on document analysis from the Municipality of Duhok, 2015

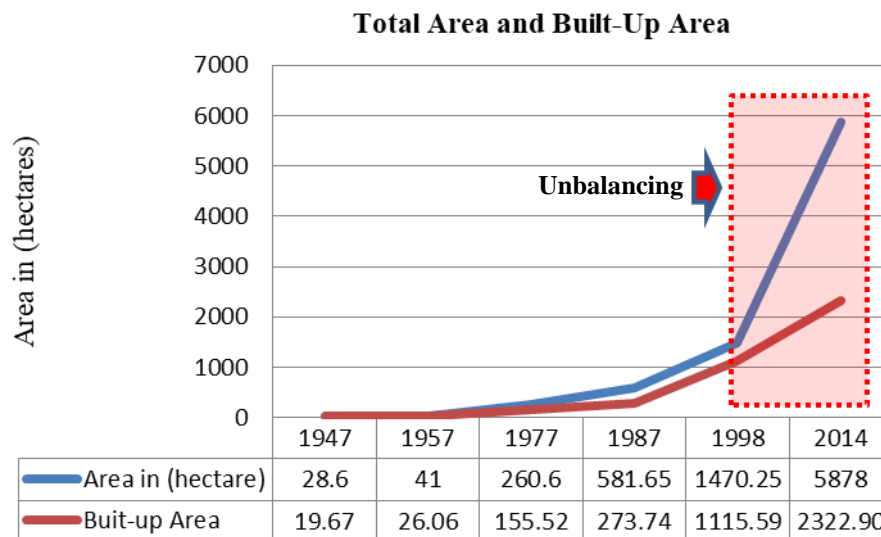


Figure 9-2: Relationship between land area and the built-up area in the city of Duhok

Source: Own construct based on document analysis from the Municipality of Duhok, 2015

Despite the existence of the system of loans to the citizens, the individuals who were granted residential plots were not encouraged to develop their plots, because of increasing values of the plots. The records of the (Municipality of Duhok, 2014) shows that only about 62% of the distributed residential plots have been developed, and half of the owners of these

developed plots were not the original owners who have directly received the plots from the government. This shows that the policy of donating residential plots to the citizens is inefficient because;

- Most citizens who have received residential plots from the government are not those who developed the plots¹⁹.
- The policy of granting residential plots is not specifically targeted needy servants, but included every employee in the public sector who did not benefit in advance from this policy.
- About 38% of the distributed plots are not developed, which remained as goods in the land market in the city.
- The granted residential plots have contributed exponentially to increase the size of the city of Duhok and encouraged low-rise housing.
- The rate of distributed plots is not reflecting the real demand for the shortages of housing.
- Developing of new residential areas was not accompanied by supplying essential infrastructures, especially roads and services (e.g. schools, health centres...etc.).
- Because of the lack of accountability, transparency and ineffectiveness in managing residential policy, many powerful individuals received more than one plot under different titles and excuses.

However, the distribution of the residential plots to the citizens has not solved the problem of housing affordability; rather has generated many problems such; sprawling the city, increasing the costs of residential plots, government inability to supply a newly developed area with required infrastructure and services.

The construction boom between 1994 till 2014 has dramatically affected the ability of the planning authorities namely; Municipality and Directorate of Constructive planning and Directorates of Electricity and Water and Sewage to respond to the problems associated with rapid urban growth due to the ineffective land use planning and incompatible regulatory framework at levels of regional, provincial and local. The consequence has uncontrolled urban development's and urbanisation that encroached fertile agricultural land and putting extra pressure on already deteriorated infrastructures. The rapid urban development and unprecedented growth have generated:

- Inefficiencies of land use allocation,
- Encouraging of low residential buildings,
- Malfunction of urban form and structure,
- Deficiency in providing infrastructure,
- Thoughtless development initiatives,
- Lack of accessibility and mobility,
- Deterioration of urban environment, and
- Creating and increasing of informal development areas.

The planning decisions lack clarity on allocating services and facilities at the required scale. The less time for planning and designing has led to extemporaneous and thoughtful developments. Therefore, the decisions need more elaborating exercises and collaboration of

¹⁹ - Interview with the president of Municipality of Duhok on 01 April 2014

urban planning institutions and community engagement in the planning process (Interview with experts).

9.2.2. Demographic Growth

The population growth rate in the city of Duhok has affected by factors such as political, economic and social. Population growth is one of the main driving forces affecting urban development pace and urban environment in the city of Duhok. The rapid population growth restrains the ability of the local government to provide basic infrastructures. The increasing population rates in the city of Duhok could be channelled into four streams: *Firstly*, natural growth with a fertility rate of 3.8%. *Secondly*, villagers' movement towards urban areas as a result of evacuating rural areas and destroying villages in the province of Duhok between the years 1961-1988 by the former regime of Iraq. *Thirdly*, massive migration happened from the rural area to Duhok as a result of unfair distribution of the resources, lack of job opportunity and urban amenity services and insecurity. *Fourthly*, the last channel of increasing population rate was the high influx of people from other parts of Iraq especially to the city of Duhok after 2003 referring to the stability prevailing Kurdistan Region in general and the city of Duhok in particular – see Table 9-1.

Table 9-1: Population growth rates in the city of Duhok and the province of Duhok

Year	Population of city of Duhok	Population of the Province (Inhabitants)	Increased population in city of Duhok	Rate of population Growth in city of Duhok
1970	18284	243113	-	-
1977	40191	240575	21907	119.81%
1987	114322	294304	74131	184.45%
1998	212469	714034	98147	85.85%
2003	249918	919431	75697	17.63%
2010	295850	1257098	45932	18.38%
2014	372944	1487035	77094	26.06%

Source: On construct based on data from general Directorate of Statistics in Duhok, 2015

In general, the ratio of rural to urban population growth in the province of Duhok has changed from 2:1 to 1:3 within the span of four decades (1970- 2010). According to the reports, more than 75% of the city population lives in urban areas (Un-Habitat, 2009a; Directorate of Statistics of Duhok, 2013). The fluctuating of population growth in the city can be attributed to internal circumstances of the region and the city– see Figure 9-3.

After the process of Safe Haven in 1991, the campaign of reconstructing of the destroyed village has started in 1992 with the assistance of Non-Governmental Organisation (NGOs) which mostly supported by the European countries and United Nations Organisations such as UNCHR, UNICEF and Habitat. Activation of the agriculture sector has endowed opportunity for numbers of workers in the villages to engage in agricultural works and attracted many villagers who reside in the city of Duhok to return to their original villages (Directorate of Statistics of Duhok, 2013). This was the major reason for decreasing the rate of population growth in the city of Duhok after 1991 to 1998 and generated opposite migration from urban to rural areas. The high numbers of the vacant villages which have not reconstructed yet in the

province of Duhok threatens urban growth in the city of Duhok and have affected urban environment and changed the original character of both rural and urban areas- see Figure 9-4.

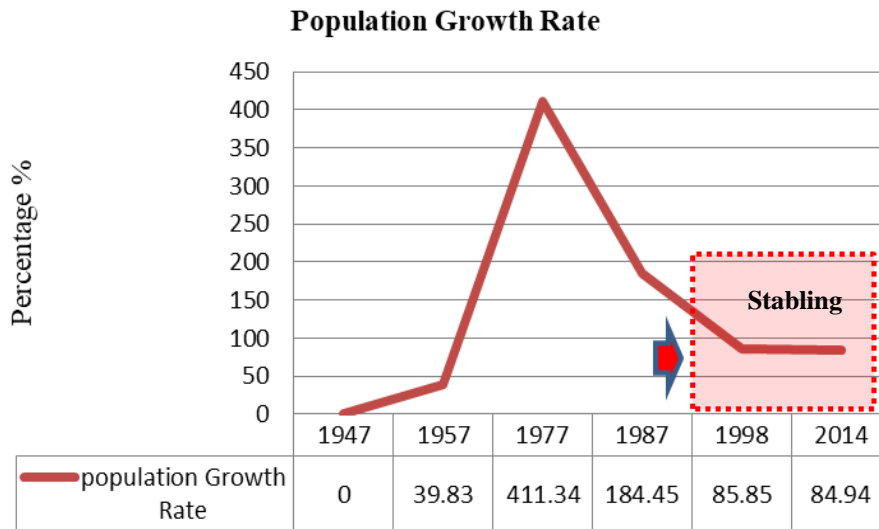


Figure 9-3: Population growth rate in the city of Duhok since 1947

Source: Own construct based on General Directorate of Statistics of Duhok, 2015

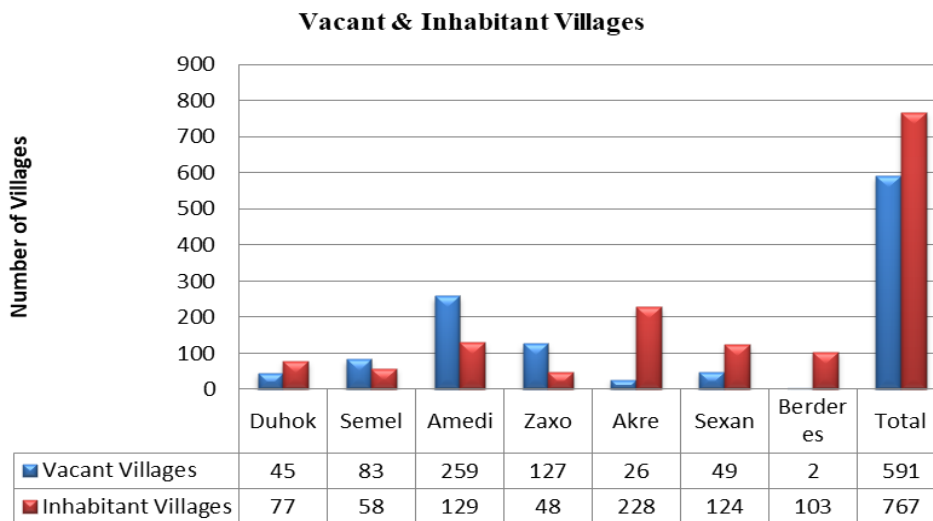


Figure 9-4: Vacant and inhabitant villages in the province of Duhok

Source: Own construct based on documents from General Directorate of Statistics, 2015; Mayor of Duhok, 2015

Lack of serious and effective steps to rebuild villages and improving rural livelihood will put the authorities under the pressure to offer more houses and face rapid urban growth, which deteriorates the urban built environment in the city of Duhok in coming years.

Prospects for the population growth depend on the path of future fertility and migration. Currently, there are signs that natural population growth rates will decline, because of the economic crises, rising of living standards and the trends of small family size (Directorate of Statistics in Duhok, 2014), however, the rate of that incline is undefined. According to the official statistics, the number of birth will continue to rise, regardless of any influence shortly.

In the long term, the fertility rate will decline depending on the increase of awareness and participating in females in the economic life of the city of Duhok.

9.2.3. Social Transformation

Social trends and aspects influence the urban environment and urban form. The migration of the people from rural and other parts of Iraq and Kurdistan to the city of Duhok has threatened the social structure and trends. The social characteristics and structure of the people in Kurdistan undergo dramatic transformations due to the high flux of migration and returns of thousands in diaspora from Turkey and Iran. The social transformations and natural dynamics of society have created an inharmonious social mixture between people from different social backgrounds and different local identities. Different social classes have emerged based on their economic and social tribe background and also on their political affiliation.

After the collapsing of the former regime of Iraq, the new challenge is facing the society in Kurdistan revealed in the opening to the world and transformation from the traditional tribal society living under the dictatorship rules towards democratised and industrialised civil society. Doubtless, the social transformation affects attitudes and priorities of the citizens such as the degree of awareness regarding environmental protection, resource management and participation which are the prerequisites for achieving physical sustainable urban development.

9.2.4. Environmental Degradation

The pressing demands on natural resources especially land, in addition to the lack of public awareness of ordinary citizens and officials have increased the tendency of exploitation and depletion of natural resources and artificial assets of the community. Such as Duhok Dam Project of Irrigation and green belts along to the main streets of Zaxo Road, green corridors and Gely of Duhok. Likewise, the limitation of the usable land for city expansion has led to build and expand over agricultural fertile land and other sensitive lands, thus changing the land pattern and the character of the green structure in the city.

The trunk infrastructure in the city of Duhok is inadequate, particularly road networks, sewerage, electricity and water. The inappropriateness of the trunk infrastructure and the depletion of the natural resources are matters related to the absence of the restriction of environmental laws in the country. Nevertheless, according to the article no. 3 of the legislation no.12 of 2010 of the Kurdistan Regional Government (KRG), the general principles and provisions of the law of improvement and protecting the environment in Kurdistan region are indicated in Box 9-1:

The law no.8 of 2008 of Environmental Protection and Improvements considers the protection of natural and artificial assets and avoiding any actions that might adversely affect them. The related laws call to protect the natural beauty of the assets, encompass the construction of gardens and parks in urban and rural areas and protect the environment from any kind of chemical or physical pollution. Furthermore, this law emphasises the importance of coordination and the corporation among all related institutions and agencies of public and civil partners for achieving a healthy and sustainable environment. More than six years have passed after the promulgation of this law, in real-life, no initiatives are proving its application. This law lacks detailed instructions, indicators and regulations showing the type and the

mechanisms of protecting the environment. On the contrary, the damages to the environment after the issuance of the law exceed the damages to the environment in Dohuk before 2008.

- Firstly:** Every individual has the right to live in a secure and protected environment, and all partners should work to protect and secure the environment.
- Secondly:** Protecting and improvement of the environment through planning process in term of legislation, programming and development plans of the different sectors in the region.
- Thirdly:** All public and private educational and academic institutions have to adopt environmental educational programming in cooperation with the Environment protection and improvement Board.
- Fourthly:** Organisations of civil society and public and private institutions which work in educational, teaching, training, researching, information, culture, religious and other fields have to promote dissemination of environmental culture and awareness.
- Fifthly:** All the administration authorities according to their specialisation have to work to rationalise the utilisation of natural resources for achieving sustainable development.
- Sixthly:** Health institutions, quality insurance and measurement board should adopt the principles of environment health in their working programs.
- Seventhly:** The Ministry can cooperate and coordinate with other international non-governmental organisations (NGOs) in field of protecting and improving the environment.

Box 9-1: General principles and provisions of the law of Improvement and Protecting the Environment in Kurdistan Region

Source: Own construct based on documents from the Board of Improvement and Protecting the Environment in Kurdistan Region, 2016

9.2.5. Institutional Deficiencies

Iraq was one of the pioneer countries in the Middle East to establish urban and regional planning centre in Baghdad in 1972 and preparing of master plans for the capital and big cities at the beginning of the 1950s. Also started preparing master plans for the all capitals of the provinces after 1973 and development plan for different sectors, agriculture, tourism and industry in Iraq, furthermore, issuing of Iraqi Standards for Housing in 1983 (Qadir, 1985). The restricted centralised planning process in Iraq, un-independent institutions and planning system and sequential wars had spoiled and corrupted everything in the country.

After 2003, the newly established institutions and planning system in Iraq as a federal state and Kurdistan Region as a region have transferred from the centralised into decentralised one. Like any new experience, the lack of financial and human resources and the political confliction and intervention in government affairs by political parties have limited the government to improve the planning system at both levels; federal and regional which return to:

- 1- Lack of coordination and cooperation between various ministries, departments and institutions,
- 2-Distribution of the roles and responsibilities of urban development planning between many institutions and ministries.
- 3-Overlapping of the tasks and interference with each other's responsibilities. For example, the role of the municipality, city council and constructive planning are

intertwined, in addition to, the incapability of the members to undertake responsibility because of lack of experiences and qualifications.

4-Absence of the sound and active executive and following-up system.

5-Absence of implementing national strategy and guidance plan.

6- Lack of compatible strategies providing guidance and orientation to the various planning actions and authorities at different levels.

9.2.6. Corruption and Political Expediency

The political instability in Iraq and the Kurdistan Region for a long time affects the other driving forces and planning system of the region. The armed political conflicts, political intervention in government affairs and the absence of independent planning decision has interrupted managing and implementing development initiatives. In such a political environment and instability of the region, it is tough to have a sound national, regional and local planning system. According to the prominent officials in the municipality and constructive planning, they face opposition from the politicians to apply laws and regulations, as well as pressures to pass planning decisions in their favour (Interview with officials). Such political environment has encouraged the positioning of unqualified persons in planning institutions, and then a failure to have independent planning decisions in the absence of effective community participation in planning.

9.2.7. Unstable Economy

The Kurdistan Region is mainly dependent on the revenues from exporting oil. The centralised economy has affected all planning decisions. All local revenues from different economic segments transfer to the Central Bank of Kurdistan Regional Government in Erbil. This has restricted any steps towards improving the independent economy of the city without the authorisation of the Ministry of Finance in Erbil. Consequently, the local economy of the city is facing significant challenges. The regional economy deals with the insecurity and instability of the oil markets, the increasing pressure of the growing labour force of the city which mostly unemployed and the limited private-sector access to capital, as well as the undeveloped institutions of the government. In such an economic situation, it is hard to implement any development plan or follow-up implementing of regional development plans and master plan.

The summary of the mentioned driving forces, their impacts and consequences are outlined below—see Table 9-2.

Table 9-2: The consequences and impacts of the driving Forces

Driving Forces	Impacts	Consequences
Rapid Physical Development	<ul style="list-style-type: none"> - Rapid physical development - Inadequate development plans - Weak in carrying out of laws, regulations and plans (if existing) 	<ul style="list-style-type: none"> - Malfunction urban forms - Increased pressure on infrastructure and road networks - Uncontrolled and chaotic developments - Encroaching agricultural and sensitive land - Concentrations on specific cities (e.g. Duhok City) - New architectural style (multi-storey buildings) - Uncontrolled urbanization - Unbalanced development - Unbalanced density - Dominating of low residential buildings - Lack of walkability and crosscutting between pedestrian and vehicles movement - Lack of accessibility and proximity to the services - Depending on the main city centre
Environmental degradation	<ul style="list-style-type: none"> - Weak Environmental Laws - Lack of Environmental Awareness - Limited Natural Resources (e.g. Land) 	<ul style="list-style-type: none"> - Encroaching Agricultural land - Expansion on sensitive areas (e.g. Green figure, buffer zone of the rivers) - Changing the land use pattern - Disturbing the natural reliefs of the city - Lack of Open Spaces
Demographic growth	<ul style="list-style-type: none"> - Return of thousands of refugees from Iran & Turkey - High fertility and birth rates - Rapid population growth rates - Internal migration - Young population 	<ul style="list-style-type: none"> - Increased pressure on land, infrastructure and resources in the city - Need for job opportunities, education and housing affordability - Urgent need for absorption of new growth population
Social transformation	<ul style="list-style-type: none"> - Changeable and alterable society - Neo-social mixtures (e.g. returnees, locals, migrants, etc.) - Politicized society - Social classes 	<ul style="list-style-type: none"> - Emerging new elite class in the city - Transformation from traditional community structure (tribal one) into modernised institutionalised one (parties, civil society...etc.) - Inharmonious social mixture - Politics dominates social interests, neglect of other social issues - Segregation and unbalanced social classes (new benefited class) - Emerging of different neighbourhoods and quarters carrying specific social backgrounds
	<ul style="list-style-type: none"> - Economy dependent on oil export - Limited private-sector 	<ul style="list-style-type: none"> - Insecure labour market - Tentative and resilient economic growth and prosperity - Free export and import - Little industrial and technological development

Economic	<ul style="list-style-type: none"> - investment - Deterioration of rural area -Evacuated villages 	<ul style="list-style-type: none"> - Investments only in construction - High rate depending on public sector - Incredible increasing in land prices - High rate of land price & land speculation
Institutional deficiencies	<ul style="list-style-type: none"> - Incapable planning institutions - Lack of coordination and cooperation - Inherited laws and planning system - Lack of experience and qualifications - Absence of executive system - Ineffectual local authorities (mainly municipalities and local councils) 	<ul style="list-style-type: none"> - No clear division of tasks and responsibilities between different levels and actors - Overlapping and interference between different institutions and departments - Outdated laws and regulations, which are often incompatible with current circumstances - Lack of community participation - Incapability of city council
Political conflict	<ul style="list-style-type: none"> - Restrictions from the federal state - Conflict between the political parties 	<ul style="list-style-type: none"> - Conflict and struggle between the regional government and federal state over land and sovereignty - Destruction of infrastructure - Highly politicised society - No freedom of expressions and participation in decision making -Interfering into the local government affairs by the political parties.

Source: Own construct based on expert interviews, observation and document analysis

9.3. Ineffective Urban Planning System

It is important to define the main constraints hindering and impeding any step towards adopting sustainable physical urban development. After having analysed the driving forces which affect Duhok context, the main constraints can be identified. These constraints are interconnected and multi-dimensional issues. The links between them need to be rebuilt for an inclusive overview of the context. The following subsections present the main constraints;

9.3.1. Inappropriate & out-Dated Laws & Regulations

Because of the ambiguous policy, regulatory and institutional environment, there is complete devolution to local government, regulatory systems that are non-inclusive, and perception of regulations as limiting and controlling tool rather than directing and development tools. The planning system in Kurdistan should recognise and give attention to opportunities that can be built on and vanquish government fragmentation through reducing the gaps between the planning institutions and implementers. There is a crucial need to reinforce regulatory systems that must comply with the principles of equity. The proactive and development roles of planning regulations in improving the built environment must be recognised in redesigning urban planning systems in Kurdistan.

The non- comprehensive planning approach which is fascinated by the master plan approach fails to obtain on-board ownership from political powers and other non-state actors. Planning institutions need to find alternative planning solutions to the current approach of the master plan, wherein, the municipality and other planning institutions have more flexibility of preparing a short- term plans with the ambit of a long-term plan.

Promoting and reorienting towards sustainable development requires the comprehensive updating and amending of existing policies, laws and regulations to pave the way for achieving this aim. However, the accumulated, inherited and out-dated laws and regulations are not able to match and cope with principles of sustainable development, and even; they are not able to correspond to the current needs of the city citizens. Since the last few years, the Ministry of Municipality and Tourism in the Kurdistan Region is incrementally updating some of the laws and regulations relating to the built performance. This process is more confusing because there are still many laws and regulations are date back to the fifth and sixth decades of the last century. Therefore, it is common to find many conflicting regulations and laws in urban planning filed. Despite that, Iraq has standards for housing since 1983 as mentioned earlier, which prepared by the Ministry of Housing in Iraq with the consultation of Polservice company from Poland. However, these standards need to be supported by the laws and regulations for their effectiveness and applicability.

The current workable policies, laws, regulations have not been compiled in handbooks or manuals to be accessible to employees in the planning institutions as well as individuals. The newly appointed employees, in most cases, do not have information on all applicable laws and regulations related to the particular issue. Most often, understanding of these regulations and laws in planning institutions depend on the staff's interpretations or the manager's decision which lead to contradictions and improper application.

9.3.2. Incompetent Professional capacity

Kurdistan Region lacks qualified people in the field of spatial planning. The political parties who control government affairs have recommended most of the prominent workers in the government departments. These workers, especially the directors, department managers have no qualifications or experiences to hold such positions. As a tendency, most of the holders of high university degrees work in the field of education leaving the practice field for the lower grades. The gap between academic and practical experience is evident and it is attributable to the political conditions of the Kurdistan Region. The legacy of long years of centralised system and dictatorships in Iraq and Kurdistan hindered the opportunities to acquire practical professional and capacities to the state joints. Since the establishment of the Kurdistan Regional Government (KRG), there have been some initiatives to candidate politicised competent officials in the government institutions.

9.3.3. Lack of Social Awareness

The level of awareness regarding environmental issues is very low in the Kurdistan Region. In spite that, the public perception in last few years towards the environment, has started to grow, but the awareness must be raised in public institutions as a primary step, to avoid further built environmental degradation and depletion of resources. Promoting environmental awareness is a process of requiring coordination among various stakeholders, governmental institutions and civil society in the city of Duhok.

Urban planning is the straight-forward means to link the green and brown agendas effectively through protecting the natural environment and human growth. Unfortunately, this linkage has been missing in the current planning system of Kurdistan, despite the existence of environment and institutions represented by Environment Protection and Improvement Board in Kurdistan Region. Many steps have been taken through the issuance of law and regulations,

but the point remains that a need of parallel efforts is required to amend bylaws, zoning regulations, and development controls.

9.3.4. Institutional Shortcomings

The absence of detailed tasks and responsibilities of the planning institutions and other workers in documented mandates confused, duplicated efforts and waste of time and money. The legislative and executive authorities do not have the power for enforcement and implementation. The lack of inter-sectoral coordination among the institutions is a major problem facing the institutions in Kurdistan Region. According to the officials from different institutions (e.g. City Municipality, Directorates of Municipalities, Constructive Planning, Electricity, Water and Sewage) who have been interviewed by the researcher they have complained of the lack of coordination and cooperation between the institutions which constrain producing of good urban performance. Adopting physical sustainability requires a high degree of cooperation among the different partners. The institutional deficiency restrains developing comprehensive strategies, policies and other plans for future physical sustainable development in the city of Duhok.

9.3.5. Inadequate Infrastructure Provision

The city of Duhok is not properly equipped to deal with rapid physical urban development. With the increase of the population of the city and distribution of more plots for residential purposes, Duhok is encountering huge challenges to offer enough wide roads and the provision of an efficient public transport system and other infrastructure amenities. The number of private cars in the city of Duhok has increased to an incredible rate, and the number of taxis inside the city, has passed 4000 cars causing congestion, noise and extra pollution. The fragmented privately based-taxi services in the city highlight the crucial need for establishing integrated, affordable and appropriated public transport in the growing city of Duhok. This is an important issue and urgent demand of the residents and officials in the city to generate potential opportunities for economic development, on one hand, and increase mobility on another hand.

The municipality and the institutions, which are responsible for sectorial issues, have been unable to fund critical infrastructure. Therefore, it is normal to find residential areas developed since years in the city of Duhok without provision of essential infrastructures such as roads, electricity and sewage. The city of Duhok needs to provide and establish efficient infrastructure for existing uses and additional infrastructure to the growing population. In many areas, the existing infrastructure has depreciated and has become inadequate and obsolete. The absence of sewage and rainwater drainage system and green urban structures has exposed the city to seasonal urban floods.

The lack of integration of utilities and spatial planning should be recognised towards creating integrated spatial-utilities city plans to overcome the traditional administrative hindrances.

9.3.6. Informal Housing and Unguided development

Urban development in the city of Duhok is interrupted by many pockets of informal settlement and unguided development areas. The informal settlements in the city back to many reasons and circumstances that the region passed through in the last decades. Most of

the informal areas and pockets existed in the eastern part of the city, and most of the villages which were captured by the urbanisation process existed in the west of Duhok River towards Sêmêl plain. These areas are lacking proximity to the services (e.g. schools, clinics, shops), shortage of open and green spaces, high population density in comparison to other areas in the city, irregular and narrow streets, irregular urban block and plots. These areas can be described as a result of a combination of three factors:

- Rapid urbanisation and population growth rates
- Wars waged against the rural and urban areas of the region by former regimes of Iraq,
- The lack of adequate planning and efficient city management to cope with the fast-growing pace of the city of Duhok.

Low income and agricultural background families dominate mainly the informal areas. The municipality is, up to recently, not able to stop informal housing in some pockets in the city of Duhok. The current regulations and ordinance become irrelevant to these areas and they need certain strategies for dealing and upgrading them.

9.4. Conclusion

Rapid urban growth and urbanisation are threatening the context of Kurdistan. The main factors contributing to the city growth are: population growth, migration from the rural to urban, the policy of granting residential plots to the residents inside the city who are not originally a citizen of the city, and encouraging of single-house pattern, consequently, more pressure on already inefficient infrastructure generates unfriendly and unsustainable city.

The demographic projection in the city, based on the previous indications and current will be doubled in the next twenty years, especially the population of rural is shrinking and through the continuous flux of migrants towards urban areas. The social transformation from a tribal society lifestyle towards modernisation has contributed to accelerating the paces of urbanisation.

Institutional deficiencies and overlapping of the responsibilities among planning institutions, the distribution of planning affairs, lack of efficient regulations and laws, lack of community participation, shortage of professional capacity have affected planning system and worsened the local built environment.

The common factors that will decrease the rapid growth of the city of Duhok and all other cities in the Kurdistan Region are improving living standards in rural areas and rebuilding of the destroyed villages which have to be the main strategies that the regional government to undertake. This will minimise rural migration and avoid any unexpected and rapid population growth in the city of Duhok.

A stable political situation can dissipate some of the constraints and mitigate the factors. The other constraints can be solved through planning and organised educational processes at various levels to steer the institutional capacity, this on one hand, and public awareness, accountability, transparency on the other hand. For example, two national development plans have been announced for the Kurdistan Regional Government, the unstable political circumstance has interrupted implementing these plans and constrained reforming planning system.

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Chapter Ten: Spatial Evolution of the city of Duhok

10.1. Introduction

The purpose of this chapter is to present a brief background concerning the morphological evolution of the city of Duhok and the rate of increasing different patterns of land uses, as well as the dominated development patterns in each stage which formulated its current shape as a proxy to display the spatial expansion of the city.

10.2. Morphological Characteristics of the City of Duhok

The first cadastral map for the city of Duhok was drawn in 1923, this map did not show any social, economic or spatial attitudes, except the real estate boundary of the plots-see Figure 10-1. Nevertheless, this map gives a clear image of the city's spatial outline and the direction of development in the early stages. The city of Duhok was growing in very slow steps in view of the available historical information till the year of 1873 - the year which Duhok became a district centre and joined to the Mosul Wilayat during the Ottoman Empire. The stages have been identified based on the three criteria:

- Year of conducting the general census
- The flux of mass migrations from rural to urban, and
- Year of developing master plans for the city of Duhok

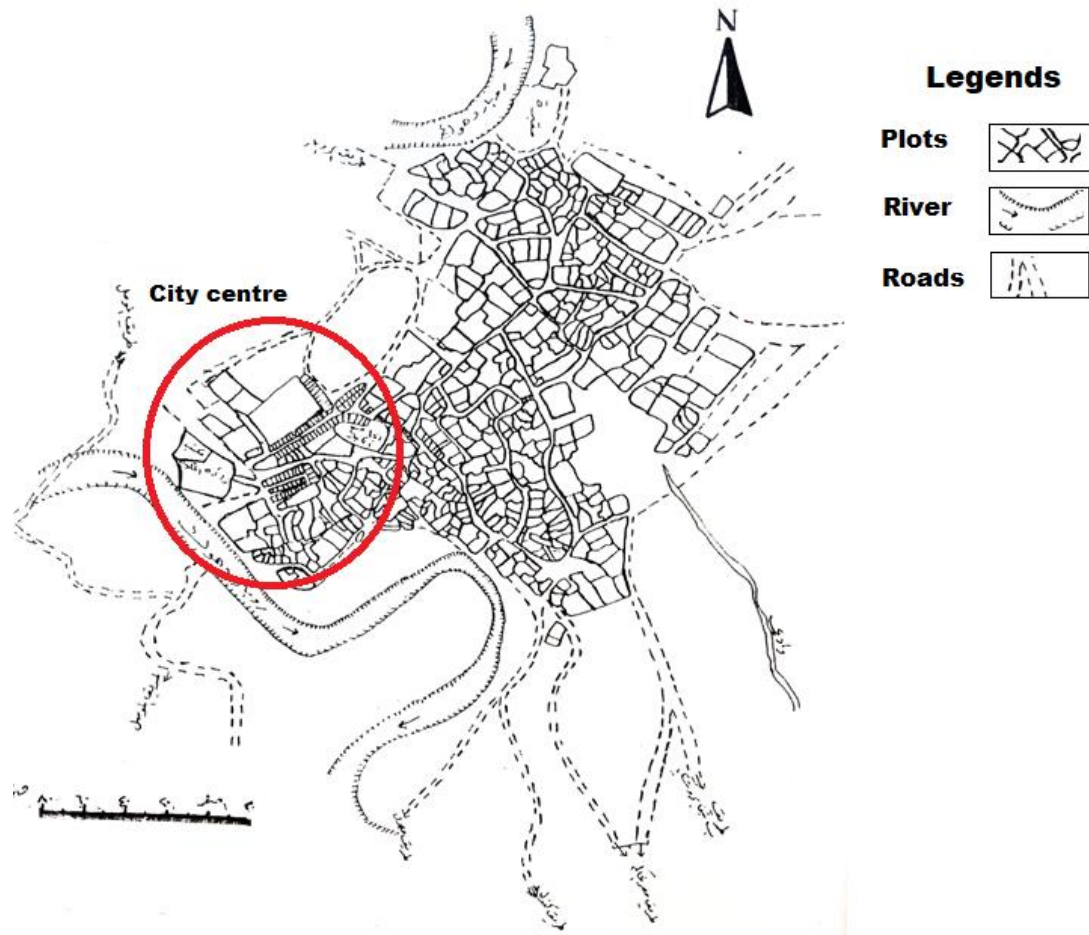


Figure 10-1: Cadastral map of Duhok in 1923
Source: Directorate of Estate Registration in Duhok, 2013

These criteria are concurrence to the spatial expansion of the city. Based on, the following morphological stages can be identified:

- 1- First morphological stage 1873-1947
- 2- Second morphological stage from 1948-1957
- 3- Third morphological stage from 1958-1977
- 4- Fourth morphological stage from 1978-1987
- 5- Fifth morphological stage from 1988-1998
- 6- Sixth morphological stage from 1999-2008
- 7- Current morphological stage from 2009-2018
- 8- Future morphological stage from 2019-2032

The following subsections investigate the morphological stages of the city of Duhok and the transformation of its traditional urban form and structure. The city has grown rapidly over the last forty years from a compact relatively highly dense urban centre to semi-metropolitan area, where agricultural and open green areas have become limited inside and around the city.

10.2.1. First Morphological Stage 1873-1947

Till the end of this stage, the city of Duhok was growing as an organic urban form and structure around its old urban nuclear (Aljanabi, 1985). The city preserved its traditional compacted urban form and structure in this stage, and started to expand and grew in expense to its agricultural area at the periphery of the city into the east and south direction. The city built- up in this stage was around 18.6 hectares calculated from the available city map of 1923 (Directorate of Estate Registration of Duhok). The city took an elliptical shape with a clear centre in the north-west direction of the city. The long side was about 625 m to the east and the short side 404 m to the south direction – see Figure 10-2.

The compacted pattern was dominated on the outskirts of the old city towards east and south. All these areas grew without any intervention from the side of the government, which could be considered as unguided development. In the early stages, developments encouraged in east and south directions, because the land is relatively flattered in these two directions of the city. The second pattern was leapfrog development pattern towards the west direction, this was for the first time that the development jumped over the Duhok River to the west side of the city. Duhok River was for a long time remained as main natural determinants on the face to any development in the west and north direction. A new neighbourhood developed at the west bank of the river which was Grêbasê (Duhok Province, 1985). The land use was distributed between main patterns namely; residential, commercial, industrial, public services, transportation and open spaces– see Table 10-1.

The centre of the activities (CBD) was located on the north-west part of the eastern side of the city around the Grand Mosque. The city core as an old part looks denser in term of the size of plots than the other part of the city, while bigger plot sizes at the east side of the city were most of the new development initiatives took place. Layouts of urban blocks were different in term of shape and size.

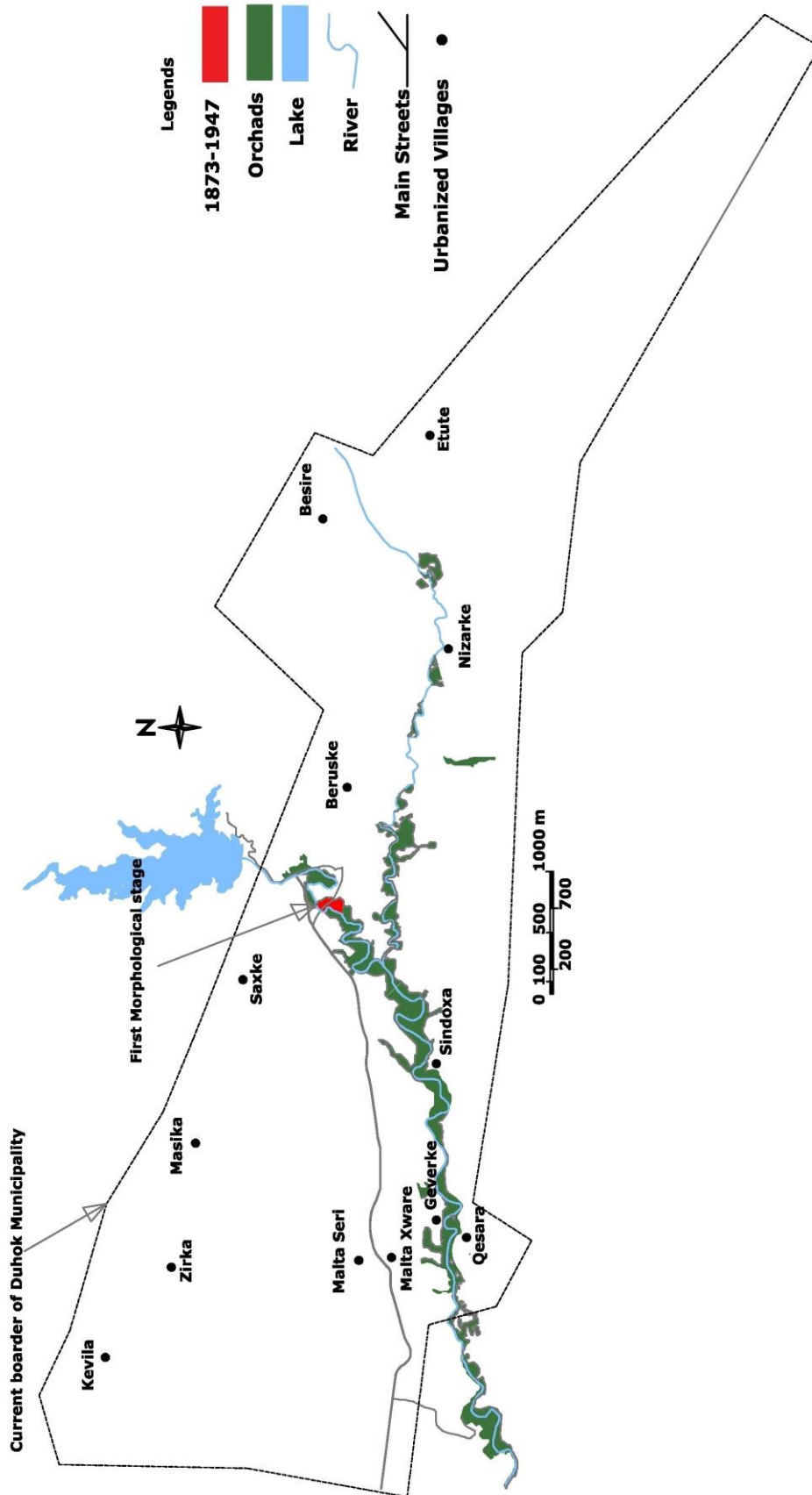


Figure 10-2: Plan of the first morphological stage of Duhok

Source: Own construct based on Directorate of Estate Registration in Duhok plans, 2013

Table 10-1: Land use pattern and the share of each person in the city of Duhok in the first morphological stage

No.	Land Use Pattern	Area (hectare)	Percentage%	Inhabitant Share m ²
1	Residential	15.25	82.00	27.13
2	Commercial	0.57	3.04	1.01
3	Industrial	0.38	2.06	0.68
4	Public Services	0.58	3.10	1.03
5	Transportation	1.32	7.10	2.35
6	Open Space & Recreation	0.50	2.70	0.89
Total		18.60	100	33.09

Source: Own construct based on Al-Janabi, 1985; Duhok province, 1985 ; Al-Feqeh, 1999; Directorate of Statistics in Duhok, 2013, Municipality of Duhok, 2014

The prevailed types of building were one floor; all rooms were opened to the internal courtyard similar to other architecture houses in Kurdistan region in Iraq. The construction material was mud-brick and clay as a binding material or stone with gypsum as binding material for the bearing walls. The roof material was timber, strews and leaves of Oak - see Figures 10-3.



Figure 10-3: Remnants of the old buildings in the city centre from the first morphological stage 1873-1947

Source: Researcher's Archive in 2008

According to the records of the (Ministry of Social Affair in Iraq, 1947) the population of the city of Duhok in 1947 was 5621 inhabitants distributed among five neighbourhoods namely; Islam, Christian, Jews, Şêlê and Grêbasê, (Al-Janabi, 1985). The number of families was 848 and the number of houses was 687. The rate of the household²⁰ was 1.23 families per house and the occupancy²¹ rate was 8.18 inhabitants per house. The high rate reflects the social and economic situation of the residences in that stage. Average family size was 7.6 persons/ family. During the end of this morphological stage, the gross density was around

²⁰ - Household is the number of the families divided by the affordable housing.

²¹ - Occupancy rate is the number of inhabitants divided by the number of affordable houses referring to the crowding rate.

302.20 persons/ hectare, relatively this density is high because of the big families' sizes, lack of open spaces and high building density of the traditional urban fabric.

10.2.2. Second Morphological Stage from 1948-1957

In this stage, the city had needed more land for residential purposes to comply with the increasing city's population number and received more migrants from the rural areas. Three types of development patterns can be distinguished in this stage, in spite that, these developments considered as unguided development and were under the pressure of high flux of migrants from rural areas to the city:

- 1- Compacted pattern at the outskirts of the old city, which preserved the city's high urban density.
- 2- Linear strip development along to the Hiskarow Orchards, which left open areas between Şêlê neighbourhoods and other new neighbourhoods like Rekan and Bintûka.
- 3- Scattered development pattern at the periphery in north, south, west and south-western direction

In this stage, three new neighbourhoods established which were; Bintûka, Rekani and Sarayi in the city outskirts at the east and east-south direction, with contiguous growth and extension of the Şêlê neighbourhoods (Al-Feqeeh, 1999). The centre of the activities (CBD) maintained its location in the west-north part of the eastern side of the city with slit extension towards east direction. Also, the city kept its urban fabric in old neighbourhoods. At the end of this stage, the overall area of the city increased to reach 41 hectares²². The city witnessed rapid growth with increasing in developed area to 54.14%, at an annual growth rate of 5.41%. During this stage, the city entered another era of uncontrolled spatial extension comparing to the last stage. The city grew as an informal settlement because the municipality of Duhok was not able to plan and guide the development in the city (Duhok Province, 1985; Al-Janabi, 1985; Al-Feqeeh, 1999).

Residential use occupied 68.05% of the land. Comparing with the last morphological stage, this stage witnessed a decline in the percentage of a residential area which returned to dominating of the loose grid pattern of the street network at the newly established neighbourhoods. The share of transportation increased due to using new modes of transportation represented by private cars and vehicles. Therefore, the area that dominated by transportation increased to display 10.88 %. The commercial use displayed 7.80 % owing to the concentration of commercial use at the old centre, while the public services and religious use increased to 2.03% - see Table 10-2 and Figures 10-4.

The area of the plots increased and took more regular shape. The block size increased and took a more rectangular shape. The building type followed the traditional pattern in the city and new building materials emerged as cement and concrete- see Figure 10-5.

According to the records of the Ministry of Social Affairs in Iraq (1957) the population of Duhok in the census of 1957 was 7680 persons distributed between seven neighbourhoods; Bazar, Birayeti, Bintuks, Grêbasê, Rekan, Islam and Şêlê. Comparing to the census of 1947 Duhok population increased by 2059 persons, at rate growth of 36.63 % and an annual rate of 3.66 %. The Gross population density was 187.32 persons per hectare.

²² -Based on the calculations from the plans of Duhok city in 1957.

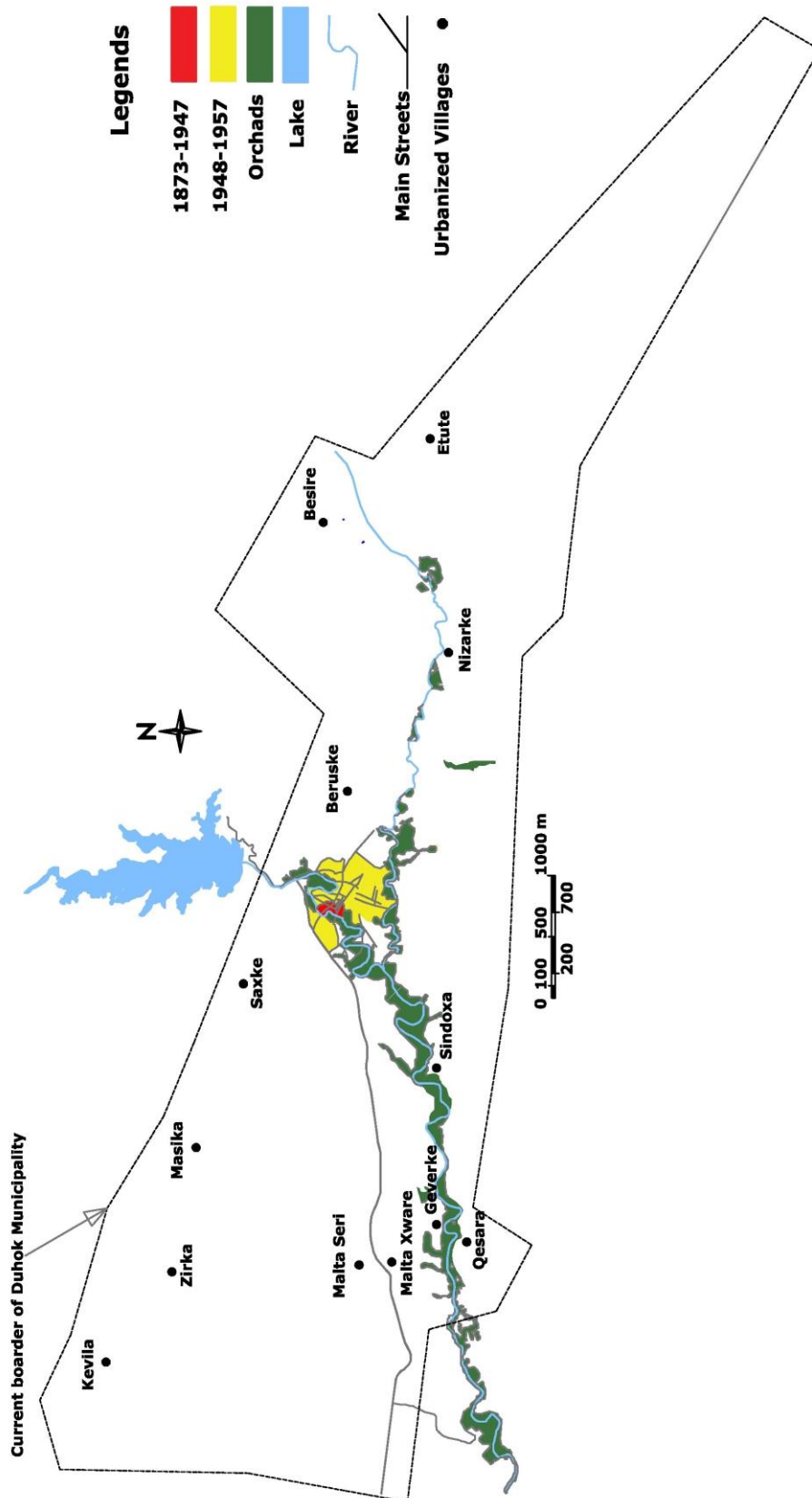


Figure 10-4: Second morphological stage in Duhok 1947-1957

Source: Own construct based on Municipality of Duhok, 2014; Al-Feqeeh, 1999; Al-Janbi, 1986

Table 10-2: Land Use Pattern and the share of each person in the city of Duhok in the second morphological stage

No.	Land Use Pattern	Area (hectare)	Percentage%	Inhabitant Share m ²
1	Residential	27.9	68.05	36.33
2	Commercial	3.2	7.80	4.17
3	Industrial	0.61	1.49	0.79
4	Public Services	2.03	4.95	2.64
5	Transportation	4.46	10.88	5.81
6	Open Space & Recreation	2.8	6.83	3.65
	Total	41	100.00	53.39

Source: Own construct based on Al-Janabi, 1985; Duhok province, 1985 ; Al-Feqeh, 1999; Directorate of Statistics in Duhok, 2013, Municipality of Duhok, 2014

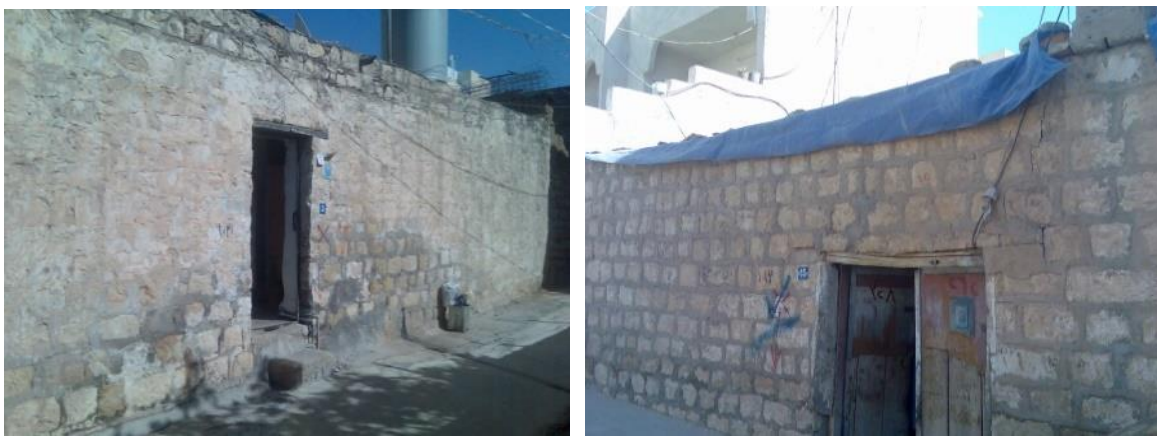


Figure 10-5: Dominated building type in the second morphological stage in Duhok

Source: Researcher's archive in 2008

10.2.3. Third Morphological Stage from 1958-1977

Lack of accurate estimation of the population number in the census of 1965 was the reason for neglecting this ten-years interval and merging it with the next interval, therefore this morphological stage has long intervals of twenty years to include the census of 1977 which was more accurate and indicating the precise number of the city population.

This morphological stage was considered the more important stage than the others with radical change was in the spatial importance of the city because of;

- 1- Duhok declared as the capital of Duhok Province in 1969, this reflected on its new position on the administrative, public services and the function of the city.
- 2- The population of Duhok increased from 7680 inhabitants in the last stage in 1957 to 40191 inhabitants in 1977, with the excessive population growth rate of 411.34%, and at an annual growth rate of 20.57%.
- 3- Increasing the total area of the city to occupy 320.6 hectares.
- 4- Preparing a first master plan of the city of Duhok by the Board of Planning and Engineering of Cities in Baghdad in 1973.
- 5- During this stage, the new neighbourhood has been established in the city represented by Nohadra and Aşfi in the western part of the city.

In this period, the city grew on both western and eastern sides of Duhok River. In the western part, the area of the developed land was 129.84 hectares, which made about 40.50% of the total area of the developed land in the city (Municipality of Duhok). The population number in this part was 10758 inhabitants which made 26.77% of the total population of the city, and gross population density of 82.86 persons/ hectare (Directorate of Statistics, 2013), showing a clear change in the residential density, which back to big plot size and concentration of many public buildings in this part of the city. While the eastern part of the city occupied 190.76 hectares of the city's area and inhabitant by 29433 persons, making 73.23% of the total population, and the gross density displayed 154.29 persons per hectare.

During this stage three development patterns emerged which were;

- 1- A linear strip development pattern in the neighbourhoods of Girebase, Newroz, Kanimehmadke and Gelî. This pattern left many vacant areas in between, which infilled later to increase density in these neighbourhoods.
- 2- Leapfrog development pattern appeared in neighbourhoods of Kanîmehmedkê and Kanixishman which was informal settlements in the outskirts of the city in the eastern part and later annexed to the city to constitute new neighbourhoods.
- 3- Infill development pattern emerged in the new neighbourhoods of Şehîdan, Nohadra and Şoreş. Vacant area left between informal settlements in Girebase and Newroz which encouraged the municipality of Duhok to develop these areas according to the first master plan to increase built-up area. Many of the government institutions are existed in these two neighbourhoods - see Figure 10-6.

Street networks, especially in the western part, improved in response to the increased number of cars as the main mode of transportation. The loose grid, iron grid and curvilinear patterns of the street can be observed in the neighbourhoods of Girebase, Newroz, Nohdran, Aşî and Şoreş. The width of residential streets is between 8m to 10m with walk side on both street sides. While the collectors' widths range between 12m and 15m. The minimum setback of the residential buildings is 2 m in the front.

Kawa Street as the main arterial road in the city developed to meet the requirements of the growing city in term of width and plantation; commercial retails emerged at both sides of the street (Al-Janabi, 1985). The commercial activities increased in Kawa Street by constructing of multi-story buildings. Also, the new bridge constructed over the Duhok River to connect the old city core with the western part of the city in Nohdra neighbourhood to increase mobility in the city (Duhok province, 1973). This bridge with its extended streets caused heavy damages to the historical urban core in the old city.

The areas of different land use patterns increased to meet the new requirements of city growth. Residential uses dominated the land use pattern in this stage to represent 61.53% of the total area of the city which occupied 247.3 hectares. Commercial use slightly increased to occupy 1.67%, while the industrial uses remarkably increased to 3.38 hectare. There was also a notable increase in the rate of the area of public services which reached 4.86% and transportation to 13.44%. Open and green space increased to occupy 6.45 from the total city built up area Tables 10-3.

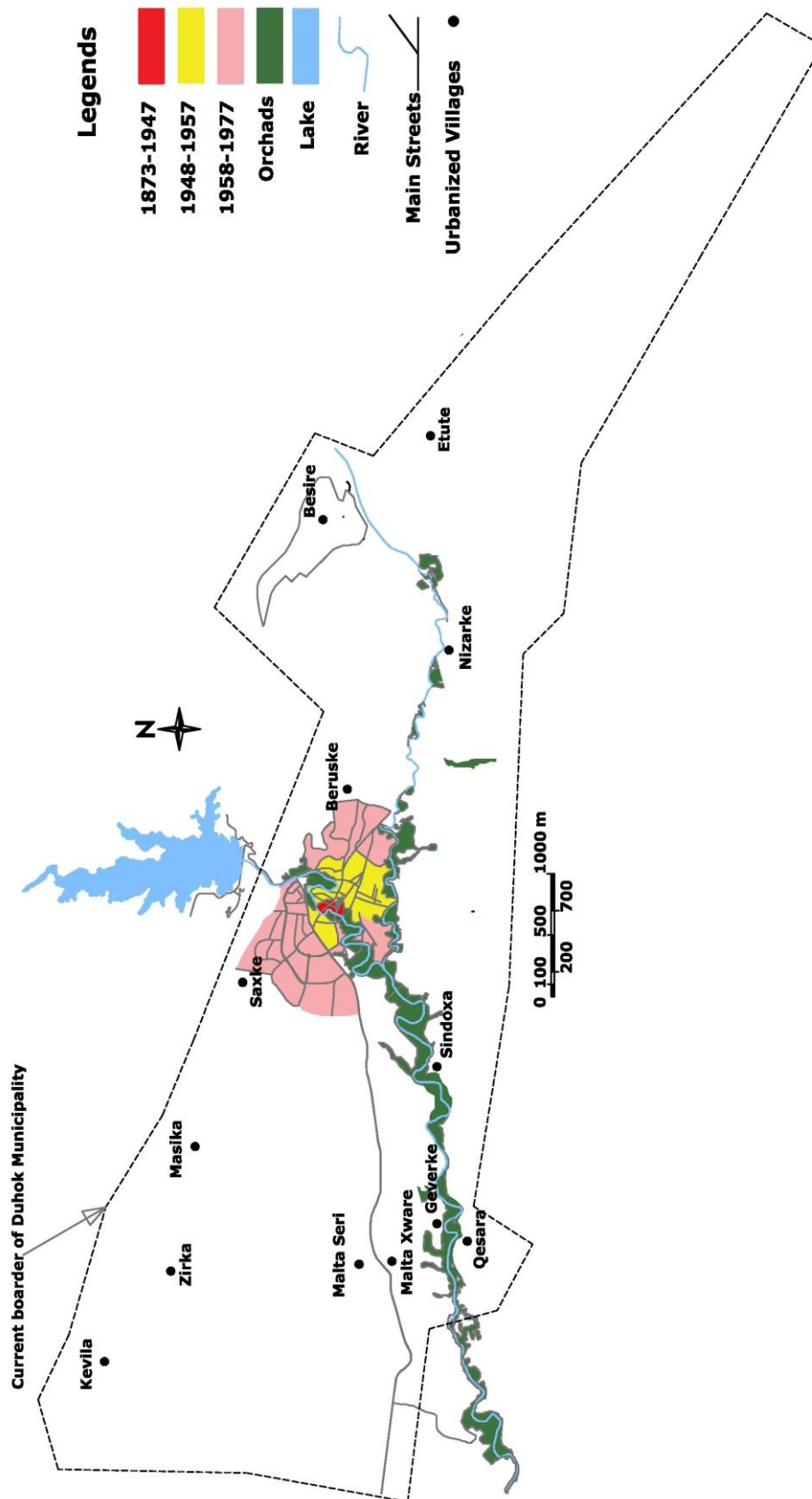


Figure 10-6: Third morphological stage in Duhok 1958-1977

Source: Own construct based on Municipality of Duhok, 2013; Al-Janabi, 1985

Table 10-3: Land Use pattern in the city of Duhok in the third morphological stage

No.	Land Use Pattern	Area (hectare)	Percentage%	Inhabitant Share m ²
1	Residential	247.3	77.14	61.53
2	Commercial	5.37	1.67	1.34
3	Industrial	3.38	1.05	0.84
4	Public Services	15	4.68	3.73
5	Transportation	43.1	13.44	10.72
6	Open Space & Recreation	6.45	2.01	1.60
Total		320.6	100.00	79.77

Source: Own construct based on Al-Janabi, 1985; Al-Feqeeh, 1999; Directorate of Statistics in Duhok, 2013, Municipality of Duhok, 2014

As a result, the rapid spatial expansion of the city was back to the emergence of new residential neighbourhoods such as; Kanîxişmanaa, Gelî, Nohedra, Newroz, Xebat, Dasinya and Kanîmehmedkê between the years of 1957-1974, and the neighbourhoods of Şehîdan, Şoreş and Aştî which established after the year of 1975 as two planned neighbourhoods according to the city master plan (Municipality of Duhok, 2014). The city grew in the direction of west and north of Duhok River. The number of neighbourhoods increased to 16 neighbourhoods with different characteristics.

The number of houses was 3968 occupied by 5910 families. The household rate was 1.49 families per house and the occupancy rate was 10.13 inhabitants per house (Ministry of Planning in Iraq, 1978). The number of houses occupied more than one family which increased dramatically showing the rate of increasing population and shortage of affordable houses, as a result of the high flux of the people from the rural area towards Duhok, because from the year 1957 to 1977 hundreds of villages destroyed by the Iraqi military in the province of Duhok.

The regular linear urban blocks are dominated in the western part with single-detached and attached buildings on one side. The blocks normally have the width of 40 m and their length range between 100 – 300m. While in the eastern part city witnessed more unguided and informal development with various irregular plot and block sizes.

The architectural style of the new buildings in the western part is showing clear change and difference - see Figure 10-7. Residential units in the neighbourhood of Girebase, Şoreş, Newroz and Nohdra have big plot sizes (300-400m²). In the western part of the city, most of the neighbourhoods developed according to the master plan, and many houses are two stories. Traditional houses style dominated in the neighbourhoods of Gelî, Kanîxişmanaa, Kanîmehmedkê and Xebat. The old core of the city gradually started to disappear because of the redevelopment and renovation process of the old buildings in the absence of clear policies towards preserving historical buildings in the city.

Many areas in the eastern part, which illegally developed in this stage, are still suffering from lack of public services. The amount of implemented services (e.g. schools, clinics, open spaces) was not spatially distributed to serve the inhabitants.



Figure 10-7: Dominated building type in the third morphological stage in Duhok
Sources: Researcher's archive in 2008

10.2.4. Fourth Morphological Stage from 1978-1987

The population almost doubled over ten years; accordingly, the city needed more area to assimilate the hastening growth of the population. The area of the city nearly doubled to two times as much. An additional area of 261.05 hectares added to the city's area to accommodate new flux of migrants, thereby the area of the city reached 581.65 hectares.

During this period, the Master plan of the city updated in the years 1982, 1983, 1984 and 1986. South and western part of the city witnessed new development initiatives. The vineyards at the south part of the city occupied to allocate new developments, while the municipality of Duhok succeeded to utilise the rocky land at the western part of the city for new developments in Şoreş neighbourhood in 1979 avoiding extra depletion of agricultural land (Municipality of Duhok, 2013). The city witnessed extra illegal developments in the eastern part of the city especially in Berûşkê neighbourhood through constructing informal houses. New residential neighbourhoods developed such as Diyarî, Ronahî, Mihabad, Bintûka, Sêgirka, Serbesti and Reza. The main industrial zone established in the western part of the city near to the village of Malta encompassing factory of food canning, Kurdish garments and the central bakery.

This stage experienced excessive annual growth rate characterised by four patterns of physical urban development (Al-Janabi, 1985; Duhok province, 1985; Al-Feqeeh, 1999; Directorate of Statistics in Duhok, 2013, Municipality of Duhok, 2014)

- 1- Linear strip development pattern along the Duhok-Amediya road in Berûşkê, extending the city to the eastern direction at both sides of the road creating Berûşkê and Serhildan neighbourhoods. Some buckets developed illegally in these two neighbourhoods. The linear pattern of the development incited the city to lose part of its centrality by increasing the longitudinal distance between the expanded area and city centre. Therefore, some shops emerged at both sides of the road to work later on as main commercial strip for Berûşkê District.
- 2- Leapfrog development pattern appeared in the south direction. The existence of the military barrack and the Dukok Dam Project of Irrigation hindered city growth towards the western direction, therefore, the city growth directed towards the north of the White Mountain and Berûşkê Mountain, and to the south direction of Hishkarow and Duhok River. Several unconnected urban nuclei emerged to create new neighbourhoods of Diyarî, Mihabad, Ronahî, Sêgirka, Bintûka and Reza.

- 3- Infill development pattern emerged in the vacant areas between neighbourhoods in the east and north direction along to the White Mountain and Beruske Mountain which dominated by illegal developed and informal houses.
- 4- Contiguous development pattern dominated in the area of outskirts of Berûşkê Village through constructing informal houses.

Street network experienced improvements in new neighbourhoods in term of width and accessibility comparing to the street network in the previous stages. Gridiron or loose-grid and curvilinear pattern prevailed in the new residential areas. Gridiron in the Serhildan neighbourhood shows restricts the manner in designing and planning streets without considering the reliefs of the area. During this period two main arterial road implemented, one was Duhok Amediya Road extended to pass through Berushky to Bêserê village in the east, and the other one was Şindoxa Road joining the first one at the end of Beruşkê to Bêserê village. Two bridges constructed over Hishkarow River to link the north part and south part of the city to increase mobility in the city (Al-Janabi, 1985; Duhok province, 1985; Al-Feqeh, 1999).

This stage witnessed different land uses patterns. The dedicated area to open green space and recreation and main roads remarkably increased. The percentage of the developed area for residential purpose declined, while the total area increased. City in this stage required more land for constructing new road networks and other public services, also the rate of the educational, health, commercial and industrial uses increased comparing with the last stages. The land dedicated to the transport noticeably exceeded to control over 20.77% from the total area, industrial uses controlled over 3.05% of the added area - see Table 10-4. Inhabitants' share from the total land decreased comparing to the previous stage. The city was under pressure due to unexpected waves of the migrants from the rural as a result of the last campaign of destroying villages by Ba'ath military between years of 1977-1987.

The urban structure of the city of Duhok transformed to take the shape of sectors thus responded to the theory of sectors at this stage instead of concentric shape in the last stages-see Figure 10-8. The city divided into different neighbourhoods. Some of these neighbourhoods in the inner city were very low quality, as well as neighbourhoods with medium and high quality at the newly developed areas in the outer city. The effect of the natural determinants is clear on the land use pattern and the spatial pattern of the street networks; in addition to the effects - see Table 10-4.

Table 10-4: Land use pattern in the city of Duhok in the fourth morphological stage

No.	Land Use Pattern	Area (hectare)	Percentage%	Inhabitant Share m ²
1	Residential	343	58.97	30.00
2	Commercial	20.8	3.58	1.82
3	Industrial	17.73	3.05	1.55
4	Public Services	32.75	5.63	2.86
5	Transportation	120.8	20.77	10.57
6	Open Space & Recreation	46.57	8.01	4.07
	Total	581.65	100.00	50.88

Source: Own construct based on Al-Janabi, 1985; Duhok province, 1985 ; Al-Feqeh, 1999; Directorate of Statistics in Duhok, 2013, Municipality of Duhok, 2014

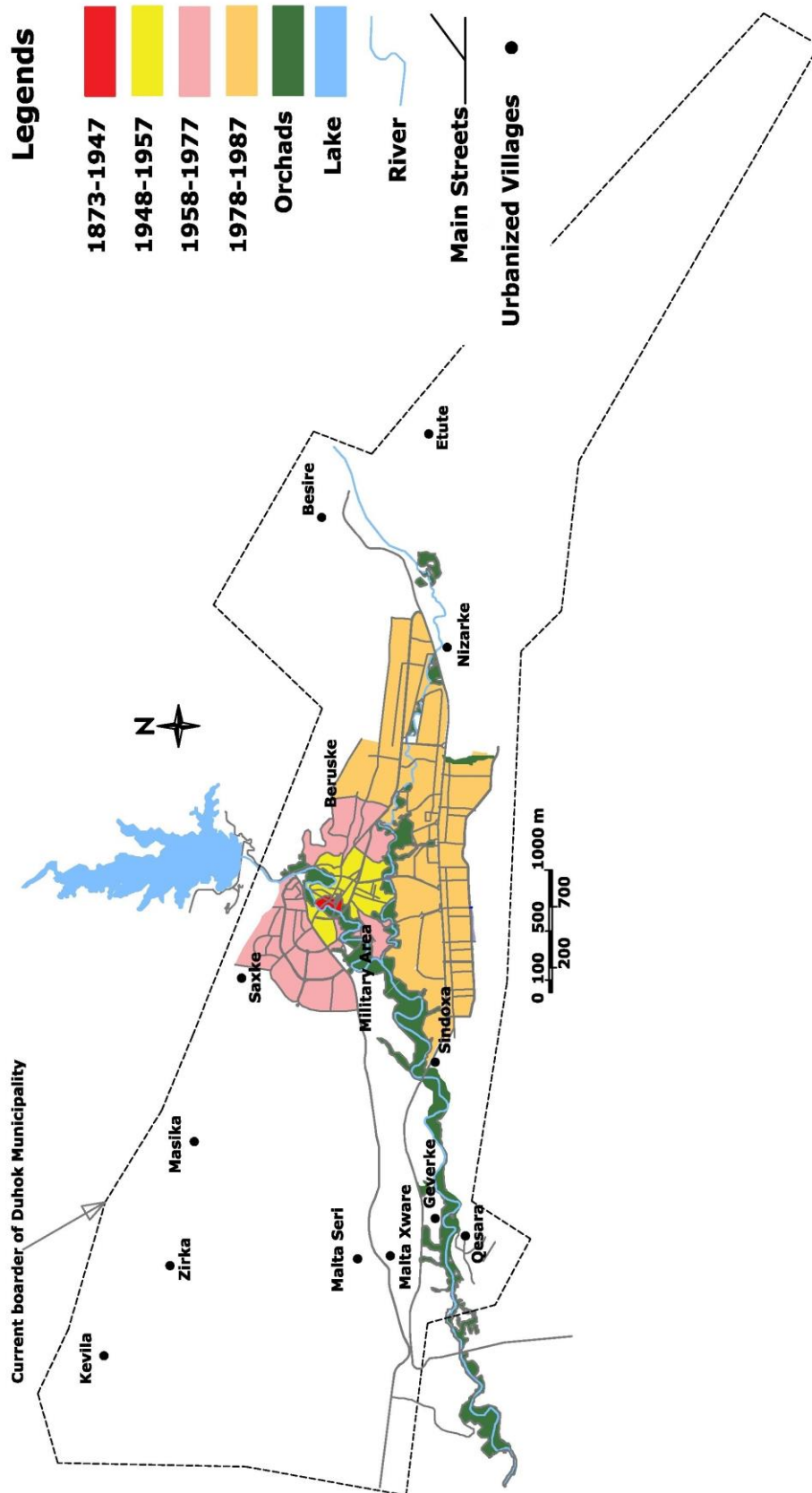


Figure 10-8: Fourth morphological stage of the city of Duhok 1978-1987

Source: Own construct based on Al-Janabi, 1985; Al-Feqeeh, 1999; Municipality of Duhok, 2013

Most of the orchards inside the city disappeared and used for urban uses, thereby the area of open green spaces in the city decreased dramatically. These orchards were the source of supplying the city with fruits and other vegetation. Open space within the new planned residential areas improved to some degree to meet the requirements of the residents with play yards and gardens such as in Aştî neighbourhood, while the illegal developed area characterised by lack of open green space as in Beruşkê and Xebat.

In this stage, different types of residential buildings were constructed by the local government of Duhok to afford low-cost houses for public servants through constructing four-story apartments²³ in Newroz and Xebat neighbourhoods and the single-house in Beruşkê neighbourhoods. The two-story houses dominated in the newly developed neighbourhoods in the southern part of the city such as Diyarî and Ronahî as an indicator for the improved economic situation and social positions for the owners at that time.

The population of the city of Duhok noticeably grew from 40191 inhabitants in 1977 and to 114322 inhabitants in 1987 (Ministry of Planning in Iraq, 1978; Ministry of Planning in Iraq, 1988). The annual growth rate of the population in the city of Duhok was 18.45% experiencing high rate comparing to the previous stages. Old neighbourhoods witnessed high population density, while the new ones relatively showed less density. In general, the gross population density increased comparing to the last stage from 125.36 to 196.55 persons per hectare (Ministry of Planning in Iraq, 1988). Some of the neighbourhoods were very dense and crowded which had density more than 300 persons per hectare like Şêxmehmedkê, Kanimehmedke, Grêbasê, Xebat and Beruşkê.

The average household was 1.19 house per family. The occupancy average rate was 8.93 inhabitants per house (Ministry of Planning in Iraq, 1988). These two indicators showed that the city witnessed new developments compared to the third morphological stage by granting more residential plots and affording loans to the citizens.

10.2.5. Fifth Morphological Stage from 1988-1998²⁴

During this period, Kurdistan underwent important events like so-called Anfal campaign by the Iraqi army in 1988, declaring the Safe Haven by the alliances in 1991 and internal armed conflicts between two Kurdish Parties between the years of 1994-1998. No doubt, these new circumstances affected the growth of the city in term of receiving another flux of migrants in 1988 from rural areas and in 1991 till 1998 from diaspora under the umbrella of the Safe Haven (Zubier, 2005). This put the city of Duhok under the pressure of rapid and unprecedented population growth. The population grew from 114322 inhabitants in 1987 to 212469 inhabitants in 1998, at an annual rate of 8.59% (Directorate of Statistics of Duhok, 2013). The accompanying population growth required the city to occupy more land through increasing of the spatial expansion to accommodate newcomers – see Figure 10-9.

²³ - Most of the apartments demolished in 2013 to be replaced by multi-story residential buildings of Dabin and Kayar Residential Projects.

²⁴ - General census in Iraq takes place in 10-years interval. In 1997 a general census conducted in Iraq except the provinces of Kurdistan Region because of the political situation at that time. Therefore, a general survey conducted by the UN for Kurdistan provinces in 1998 for the purpose of ration card (Food against Oil programme).

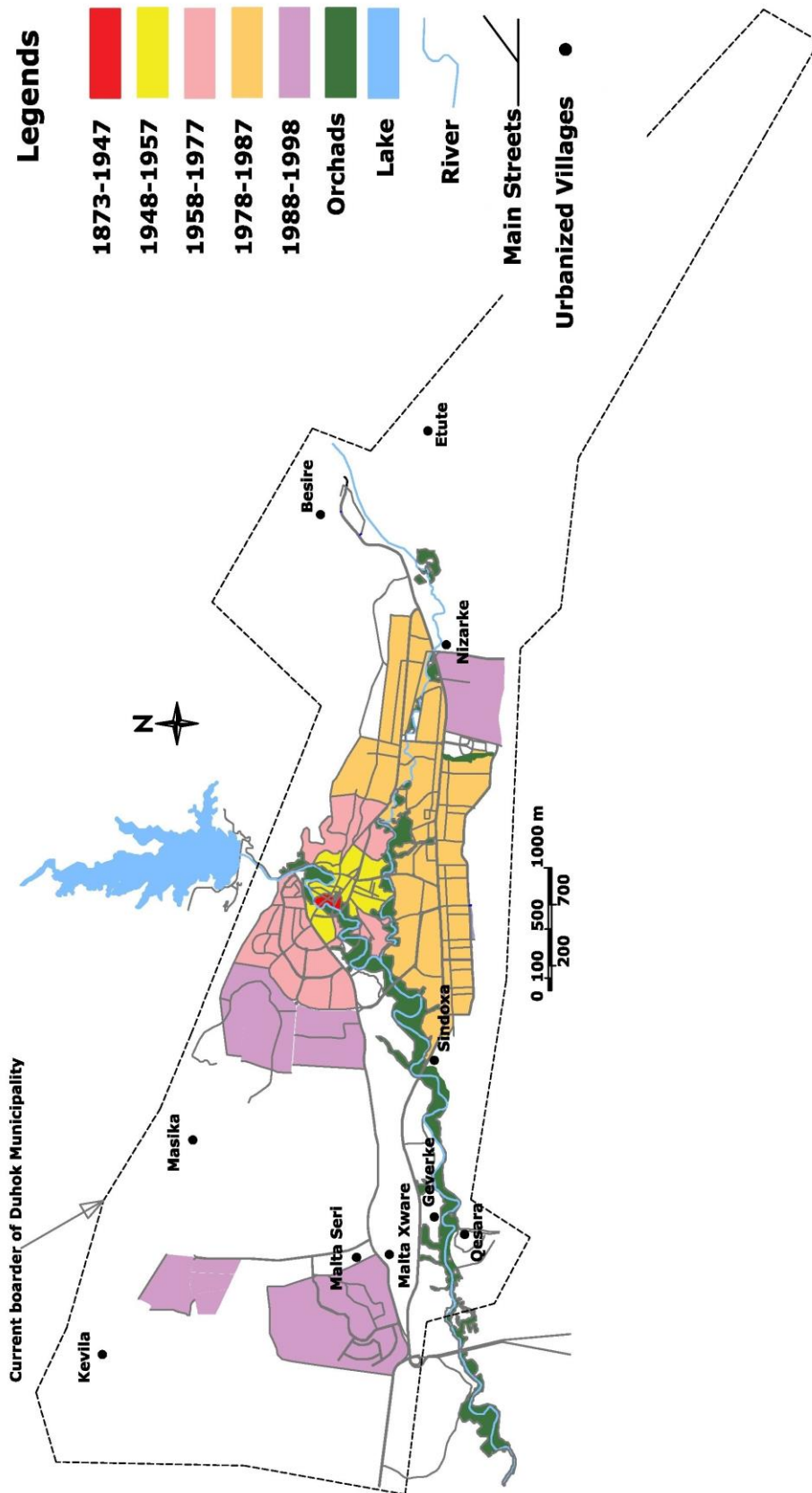


Figure 10-9: Fifth Morphological stage of the city of Duhok 1988-1998
 Source: Own construct based on Al-Feqeeh, 1999; Municipality of Duhok, 2013

The area of the city increased from 581.65 hectares in 1987 to 1470.25 hectares in 1998 at an annual growth rate of 15.28%. The gross population density in 1987 was 196.55 persons per hectare while in 1998 decreased to 144.52 persons per hectare causing excessive growth rate of the urban areas, displaying imbalance between the spatial growth and population's growth.

The direction of the development was limited towards because of situating of Former Iraqi Barracks in the south-west and existing of Duhok Dam Irrigation Project (DDIP) in the west-north direction. These two factors hindered city growth to the west direction from the 1970s and 1980s of the last century.

In 1994, the third master plan of the city of Duhok prepared by the Directorate of Constructive Planning of Duhok and under the supervision of the Ministry of Municipalities and Tourism in Kurdistan Region with efforts of local staff.

This master plan associated with many deficiencies, therefore, it was not able to steer the city towards more sustainable development, rather, all the existed problems worsened and brought other new problems to the city in term of density, accessibility and depleting of agricultural land and natural assets.

New neighbourhoods developed in this stage such; Azadî, Serbestî, Şoreş and Zanko. New villages have annexed to the municipality boundary such as Malta jorî, Malta Jêrî, Geverkê, Şindoxa, Şaxkê, Nizarkê and Êtutê, in addition to the industrial zone in Malta which was hosting factories of Food canning, Kurdish garments, central Bakery and Wood industries. The city experienced distinctive patterns of physical development patterns which were;

- 1- Infill development pattern, this pattern displayed in the new neighbourhoods as a response to the master plan schedule through adopting the infill pattern in a vacant area between the newly constructed neighbourhoods. This pattern dominated in the southern part of the city in neighbourhoods of Diyarî, Sêgirka, Azadî and Reza. This pattern also displayed in the north-west part of the city through growing of the old neighbourhoods and capturing the village of Şaxkê and linking it to the city border. In this stage, the contiguous development pattern dominated especially in the west direction while there were some pockets of infill development pattern in Beruşkê neighbourhood in the eastern part of the city.
- 2- Leapfrog development pattern along to the Duhok-Zaxo road displayed in the neighbourhood of Zanko in the west direction of the city through establishing of University campus.
- 3- Scattered development pattern displayed clearly in the north-east in neighbourhoods of Beruşkê, Gelî, Kanîmehmmadkê and Serhildan along to the White Mountain steps, and the Reza in the valley near to the Duhok Stadium.

Informal development accelerated around the invaded villages in Şindoxa, Şaxkê, Geverkê, Malta Jorî and Malta Jerî before the land expropriation process took place, which encouraged landowners to divide their agricultural land for residential purposed and selling it at a low price. Therefore, the citizens' attention directed towards these villages for investment and constructing houses. During this time the Municipality of Duhok was not able to control over the new developments in these areas, therefore, the size of these new annexed settlements started to grow illegally.

This stage was mainly depended on the urban services developed in the previous stages. The percentage of the devoted land to commercial, industrial, transportation and open space declined, simultaneously, the granted amount of the land to the residential uses increased. Residential uses occupied 57.08% from the total area and displayed declining in the percentages by 1.89%, while the actually developed areas were doubled. There was a remarkable increase in the favour of the educational sector represented by adding 311 hectares as a new area for the University campus- see Table 10-5.

Table 10-5: Land use pattern in the city of Duhok in fifth morphological stage

No.	Land Use Pattern	Area (hectare)	Percentage%	Inhabitant Share m ²
1	Residential	839.22	57.08	39.50
2	Commercial	41.31	2.81	1.94
3	Industrial	23.67	1.61	1.11
4	Public Services	312.58	21.26	14.71
5	Transportation	191.57	13.03	9.02
6	Open Space & Recreation	61.90	4.21	2.91
	Total	1470.25	100	69.20

Source: Own construct based on records of Directorate of Statistics in Duhok, 2013; Municipality of Duhok; 2014

The streets remained narrow as old streets patterns in the city without considering the growing the rate of private cars in the absence of promoting public transportation and implementation of sound plans to increase mobility in the city. The gridiron and loose grid dominated as main patterns without considering topographical reliefs creating inefficient street networks. The development pattern of this stage was a copy of the previous developments with its pros and cons.

Different types of plot sizes granted to the citizens by the government ranged from 200m² to 500m². Single attached houses of the two-rows predominated in all the developed areas, in addition to the new projects of medium and high rise apartments implemented in the neighbourhoods of Masika and Newroz.

The rate of open spaces increased comparing to the previous stages, while population density, proximity and accessibility were not properly considered to afford sufficient open areas for all the residents of the neighbourhoods.

The total number of neighbourhoods in the city increased to 27. The population of the city of Duhok almost doubled in ten years from 114322 inhabitants in 1987 to 212469 inhabitants in 1998 (Directorate of Statistic in Duhok, 2013). The annual growth rate of the population in the city of Duhok was 7.81%. The previously established neighbourhood experienced high density except for Bazar neighbourhood in the city centre displayed half of the previous density. This returned to the fact that the city centre was transforming towards commercial uses and expelling inhabitants outside the centre.

The linear block dominated the urban block patterns in the newly developed areas. Block length in many areas exceeds 240 m without considering permeability and easy access. The depth of the blocks remained 40 m in most areas. Building types did not change in term of setbacks, allocating front garden and concrete fence approaching the street.

10.2.6. Sixth Morphological Stage from 1999 -2008

In 2003, Iraq witnessed the collapse of the former regime by the American Alliance and establishing of federalism in Iraq in 2005. These events have affected all Iraq and Kurdistan region. New constitution prepared for Kurdistan Region and many authorities have given to the local governments of the three provinces namely; Duhok, Erbil and Sulaimaniya to establish a sort of decentralisation system in the country. Relatively, the region enjoyed stability and security which pushed the government to encourage local and foreign investments. The region witnessed economic booming and the local government granted thousands of residential plots to the citizens to solve the housing problem which led the city of Duhok to enter the rapid construction phase. Therefore, new residential neighbourhoods have emerged with different sizes and forms such as Botan, Mîdîya, Geverkê, Masîkê, Nizarkê and Pêşangeha, an additional area of 2503.67 hectares has added to the city area. The size of the city was doubled in this stage. The city demonstrated three clear patterns of physical development which were;

- 1- Infill development pattern, this pattern displayed in the vacant area of the already developed neighbourhoods such as; Serbestî, Bituka, Ronahî, Reza and Diyarî in the south part of the city.
- 2- Compact development pattern displayed in the neighbourhoods of Şaxkê, Beruşkê, Serhildan and Reza, with additional illegal development in these areas.
- 3- Contiguous development pattern displayed in the neighbourhoods of Botan, Mîdîya and all other new neighbourhoods in the western part of the city.

This stage practically overlapped with the previous and the next stage. All the land uses increased with a slight declining in the percentage of residential use. Residential uses occupied 56.40% from the total area, displaying less percentage compared to the previous stage, while the actual area dedicated to residential uses tripled and increased by 1402.07 hectares. More land was needed for other uses such as transportation, open spaces and educational. The percentages of the commercial, industrial and public services doubled. Open space areas in the valley of Duhok annexed to the municipality's boundary, therefore, there was a significant increase in the amount of the green open areas. All these areas orchards and are not all accessible to the residents in the city - see Table 10-6 and Figure 10-10.

In this stage, the city witnessed the constructing of many residential high rise buildings in the neighbourhoods of Zeriland and Newroz- see Figure 10-11.

Table 10-6: Land use pattern in the city of Duhok in sixth morphological stage

No.	Land Use Pattern	Area (hectare)	Percentage%	Inhabitant Share m ²
1	Residential	2241.29	56.4	75.07
2	Commercial	136.12	3.43	4.56
3	Industrial	158.96	4	5.32
4	Public Services	439.52	11.06	14.72
5	Transportation	521.16	13.11	17.46
6	Open Space & Recreation	476.87	12	15.97
	Total	3973.92	100	133.11

Source: Own construct based on Municipality of Duhok, 2014; Google Earth

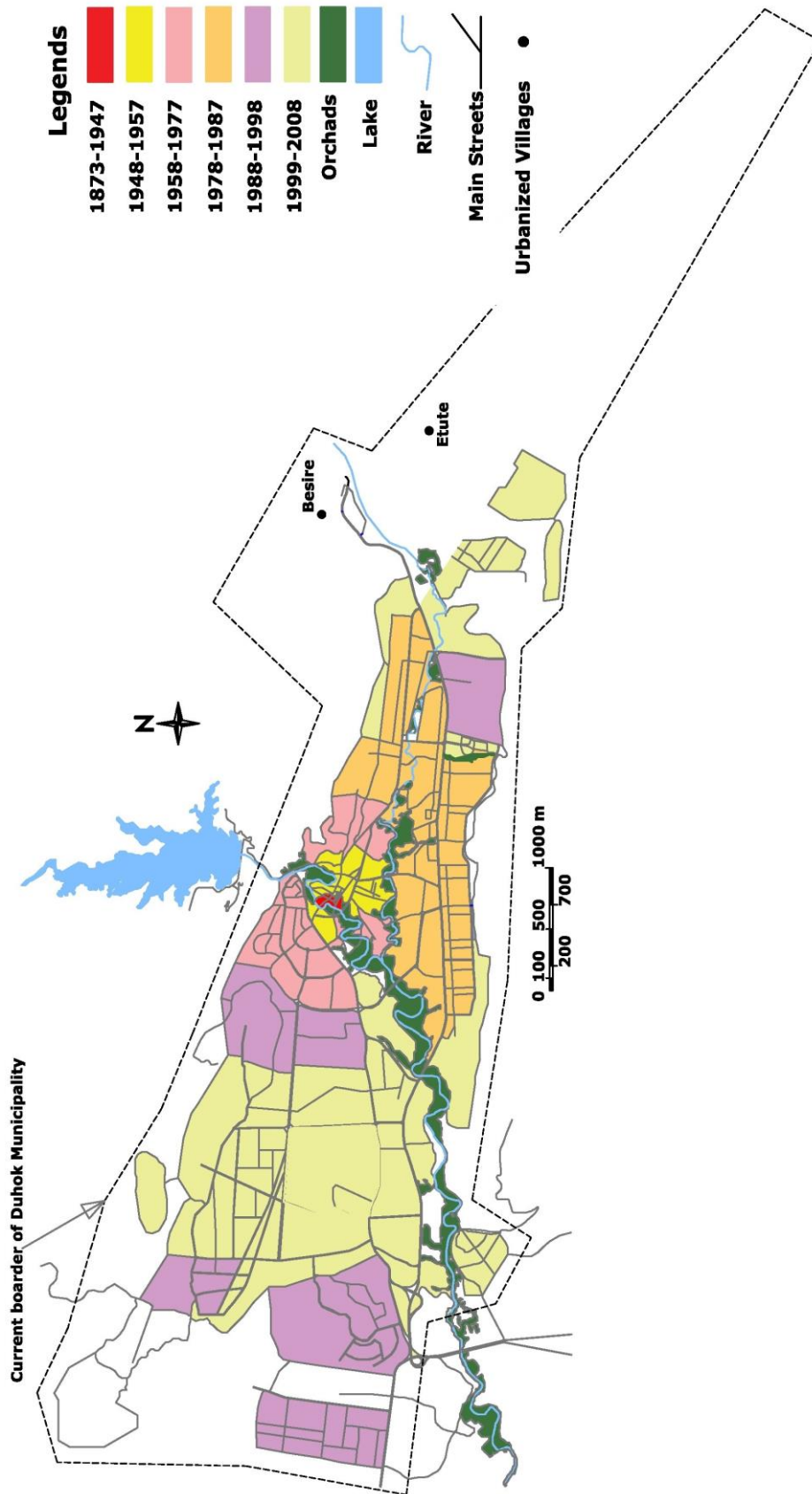


Figure 10-10: Sixth morphological stage of the City of Duhok 1999-2008
 Source: Own construct based on Master Plan of Duhok in 1994



Figure 10-11: High residential buildings of Dabin project in 2005 (left), high residential buildings of Zeriland project in 2007 (right)

Source: Photo by the Researcher in 2013

Street networks occupied 13.11% of the developed land, the percentage declined while the area doubled to capture extra 329.59 hectares. The percentages of the street increased back to the new opening of arterial roads of Q- Mehemmed, Malta, Zirka and Kevîlan. These streets did not improve in term of accessibility, the width of the street, sidewalks width, the number of the intersections and turn-angles.

Commercial use occupied 3.42 % because of transforming residential uses into commercial uses at the arterial streets. According to the regulations- which are still effective - the streets with width 15m, 20m, 30m and 40m are allowed to be transformed to commercial uses in regardless to their locations- for more details see section 12.8 in chapter twelve. The concentrated commercial activities along to the main streets, thus the streets attracted more vehicles and generated congestion and land speculations in these streets, as a result of defaulting regulations and flaws in land use allocation.

The amount of the green open spaces remarkably increased due to the abandonment areas left as barriers for the high power transmission line in the city. The total amount of open green spaces and recreational areas including cemetery and orchards in Duhok Valley was 476.87 hectares.

The linear block pattern predominated in the newly developed areas, without noticeable changes in term of length and numbers of plots and pattern. Houses witnessed changes in term of the number of stories and architectural design and characters. Buildings' setback did not improve to consent to the right of the way and walkability. Attached houses on three-sides prevailed with 2.50 metres setback in front, except the corner houses have setbacks in two sides– see Figure 10-12.



Figure 10-12: New typology of buildings (left), and two stories corner house (right).

Source: Photo by the Researcher in 2013

In ten years the population grew from 212469 inhabitants in 1998 to 298548 inhabitants at the growth rate of 40.51% in 2008, at an annual rate of 4.05%. Such population growth accompanied by high physical growth rate. The city expanded to cover an area of 3973.92 hectares in 2008 at an annual growth rate of 17.03 %. City spatial growth was not compatible with the population growth rate. The gross population density in the previous stage was 144.51 persons per hectare, while in this stage the gross population density dropped down to 78.67 persons per hectare displaying sharp declining. At the same time, the number of neighbourhoods increased to 41 carrying various characteristics.

The huge physical developments which took place in this stage accelerated and fuelled the city's urban growth. In the absence of a strategic plan and sound development framework, the new urban development's incited many problems in the city's form and structure at macro and micro level in both of the architectural and urban planning perspectives. For example, noticeable characteristics and features of this stage represent by high rise buildings in different places that distorted city's skyline, adjacent of the high rise buildings to the low rise buildings without separating them by dense green structures of the buffer zone has generated problems of the privacy and blocking the sun and winds from low rise buildings. Seeking more land for different activities inside the city pushed the municipality to exploit green and open spaces, especially in the city centre and other newly developed areas. Most of the green open spaces in the city centre filled with commercial buildings, for example, the places of Bira, Panorama and Zer Malls in the city centre. The greed of investing land forced the municipality to fill up green fingers and valleys for new projects. Rapid mode of the development overloaded the city's infrastructure and distorted the city's form and environment.

10.2.7. Current Morphological Stage from 2009 till 2018

In practice, this stage has overlapped with the sixth morphological stage. It is worthy to notice that the direction of urban growth has radically changed. The city has occupied areas administratively is not belonging to the city of Duhok. Current characteristics of this stage are investigated in details in Chapter Eleven.

To respond to the new challenges, the project of Duhok master plan is enacted and put in practice in 2009 by the Ministry of Municipality and Tourism in Kurdistan Regional Government (KRG). The master plan which is the fourth is considered to be the main development plan till 2032 for the Great Duhok (Duhoka Mezin). The plan was a turning point in the history of the city of Duhok because it was the first time in the history of the city to undertake the responsibility of preparing a master plan to the foreign experts.

The fourth master plan has jumped to the other side of the Zawa Mountain in south direction invading agricultural fertile land of villages of Zawa, Kalabedrê, Shariya, Şêxidrê, Dosteka, Girêpanê, Bazelanê and Domîz see Figure 10-13. New residential neighbourhoods of Avrocity, Tenahî, Kêvilan, Zozan, Qesara and Êtûtê have annexed to the city to reach the total numbers of the neighbourhoods to 48 in 2014.

The new plan has seized 14000 hectares of land for future development (Directorate of Agriculture in Duhok, 2014). This plan is facing strong opposition from the landowners in these villages and also citizens have objections on the plan. Administratively, Municipality of Duhok is not responsible for the development of the new area outside its juridical boundary-see Figure 10-14.

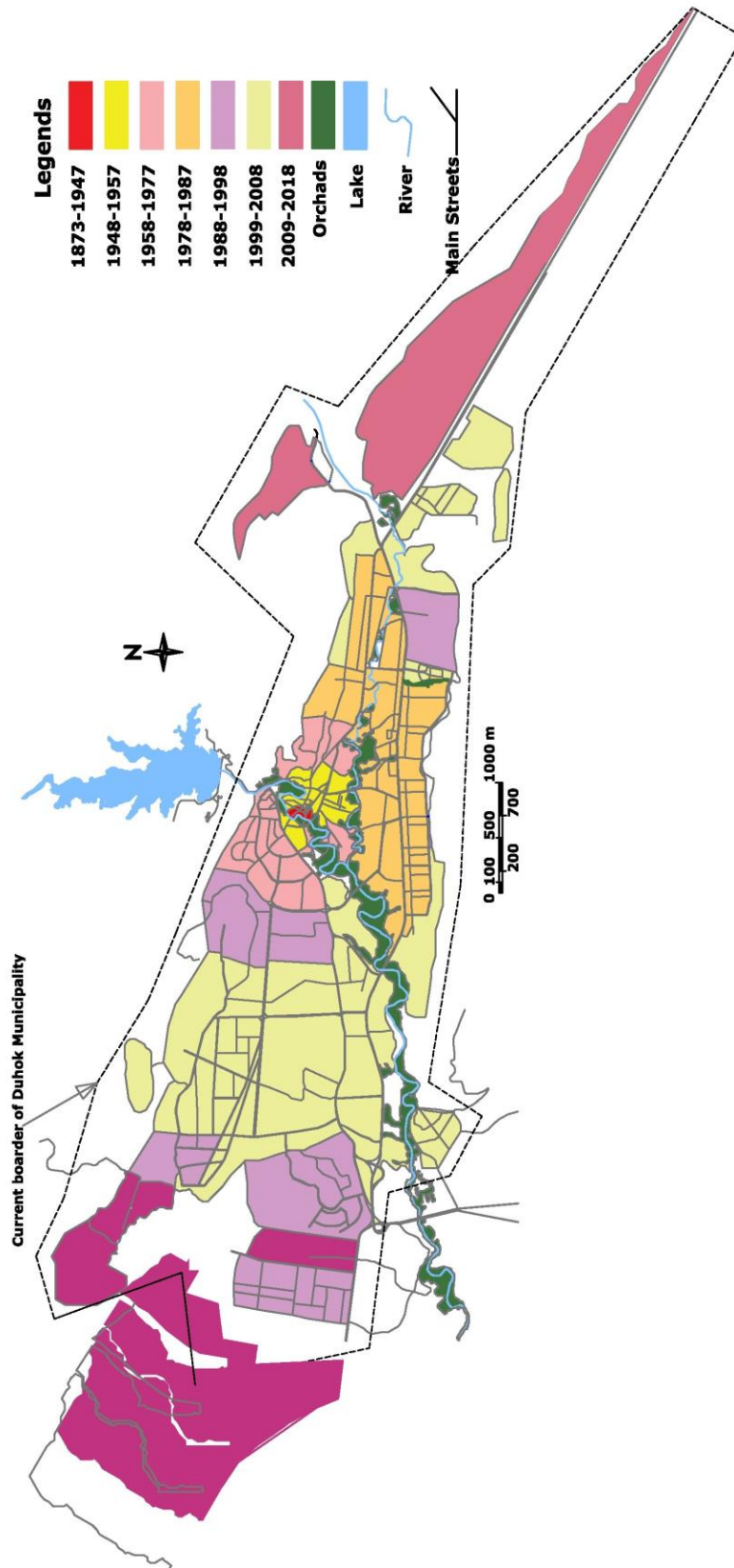


Figure 10-13: Current morphological stage from 2009-2018

Source: Own construct based on Al-Janabi, 1985; Al-Feqeeh, 1999; Municipality of Duhok, 2013; Master Plans of Duhok of 1994 and 2009

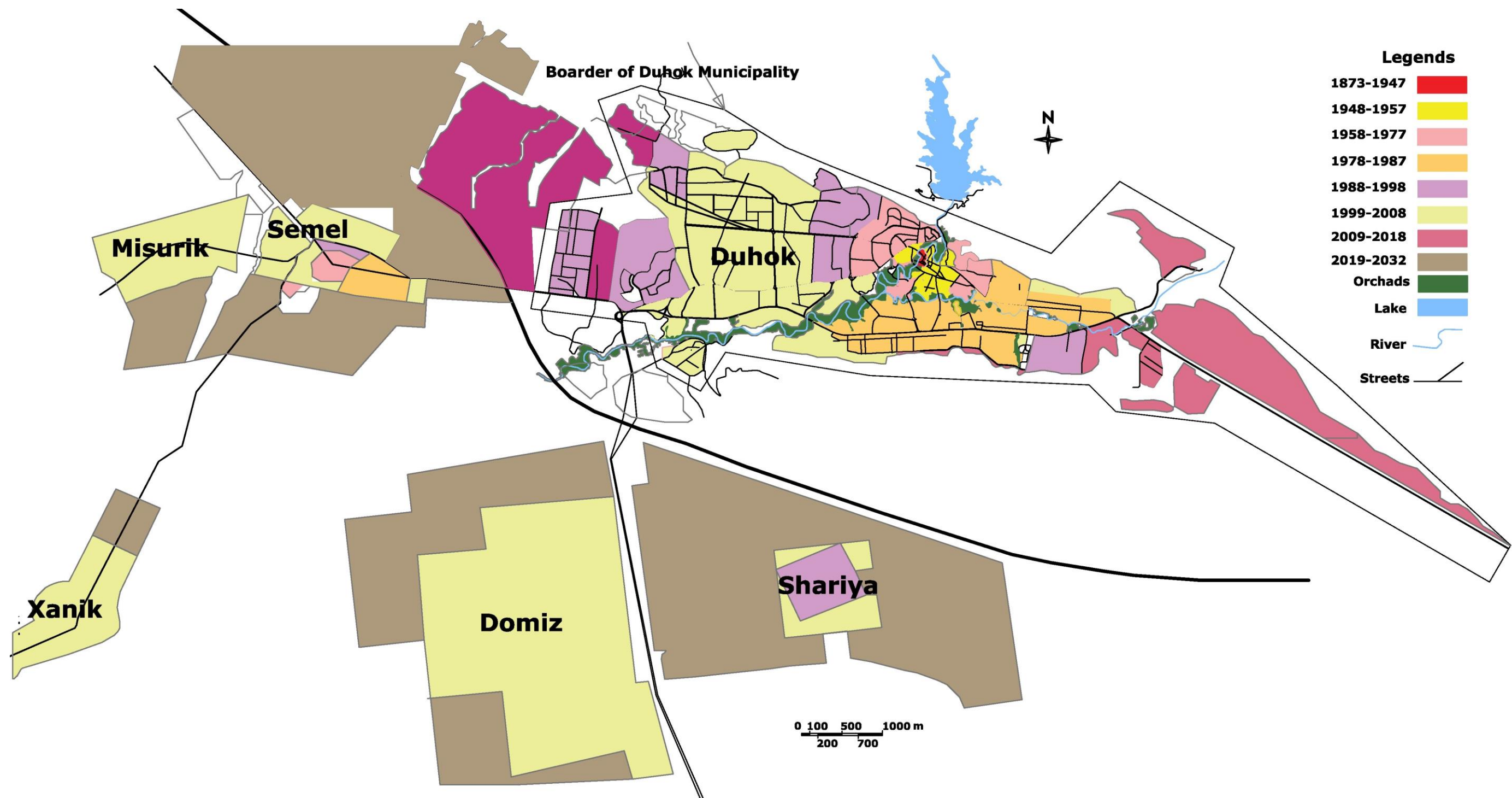


Figure 10-14: Chronological development of the City of Duhok from 1947 to 2014
Source: Own construct based on Al-Janabi, 1985; Master plan of Duhok, 1994; Al-Feqeeh, 1999; Duhok municipality master plan, 2009; Municipality of Duhok, 2013;

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10.2.8. Conclusion

The city has grown in fast paces from a small village to a medium-size city hosting about half a million inhabitants in sixty years. The area of the city grew from 18.60 hectares occupying 5621 inhabitants in 1947 to cover 5763 hectares with 355193 inhabitants in 2014. The city of Duhok manifests a changing pattern of a dynamic urban development reflecting socio-economic and political trends. The city of Duhok has gone through various morphological stages; during these stages, the city has taken many different spatial urban forms and structures. In the first and second morphological stages, the city developed without any intervention from planning institutions in directing, controlling and managing the development. Therefore, the city grew as an organic urban settlement taking concentric shape and the developments were contiguous to the urban fabric.

In the third and fourth morphological stages, the first and second master plans were prepared to direct the city development. In the third stage, two new neighbourhoods developed in the western part, thereby, the city started sprawling and entered a new era of encroaching agricultural lands. In the fourth stage, all the developments took place in the south part of the city crossing Hişkaru River demonstrating new leapfrog development initiatives and adding four new neighbourhoods to the city.

The most influential morphological stages were the fifth and sixth. In these two stages, the city witnessed unprecedented and uncontrolled developments. The third and fourth master plan prepared during this period. The effect of the fourth master plan was clear in destroying many natural and artificial assets of the city such as; the Irrigation Project of Duhok Dam, green area in the Gelf of Duhok and other green fingers, and creating many deficiencies in the city urban form and structure. In these two stages, gross population density declined while inhabitants' share of the other urban facilities has increased. The development approaches have not been changed or improved in these two stages, rather, the previous initiatives were considered as models.

The main source of the population growth was the migration from the rural to the city of Duhok. City population increased exponentially stage after stage, while gross population density declined and the share of each inhabitant from the land increased demonstrating incompatibility and misbalancing between population growth and land consumption.

The city of Duhok hosts about one over three of the province population. Undoubtedly, the increased amount of the population has its pressure on the different aspect of life in the city. The city attracted many people as a result of; *firstly*; the sequential wars against to the region which destroyed rural area through military operations by the former regime of Iraq, and *secondly*; disparity in distributing resources between rural and urban areas.

The city of Dohuk has expanded beyond the ability of the planning institutions to control and manage it, in addition to the inaccuracy of the population projections and neglecting of the social and economic trends. The development of the city was an urgent response to certain events. The city of Duhok is facing many vexing problems which consider antithetical to urban planning and the process of promoting physical sustainable development.

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Chapter Eleven: Outlining Main Spatial Characteristics of the city of Duhok

11.1. Introduction

This chapter outlines the main spatial characteristic of the city of Duhok and identifies land use patterns and their physical features and identify issues concerning social characteristics such as; population density, accommodation gross density, family size, household size and occupancy rate.

11.2. Land Use Patterns in the City of Duhok

Land use patterns are usually categorised based on their position and functional characteristics. However, many driving forces were influencing and changing the pattern of the land uses amount and their distribution in the city of Duhok. The limited suitable land for development within the city's boundary and the city shape has influenced the pattern of the land uses in the city in addition to the zoning ordinance and other regulations. The main patterns of the land uses are residential, commercial, industrial, transportation, urban services and open spaces– see Table 11-1 and Figure 11-1.

The dedicated land to the residential uses has increased to 2909.16 hectares and at the same time, its percentage has declined to 50.48% from the total area of the city, while the area which dedicated to the transportation has doubled compared to the sixth morphological stage.

Table 11-1: Percentages of different land uses in the city of Duhok in 2014

Land Use	Area Hectares	Percentages %
Residential	2909.16	50.48
Commercial	186.12	3.23
Industrial	196.52	3.41
Urban Services	518.67	9.00
Transportation	1099.41	19.08
Recreational Area	97.98	1.70
Open Spaces & Orchards	555.14	9.63
Undeveloped Area	200	3.47
Total	5763	100.00

Source: Own construct based on calculations from master plan of Duhok, 1994; master plan of Duhok, 2009 and satellite images

The land use structure in Duhok in the early stages was following the concept of the concentric zone, whereas all the commercial activities located in the centre of the city. However, the rapid physical and population growth during the economic boom that derived the development process has created some features of sector concept since the fifth morphological stage through the way in which the residential neighbourhoods and the industrial areas distributed. There is no clear concept of the land use structure in the city, rather it ranges between the concentric and sector concept with movement towards multi-nuclear through emerging Berûşkê and Zirka sub-centres.

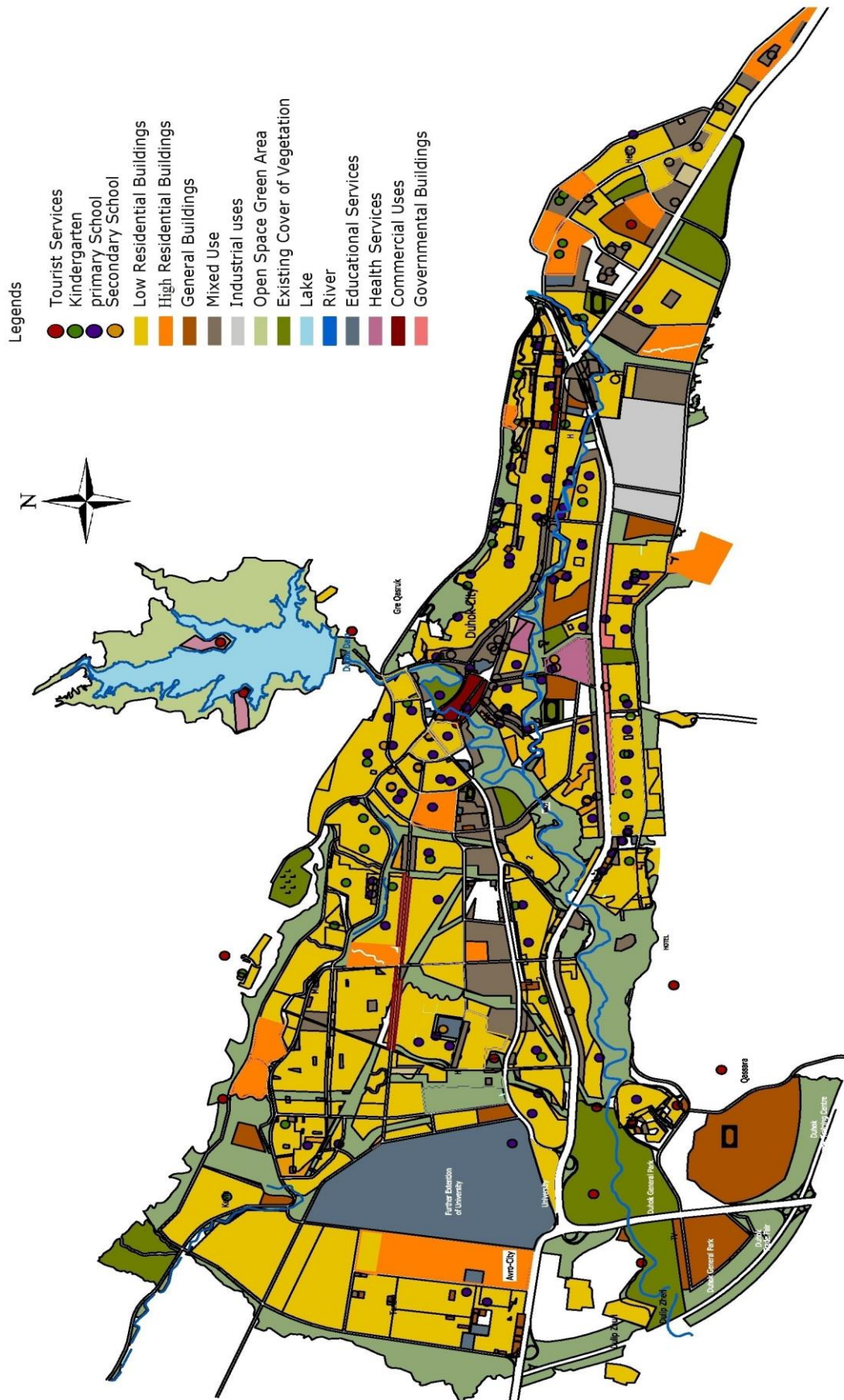


Figure 11-1: Current land use pattern in the city of Duhok
 Source: Modified from Master plan of Duhok, 2009

The following subsections try to outline the essential characteristics of the main land use patterns in the city of Duhok.

11.2.1. Residential Areas

Residential use is forming the main portion of land uses as demand for offering housing. Presently, Duhok is encompassing 48 neighbourhoods, which vary in their architectural characteristics, population density, built-up area and development backgrounds. Urban fabric in these residential areas can be put under three classes as concerned to this research: In term of development formality, two patterns can be observed; the planned-developed areas which formally developed and unplanned-development which informally developed. The latter is two types; unguided and informal development. In term of residential buildings height, there are three main types; Low-rise housing of single-family, medium-rise of multi-family housing and high-rise residential housing. Moreover, in term of plan-type, there are two types; the open-plan or traditional court-yard houses (locally known as eastern style), and closed-plan houses (locally known as western style).

The urban fabric of the formally developed residential areas is organised and implemented according to the planning schemes. Usually, these areas are predominated by one type of plot size, area and urban block. The urban blocks commonly take linear shape arranged according to the certain patterns. Houses in these areas enjoy setbacks in front and occasionally on other sides. Often, these areas are prevailed by low residential areas.

Low-rise residential housing is mostly one, two or three stories. They have many typologies and designs which emerged in different morphological stages in the city. One story building can be found in all residential neighbourhoods, no regulations available to enforce house owners for constructing more than one story during the implementation period, even within the same urban block. Thereby, the heights of the buildings in the residential areas are not regulated giving the impression of a chaotic and disorganised skyline. Normally, the one-story houses in early morphological stages contained traditional courtyards (opened-plan). This type has a direct entrance and openings on the streets and alleys granting liveability to the residential streets - see Figures 11-2 and 11-3.

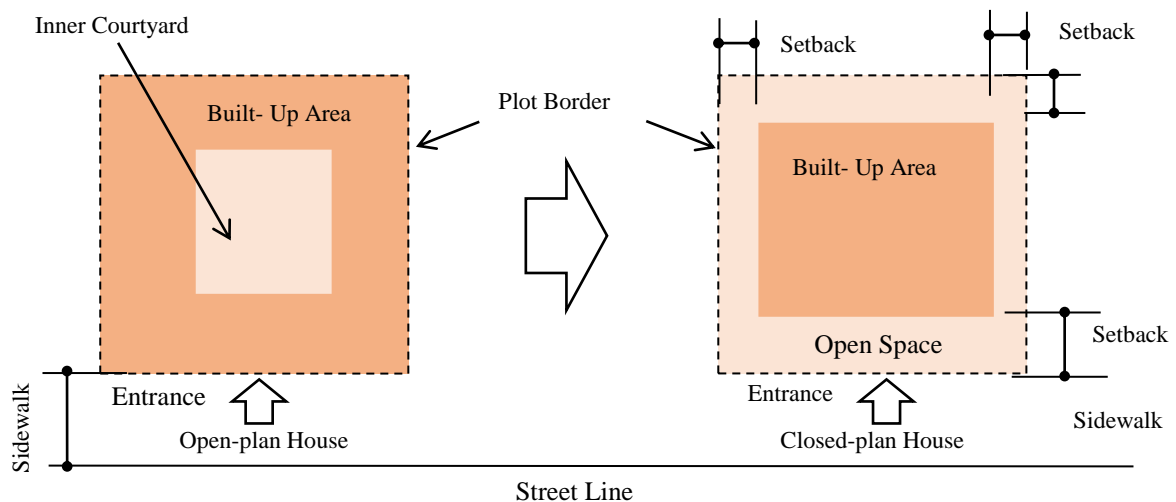


Figure 11-2: Transformation of traditional open-plan to closed-plan
Source: Own construct based on observation, survey and plan analysis



Figure 11-3: Transformation of open-plan house (left) to Closed-plan house (right) in Duhok

Source: Photo by the Researcher in 2012

In the late third morphological stage, the closed-plan houses emerged as a new trend for house plan. In the following stages, the closed-plan becomes obligatory in all newly developed areas. The type of two-story building has prevailed in the late 1960s (Duhok Province, 1985). The built-up area of the first floor has approximately half of the base area (locally known as one and a half story) which is still applicable in many new neighbourhoods.

According to the article 1094 in 1994 of the Ministry of Municipality and Tourism in Kurdistan Region which based on the former articles of 1977, every low residential house should have at least 2.50 m setback from the property line in front elevation which put death on the traditional style and no more approved by the municipality of Duhok. Despite that, the traditional style is more adapted to the climate issues in the region and is more compacted (Al-Khually, 1975).

The type of closed-plan is found in the neighbourhoods of Nohedra, Asti and Şoreş and all new neighbourhoods developed after 1977. It has accompanied with two stories height plus penthouse (Province of Duhok, 1986) - see Figures 11-4. The area of the first floor is almost equal to the base area. The first generation of the attached housing has a minimum setback of 2.00m from the property line in front and rear elevation to increase the natural ventilation and respect privacy of the neighbours. The second floor has normally a setback determined by the first floor.



Figure 11-4: Increasing of Built-up area from one and a half stories (left) to two stories Type in the city of Duhok (right)

Source: Photo by the Researcher in 2012

Houses with one and two attached sides prevailed in the third and fourth morphological stage of the city between the years 1957-1985 (Al-Janabi, 1985), while the attached house in three sides prevailed in late of the 1980s. Increasing of built-up area in the newly developed area was a response to the residents need for more living space due to rising of family's income. Therefore, the single-detached houses have transformed into attached two-row housing type in the newly developed areas. The single-family detached houses dominated in the formally developed neighbourhoods till 1988 and prevailed in Ronahi, Serbasti, Mihabad and Sêgirka neighbourhoods. This trend has not been controlled by the municipality and has not legalised due to the weak enforcement of regulations despite the effective regulations determine the coverage area for residential plots to 65% from the total plot area.

In 1998, there was a tendency towards increasing built-up area of plots to touch the line properties of the neighbours' plot in back, left and right sides through leaving small shifts between adjacent plots for light and ventilation. These small shifts differ in size and shapes, but normally the area is 1.00m² and more. This tendency can be seen clearly in Masîka Rojava and the entire neighbourhoods developed after 2003- see Figure 11-5. The situation can be traced back to laxity in enforcing development control from the planning authorities in the city of Duhok and the absence of strategies to adapt to the new residents' requirement in inquiring more living space.

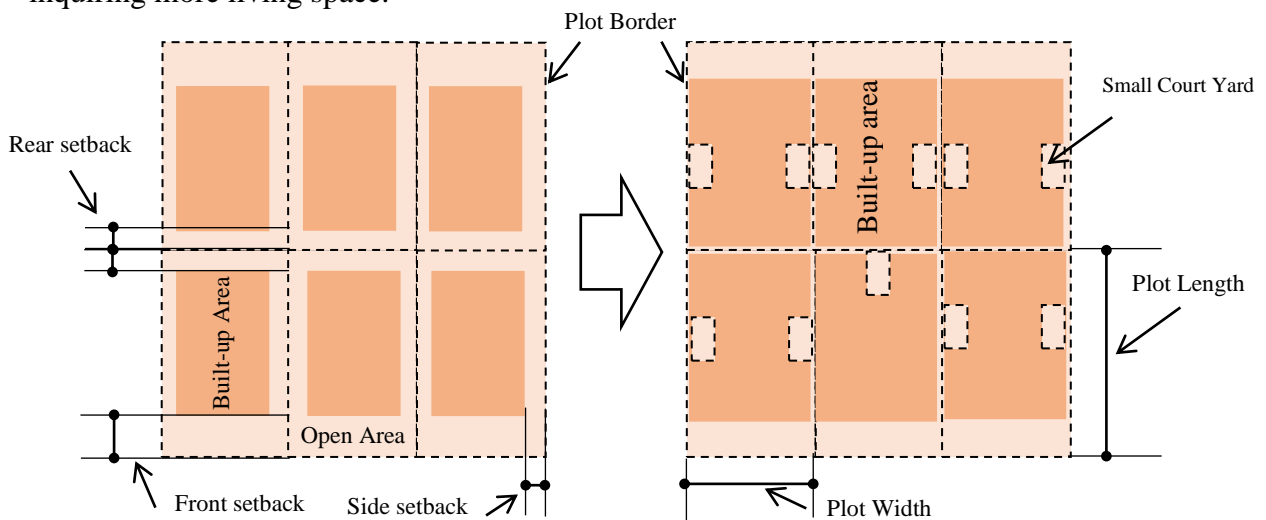


Figure 11-5: Increasing of built-up area in the plots

Source: Own construct based on observation, survey and plan analysis

Housing type of three stories plus penthouse has appeared in the last ten years. This type has the ground floor for none-residential uses with two stories for residential use above. The built-up area of the ground floor in most cases is equal to the area of the plot despite regulations restricting the ground floor setback to 4.00m and built-up area. This type has prevailed in the newly developed neighbourhoods in the city of Duhok (e.g. Mîdîya, Behdînan, Masîka Rojava, Botan and recently developed plots), it is emerged as a response to the lack of space for urban freights in the city in the time of economic boom between 2003-2012 through engaging many residents in trading activities. The ground floor in the houses was used as depots for goods (Directorate of Municipality and Directorate of Statistics in Duhok). Later on, became a tendency in all newly developed areas. It could be said that this

was an initiative for promoting mixed use in residential areas forced by the market, but it was not controlled by the municipality. By transforming the ground floors of the houses to depots in many residential areas, the residents complained of having problems of accessibility, car noises and accidents. Therefore, new bylaws issued by the Municipality to restrict three stories in residential streets of less than 12m width, but the Municipality was not able to stop it²⁵. Three stories buildings have distorted the skyline of the residential streets, trespassed privacy and restrained the sun and wind from the adjacent buildings of less height – see Figure 11-6.



Figure 11-6: Transformation of residential houses from two stories (left) to three stories (right) in the city of Duhok

Source: Photo by the Researcher in 2012

Single-family detached houses are observed in few neighbourhoods such as; Asti, Şoreş, Nohadra, Grêbasê and Avrocıty neighbourhoods. There are different typologies of detached houses, the size of the plots ranges from 300 to 600 m².

High-rise residential housing is relatively new in the context of the city of Duhok. The first initiative of the high rise building was limited to the four stories height which developed in 1978 to afford low-priced houses for public servants (Province of Duhok, 1986). After 2003, high residential projects of Zerîland complex implemented as of the pioneer projects, then followed by other projects for more than fifteenth stories such as Avrocıty, Mazî and Kayar complexes- see Figure 11-7. These high-rise residential buildings differ in term of the number of stories, number and size of apartments. They are mostly implemented as investment projects by foreign and local investors. There is an acute shortage of bylaws and regulations concerning property rights.



Figure 11-7: Old apartments (left), Kayar housing projects (right)

Source: Photo by the Researcher in 2016

²⁵ - Personal interview with the officer of master plan in the municipality of Duhok in 12th sept. 2015.

The most common sizes of the plots-with exceptions- in the formally developed areas are; 10m x 15m, 10m x 20m, 12.5m x 20m, 15m x 20m, 20m x 25m and 25m x 25m, while the common areas of the residential plots-with exceptions - are; 150m², 200m², 250m², 300m², 400m², 500m² and 600m² (Municipality of Duhok). Plot divisions in the formally developed neighbourhoods usually dominated by residential plots of 200m², 250m², 300m² and 400m² areas. After 2011 there is a tendency for acquiring small residential plot sizes as a response to the rising costs of residential land in the city and shortage of residential areas due to the high flux of many migrants from other cities to Duhok, as well as, the tendency of early family splits. In many neighbourhoods such as Kêvilan, the residential plots of size 250m² (12.5m x 20.00m) and 300 m² (20 x 15m) have been sub-divided by the owners into two small plots of size 125m² (6.50m x 20.00m) and 150 m² (10 x 15m). In the beginning, the trend forcibly restricted by the municipality of Duhok, therefore, many plots have been subdivided illegally by the residents through issuing of a unified certification of ownership for the whole plot. Although, the existence of residential plots of size 150 m² was not a new trend in the city, the plots of size 150 m² granted by the government to the low-income families in Şehîdan neighbourhood in 1973 and Beruşkê neighbourhood in 1983 (Province of Duhok, 1986). According to the new regulations from the municipality of Duhok in 2014 based on Article no. 25346 on 2010 of the Ministry of Municipalities and Tourism in Kurdistan Region about residential plot sub-divisions, the plots of size 300m² and more can be divided into two equal plots of size 150 m², but it is restricted for the plots of less area including Êtûtê neighbourhood. Currently, each owner has the right to obtain an independent certificate of plot ownership.

Three classes represent un-planned residential housing. The *first type*; is the informal residential housing dominating by low-residential buildings with one story, these residential areas have bad living conditions and occupy 4.02% from the residential areas in the city of Duhok. These areas illegally developed and prevailed in different pockets in the city contiguous to the old development areas in Beruşkê, Reza and Diyarî neighbourhoods. The *second type*; is the organic form of residential housing dominated in the thirteen urbanised villages which annexed to the city and occupying 8.50% of the total residential areas in the city. These organic nuclei are developed without prior planning intervention, which developed through hundreds of years. It is observed clearly in Malta Xuware, Malta Serî, Qesara, Aloka, Geverkê, Şindoxa, Nizarkê, Êtûtê, Besere, Şaxkê, Makîsê, Zirka and Kêvelan neighbourhoods. The *third type*; is unguided residential housing observing in the area of second, third and fourth morphological stages representing 9.14 % from the total areas of the residential uses in the city and demonstrate in neighbourhoods of Xebat, Şêlê, Girêbasê and Kanixîşmana. The unguided residential housing is the outcome of illegal and uncontrolled development took place by the landowners through selling plots at cheap price for residential purposes. These un-planned areas encompass many types of buildings which vary in their forms and shape from; single-family detached of two-row houses and attached two-row houses with different urban block typologies, plot sizes and housing styles.

The total areas of un-planned residential housing (informal, urbanised villages and unguided development) are representing 21.67% of the residential area of the city. This, by itself, is a big challenge to the municipality of Duhok in taking any step towards promoting sustainability in the city- see Figure 11-8.

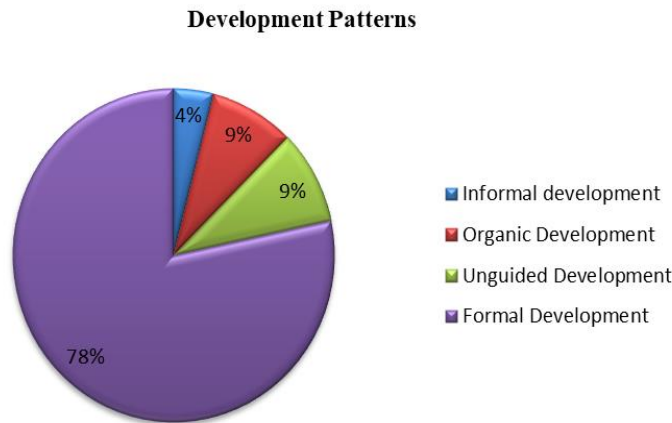


Figure 11-8: Development patterns of the residential areas

Source: Own construct based on calculations from satellite images, 2014; updated master plan of Duhok, 2015

11.2.2. Commercial Uses

The dedicated land for the commercial uses has exponentially increased, while the percentages of the land oscillated. There were many factors affected the amount, location and distribution of the commercial land use and facilities inside the city of Duhok such as increasing of residential areas, economic prosperity and political stability in Kurdistan region.

The main commercial activities in the city of Duhok are concentrated in the old core of the city. The analysis of the population number and density displays that the city centre is deporting the remaining residential uses outside the centre. There is a continual transformation of the remaining residential uses to commercial uses since early morphological stages depending on the market requirements to the commercial services and activities.

By growing the city, the old commercial core started to grow to capture the old neighbourhoods of Bazar and Birayetî. The Central Business District (CBD) in all the stages of the city of Duhok is represented by the old city core – see Figure 11-9. The commercial uses in the city of Duhok can be classified into five types:

- 1- The centre of the city which most of the commercial uses are concentrated, the centre is delineated with Kawa Street starting from Xani roundabout the point where Zaxo Street and Kawa Streets meet in the west direction till the roundabout of Dayêşireen in the east where the Kawa and Zozan Streets meet. Then the centre goes towards the south direction to the intersection of Şimikzera and Sulave Streets. From Reza Street to the intersection of Kanixişmana along with Şoreş Street to Êlul and Noharda Streets and to meet again with Xani roundabout. The area of the centre is estimated to be about 40 hectares.
- 2- Commercial ribbons in the arterial streets and other wide residential streets in; Srhildan, Zozan, Şimikzers, Sulav, Reza, Malta, Qazimehemed and Memozin Streets.
- 3- Commercial nucleuses serving neighbourhoods, they are of two types; planned centres like; Rabeea, Kanimehemdkê, Bintuka, Azadî, Reza, Asti and Şaxkê serving one neighbourhood or more, and the other type is the small shops scattered between residential areas serving a small number of houses.

4- Modern Malls and supermarkets appeared after 1998 such as Mazi, Biharecity and Karfor.

5- Specialised commercial zones such as car show (pîşangeha) and food depots.

During the last five decades of the city’s fast growth in term of spatial expansion and population growth the city centre has not grown beyond the old core, which attributed to;

- Continuation of the commercial use in the city centre by controlling high rates of commercial lands and the ability of the old core to receive more uses through transforming of residential uses to commercial.
- Adaptation of the old residential buildings to the new commercial uses by occupying ground floor or demolishing of the old buildings and establishing new high rise buildings.
- The integration and the functional interdependence between the commercial facilities and increasing the number of the specialised retail (e.g. Shops of shoes, kid’s clothes, women’s clothes, men’s clothes, dairy and sweets, goldsmiths...etc.).

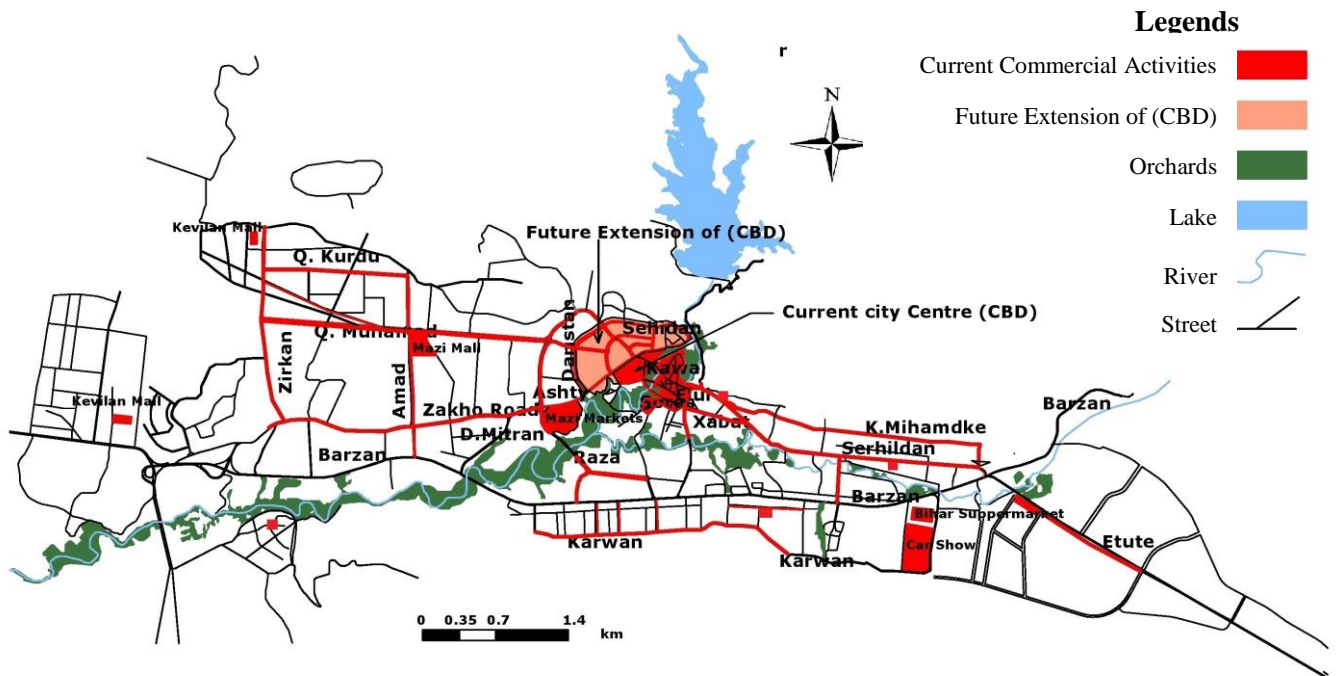


Figure 11- 9: Location of the commercial activities with future extension of the city Centre
 Source: Own construct based on survey, satellite images and municipality plans, 2015;
 Directorate of Constructive Planning in Duhok, 2015

The pattern and the type of commercial services have radically changed in term of the mode of displaying and the areas of the retails. The most essential features of the structure of the current commercial land uses can be listed below through the emergence of:

- 1- Increasing the area of the retails as an outcome of the new requirement to the commercial services.
- 2- Commercial ribbons along to the main streets in the city since the fourth morphological stages. The significance of these streets has depended on the type of commercial facilities and their spatial distribution.

- 3- Commercial zoning, which specialised to certain facilities in the city of Duhok such as car shows, whole sell retails for foodstuff and construction materials.
- 4- Modern supermarkets and malls after 1998 in the city.
- 5- Covered markets in the city centre as an attempt to revive the traditional covered markets (Qeyseri) to protect visitors from the hot of the summer and the rain in the winter– see Figure 11-10.



Figure 11-10: Panorama mall in the city centre of Duhok (left), covered markets (right)

Source: Photo by the Researcher in 2014

Street network is the main factor in changing and improving the structure of commercial land uses. The longitude shape of the city of Duhok has led stretching out commercial ribbons to the suburb areas. Opening of new streets in the city has increased the number of retail services in the streets.

11.2.3. Mixed Uses

The strategy of adopting vertical residential and commercial mixed use in the city of Duhok is formulated and pushed by demands and market forces. During the last decades, no clear indications show serious efforts towards promoting vertical mixed use in the new residential areas.

Mixed uses (commercial, industrial and residential) in the city centre of Duhok are back to the first morphological stages when the commercial facilities and some handcrafts occupied a part of the ground floor of the houses that faced the main streets or alleys (Al-Janabi, 1986; Province of Duhok, 1986). City core in the early stages was a mixed use of residential, commercial, light industries (handcrafts) and institutional facilities (e.g. mayor office and police station). The segregation of services and zoning strategy has contributed to spreading or aggregation of the urban services in the city after 1977. Many neighbourhoods in the city are experiencing mixed land use (e.g. Bazar, Birayetî, Nohadra and Grêbasê). These neighbourhoods are considered as new areas for the future extension of the city centre as indicated by the new guidelines for urban design in the city centre. Residential uses still exist in the centre, but they are on the way to be transformed into commercial uses because of the high price of the land.

In the city centre, commercial uses mostly occupy the ground floors, and the upper floors occupied by private clinics, offices, cafes, sports halls. There are some old residential buildings in the city centre which have adapted to the mixed use, such initiatives can be seen in Bazarê Çargoşe which specialised in offering man cloths. The tendency is to demolish the old buildings and replacing them with the new high rise buildings.

Vertical mixed uses in the city centre of Duhok are encouraged through constructing multi-story buildings coinciding with the diminishing of the low residential buildings. Most of the vertical initiatives of mixed uses are located in the city centre and streets such as; Q-Kurdu, Asti, Şehîdan, Serhildan, Xebat Qazîmuhammad, Amed. The mixed use initiatives also observed in Beruşkê Neighbourhood near to the Souq Asri intersection. This node hosts many residential, commercial and light industrial uses. Recently, many clinics have been moved to this place generating much traffic flows of pedestrians and vehicles causing continual congestion in the street.

In the collector and arterial streets, the commercial initiatives usually occupy ground floors for different facilities such as retails, shoes and clothes shops, restaurants, sweet shops, light industrial workshops (e.g. windows and doors), while residential uses occupy upper floors – see Figure 11- 11.



Figure 11-11: Mixed uses of residential and commercial uses; in the Apartment (left), and three stories House (right)

Source: Photo by the Researcher in 2014

Despite the implementation of the new high residential complexes in the city such as Dabîn, Zerîland and other complexes, there is a clear segregation of the uses inside these complexes with the absence of mixed uses initiatives.

In recent years, there is a trend of dedicating a single building to a single commercial use such as; clinics or offices or specialised retail, which can be observed in many places, especially in the city centre.

In broad, two patterns of mixed use development can be identified and approved by the municipality of the city of Duhok;

- Zones allowing mixed use development outright
- Zones allowing mixed use development conditional

Outright mixed use developments are located in the streets and city centre. Conditional mixed use developments are located in zones dedicated to the public services inside the residential neighbourhoods.

11.2.4. Industrial Zone

The industrial zone in the city of Duhok is situated in the neighbourhoods of Pîşesazî and Pîşangeha in the eastern part of the city – see Figure 11-12.

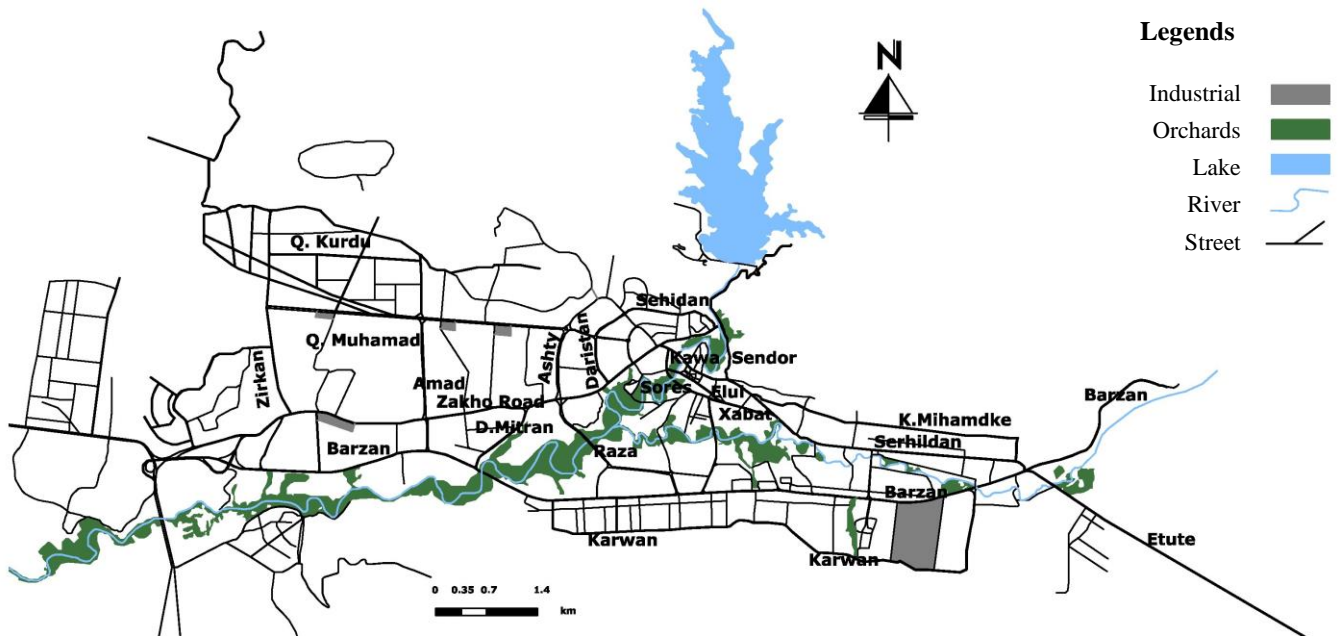


Figure 11-12: Locations of the main industrial activities

Source: Own construct based on survey, Directorate of Constructive Planning in Duhok, 2015; plans from Municipality of Duhok, 2014

There is a clear indication that the land, which developed for industrial uses after 1998, has increased. In 2014, the industrial activities have occupied 3.41% of the total area of the city which makes 196.52 hectares.

Pîşangeha zone provides the opportunity for the industrial business that carries out their operation in closed space, in addition to, carrying out light industries with limited outdoor activities such as blacksmith, carpentry, plumbing, and area of car services. According to the new master plan, the car service area in Pîşesazî will be transformed into Sêgê village about 22 km away from the city centre. This will have negative impacts on the residents' accessibility.

The two industrial zones lack services (e.g. car parks, paved roads, some vacant plots which are dedicated for open green spaces and have not developed yet) and they produce much traffic and congestion on pick hours in Barzan Street near to Biharcity intersection and the ring road in Nizarî sector. Pîşangeha industrial zone is surrounded by residential areas giving no space for any future extension. There are many industrial activities in Nizarkî such as mills, foodstuff, beverage factories and main food depots. Many industrial workshops are located in residential areas in the city.

In general, the industrial areas in the city of Duhok encompass three types of industrial activities;

- 1- Workshops of services, these workshops present services for repairing cars and other heavy machines.
- 2- Workshops of production, these workshops produce most required materials that entering building construction processes like; windows, doors, tiles... etc.
- 3- Production manufactories such as; foodstuff, construction, chemical, garments and mills.

The light industrial activities are concentrated in three main zones in the city of Duhok; Malta Xuwarê, Pîşangeha and Pîşesazî, they seize different amounts of land -see Table 11-2. The two areas of Malta and Pîşesazî are dominated by car services and heavy machines.

The main heavy industrial zone is located in Kwaş area outside the city between Duhok and Zakho road about 35 km west of the city of Duhok. Factories of canning jams and Kurdish cloths, which were located in the Malta neighbourhood, have transformed into the new zone of heavy industry in Kwaş.

Table 11-2: Distribution of the industrial land use according to activities in Duhok

Type of the Activities	Area (hectares)	Number of Activities	Percentage %
Service Workshops	33.21	985	16.9
Industrial Workshops	23.64	432	12.03
Manufactories	139.67	67	71.07
Total	196.52	1484	100

Source: Based on Al-Berwari, 2005 updated by the Researcher in 2014

11.2.5. Green and Open Areas

Public green open space and recreation area have noticeably increased inside the municipality's boundary in relation to the other land uses, this was a reflection of the realisation and recognition of the authorities to the importance and the need for more open spaces inside the city.

In term of running and managing public green open space inside the city of Duhok, it can be classified into;

- Municipality-owned parks (e.g. Azadi and Barzani parks), these parks are owned and managed by the municipality. The numbers and the quality of the provided facilities have improved in recent years.
- Private-owned parks inside the city (e.g. Dreamcity Park, Zeri Park), these parks are investment projects run by local private companies by charging an entry fee for every visitor. These parks host many facilities and provided services, therefore, attracting many visitors. In general, the private-owned parks are better in terms of the quality and the provided facilities than the public parks.
- Private-Rented Parks (e.g. Baxçêgiyneweran), these parks rented by the private sector from the municipality of Duhok. The municipality has the authority to control the fees and the provided services in these parks.

Public green space in the city of Duhok in term of the area and the type of the provided services can be divided into types which are;

- 1- Community Green Spaces are located inside the neighbourhoods their area varies between 0.2 to 2 hectares. These green areas offer space for a small community in the neighbourhoods. They are equipped with games for children and other facilities (e.g. benches). Some of the neighbourhoods have more than one of these community parks, while others don't have any, especially in unguided development neighbourhoods and urbanised villages.
- 2- District Green Parks are designated for more than one neighbourhood and accessible to many residents (District Park). Mainly, these green spaces are located on the main

arterial roads or adjacent to the borders of two or more neighbourhoods. These parks have some services such as; small kiosks, cafes, fast foods and children play games (e.g. Azadî Park). All of these parks are situated in the west and south part of the city within the planned neighbourhoods and they are free of charges – see Figure 11-13 and Table 11-3.

- 3- City Park: the area opposite to the campus of the University of Duhok between Qesara, Geverkê and Malta neighbourhoods is reserved as main city park according to the current master plan, it has not been developed yet. The estimated area of this park is 96 hectares.
- 4- Green lines: it is including roadside and medians greenery at both sides of the main roads and streets in the city, often this greenery has been threatening and suffers from lack of maintenance and drought. In most areas, the place of the planted trees and greenery on roadsides have not been designed and planned according to streetscape requirements.

Table 11-3: Main green parks in Duhok

No.	Name of parks	Location	Area (hectare)	Type of Management
1	Azadî	Reza	10.86	Public
2	Barzanî	Bintuka	6.70	Public
3	Zirka	Zirka	3.85	Private
4	Geli	Duhok Dam	7.84	Private
5	Dream City	Mazî	9.49	Private
6	Zerîland	Masîkê	2.11	Private
7	Masîkê Rojava	Masîkê	2.98	Public
8	Giyanevrân	Behdînan	2.00	Private
Total			45.83	

Source: Own construct based on survey; Directorate of Constructive Planning in Duhok, 2015



Figure 11-13: Public green space inside the neighbourhood (left), Azadi City Park (right)

Source: Photo by the Researcher in 2015

The mountainous nature of the land in the city of Duhok has granted the city with many natural gullies descending from the mountains to Duhok valley (Rûbarê Duhokê). These green fingers provide many benefits to the city through working as; air passages to soothe the city's environment in summer, green lunge, corridors for wild animals and birds and maintain water regime in the area. Most of these corridors were destroyed and levelled to be used for different uses (e.g. Şivçerdan, Gelyê Duhokê, Şoreş Bridge) or has been concreted such as the Valley of Duhok which affected the entire ecosystem in the valley – see Figure 11-14.



Figure 11-14: Filling up green fringes in Şindoxa (upper left), Lack of required furniture in Public Green Spaces (upper right), Concreting of the Duhok Valley (below left), and Building in the Green fringes (Below right)

Source: Photo by the Researcher- 2014

In some neighbourhoods, there is a collaboration between the residents and the municipality for developing and managing community gardens. The residents whom their houses face these gardens financially support the municipality to develop the gardens, such attempts and initiatives prevailed in the newly developed neighbourhoods which inhabited by middle and high incomes families such as Behdinan, Sêgirka and Botan neighbourhoods.

In other neighbourhoods, the undeveloped gardens have been exploited by the residents as a small garden for producing vegetation and fruits or as private gardens. These gardens, many of them have illegally developed or with permission from the municipality after paying certain fees.

There is a lack of open spaces such as plazas, public gardens and other entertainment places inside the city centre. In general, the following deficiencies in green and open spaces can be observed in the city of Duhok:

- 1- Green open spaces have not been spatially distributed in the city. Most of the green open spaces located in the west and south part of the city, while many neighbourhoods

lack public green open space such as; Xebat, kanîmehmedkê and Şêlê neighbourhoods.

- 2- Some of the public green parks are situated on the main roads. The noise disturbs the visitors. Parks and green spaces require tranquillity and quietness.
- 3- Many of the green open spaces have not been developed in the old neighbourhoods which established before 30 years, while in some new neighbourhoods these green open spaces have been developed.
- 4- The undeveloped green open spaces in many neighbourhoods have turned into a place of construction debris,
- 5- The available green open spaces miss adequate planning standards, proper allocation and facilities.

11.2.6. Urban Services

Urban services include all the activities that are practised by the government or private sectors to provide facilities and services to satisfy the social, scientific, health, mental, psychological and environmental needs of the population inside the city (Al-dilimi, 2009). These services are part of the land use that complemented other land use to identify the city's form.

Educational services occupy the highest percentages of the land developed for implementing of different types (e.g. kindergarten, primary schools, secondary and preparatory schools, basic educational centres, vocational centres and universities...etc.), followed by health services which include (hospitals, health centres, clinics) occupies 40.9 hectares concentrated in the Serbesti neighbourhoods -for more details see Section 12.7 in Chapter Twelve.

Institutional and administrative services are represented by all governmental and non-governmental offices that manage the public affairs in the city (e.g. municipality, land registration, Directorate of Natural Resources, Directorate of Electricity, Statistical offices, police stations...etc.). There is a clear concentration of these facilities in the Newroz neighbourhood and along Barzan Street in the Nizarî sector. The land dedicated for development to the different urban services depended on the types of urban services - see Table 11-4.

Table 11-4: Distribution of land use between different urban services

Type of the Service	Area (hectares)	Number of Services	Percentages % (total area of the city)
Educational	402.63	153	6.97
Health	40.9	43	0.71
Institutional	55.6	97	0.96
Religious	19.54	65	0.34
Total	518.67	358	9.00

Source: Own construct based on survey results

11.2.7. Street Networks

The fundamental function of the street network is to connect and harmoniously interact with different land uses creating smooth movement and mobility in the city. The street pattern

plays a great role in shaping and identifying the form of any city. Generally speaking, the street pattern in the city of Duhok as a whole gives the impression of longitude and semi-radial pattern. The street pattern in Duhok city is reflecting planning and design approaches adopted in different morphological stages of development, also the city's topography contributed to the formulating and shaping of current street networks –see Figure 11-15.

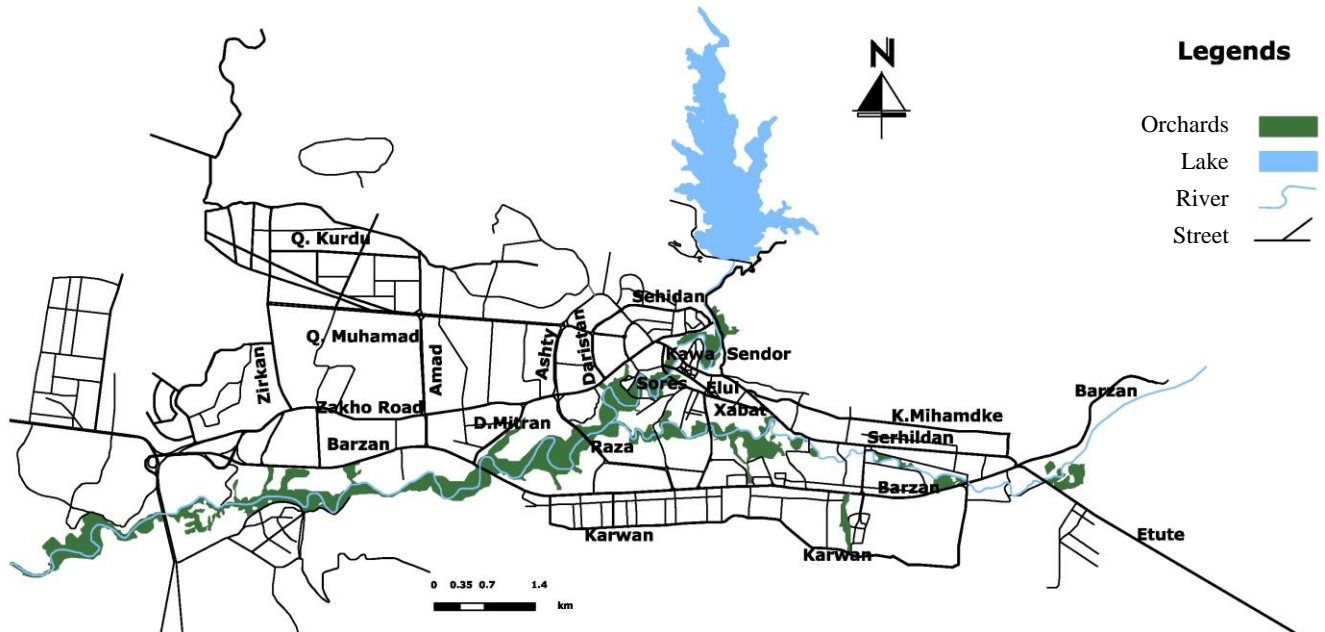


Figure 11-15: Main street network in the city of Duhok

Source: Own construct based on satellite images of the city of Duhok and Municipality plans, 2015; Directorate of Constructive Planning in Duhok, 2015

The following street patterns can be observed in the city of Duhok:

- 1- Organic pattern (Altstadt), this pattern is irregular and mainly can be observed in the old core of the city and prevailed in the first and second morphological stages of the city constraining efforts to provide essential infrastructure. This pattern is dominated in the neighbourhoods of Bazar, Birayetî, Şêlê, Xebat, Kanîmehmedkê and Gelî. The average width of the streets in these neighbourhoods is between 3.00 and 9.00 meters.
- 2- Radial pattern, this pattern cannot be clearly observed in the city of Duhok. It is observed in Kawa Street and Êlul, these streets penetrate the old neighbourhoods and considered to be the main important streets in the city of Duhok, they meet at Bedirxan and Naur intersections. Zaxo Street in the western direction and Zonzan Street in the east direction are two extensions of Kawa Street in both directions of the city. Qazî-Mehemed Street starts from Azadi intersection to form the main access penetrating most developed neighbourhoods in the western part of the city.
- 3- Grid Pattern (Bilateral), this pattern can be divided into types; iron grid and loose grid. The iron grid is predominated in the new neighbourhoods developed after 1977. It is mainly observed in the Ronahî, Bintuka, Azadî, Sêgirka, Medîya, Botan, Behdînan, Masîka, Masîka Rojava and Malta Serî. This pattern is better accommodating different types of infrastructure and more flexible to any future changes, but it is not suitable for the mountainous and sharp slop land.

- 4- Curvilinear pattern, this pattern is more suitable for the city of Duhok. Mainly can be observed in arterial streets of Daristan, Barzan, Şehîdan, Asti, Zaxo, Şoreş, Beruşkê and Êtûtê neighbourhoods.
- 5- Linear Pattern, long linear streets are rarely found in the city of Duhok due to the mountainous and sloppy nature of the land in the city. It is observed in the newly developed neighbourhoods in the western part of the city where the land is flatter such as; Qazîmuhemmed, Q-Kurdu and Amed Streets.

Based on the capacity and traffic flow, the following classes of streets can be observed in the city of Duhok:

- 1- Residential alleys have a width of less than 8 m; these streets are observed in the old neighbourhoods and all the unguided development areas in the city. This class of street is without sidewalks and primary paved with concrete and has a shallow channel in the middle for discharging sewage and rainwater.
- 2- Residential streets with 8m and 10m width, these streets are located inside the residential areas giving character to the neighbourhoods.
- 3- Collector streets are mainly found in the border of residential areas and work for collecting the traffic flows, the width of these streets are 12m,15m
- 4- Main Arterial streets are the streets of 25m, 30m, 40m width and more. These types of streets are considered as main channels and major roads for carrying the traffic flow of vehicles. These arterial streets in the city are hosting commercial ribbons (e.g. Q-Kurdu and Amed). Most of the traffic jam is observed in the nodes of these streets.
- 5- Transit streets carry traffic flow from Duhok to Erbil, Mosul, Amêdîyê and Zaxo. Barzan Street 40m width, Zozan and Zaxo Streets could be considered as transit roads.

The third master-plan of Duhok in 1998 suggested a street loop around the city of Duhok to confine farther illegal developments at the edge of the neighbourhoods in Nizarî and to increase mobility in the city. In practice, the loop failed to restrain further illegal developments beyond the loop. The loop partially implemented in some areas, Karwan Street in Nizarî sector is part of that loop.

The streets occupy about 19.08% of the total land use of the city of Duhok covers 1099.41 hectares. The following table shows the length and area of each class of streets- see Table 11-5.

Table 11-5: Classification of streets in the city of Duhok

Street category	Number	Width m	Length m	Area (h)	Area Percentage %
Residential Alley	432	3.5-9.0	14052.4	9.83	0.89
Residential Str.	3452	9.0 -12.0	695189.12	680.19	61.87
Collector	512	12.0-15.0	82673.33	100.74	9.16
Arterial	63	21.0-30.0	99434.8	246.40	22.41
Transit	1	31.0-40.0	15560.35	62.24	5.66
Total			906910	1099.40	100.00

Source: Own construct based on calculations and measurements from plans using ArcView 10 and AutoCAD

Street sidewalks in the city of Duhok have lost their function as ways and channels for safe movements for pedestrians. Main streets' sidewalks in the city centre have been exploited for displaying goods. There is a great deficiency in streets' furniture and infrastructure in the city (e.g. height of the sidewalk, the type of the pavement, lack of facilities for disabled people, garbage bin, greening) - see Figure 11-16.

The streets which carry the highest traffic volume in the city centre are Zakho Road, Raza Road-Şoreş Bridge, the eastern section of Kawa Road to the Souq and Dasinya, Şehîdan Road, Elul Road, Azadi Road and Galy Way. Also, high traffic volume observed in the streets of Qazî-Mehemed, Mediya, Beruşkê and the intersections of Barzan Street. It could be said that all the main arterial streets and nodes in the city are congested during day time especially during peak hours (Omer, 2010).



Figure 11-16: Pedestrian movement and sidewalks in Elul Street
Source: Photo by the Researcher in 2014

To address the issue of traffic calming in the city centre the municipality of Duhok instituted daytime on-street parking restrictions on the main streets of Kawa and Elul and their extensions. These regulations are not effective and traffic police are not able to control it. To offer off-street parking four multi-storey car-parks in the city centre have been constructed (e.g. Panorama, Oruzdi, Duhokland and Bira), many of these constructions do not comply with planning standards and municipality regulations. Other vacant plots in the city centre have currently used as private car parks. Each of these car parks approximately has an area of 300 -1400 m². The available car parks are not enough to accommodate the high number of visiting private cars to the City Centre - see Figure 11-17.



Figure 11-17: Main terminal and car park (left), Kawa multi-story car park (right)
Source: Photo by the Researcher in 2014

Private-car dependency on mobility is the main cause of high traffic flow in the city of Duhok. There is an uncontrolled car growth rate in the Province and the city of Duhok. The number of private cars in the province of Duhok has exponentially increased to 183209 vehicles in 2014. The percentage of private cars is 56.1%, Taxies 15.5% and heavy vehicles 28.4% with an annual growth rate of 83% between the years 2013 and 2014 (Directorate of Traffic in Duhok). The natural annual growth rate for private cars is 4% according to international standards (Omer, 2010).

To facilitate citizen’s mobility, there is a sort of collaboration between the Municipality of Duhok and the Syndicate of Transportation with the private owners of minibuses to carry passengers to limited areas with suitable fares against to subsidies by the local government through the offering fuel at a cheaper cost. These buses only move along to the main arterial roads without accessing other streets and have no fixed arrival and departure timetable. The following table displays the current routes and average travel time²⁶ for the lines of public transportation in the city of Duhok – see Table 11-6 and Figure 11-18.

Table 11-6: Current public transportation routes in the city of Duhok

Line	Destination	Length of Line (m)	Number of Nodes	Number of Buses	Average Daily Trips	Average Travel Time (minute)
Beruşkê	Sinaa	5026	6	124	4	25
Diyari	Êtût	10055	9	70	3	32
Reza	Qesara	13246	13	112	3	27
Serhılan	Sinaa’a	6734	3	62	4	30
Şehîdan	Masik	6668	10	50	2	45
Malta	Tenahî	8532	10	54	3	35
Zirka	Kêvilan	17672	14	52	5	37

Source: Own construct based on measurement, observation and Survey

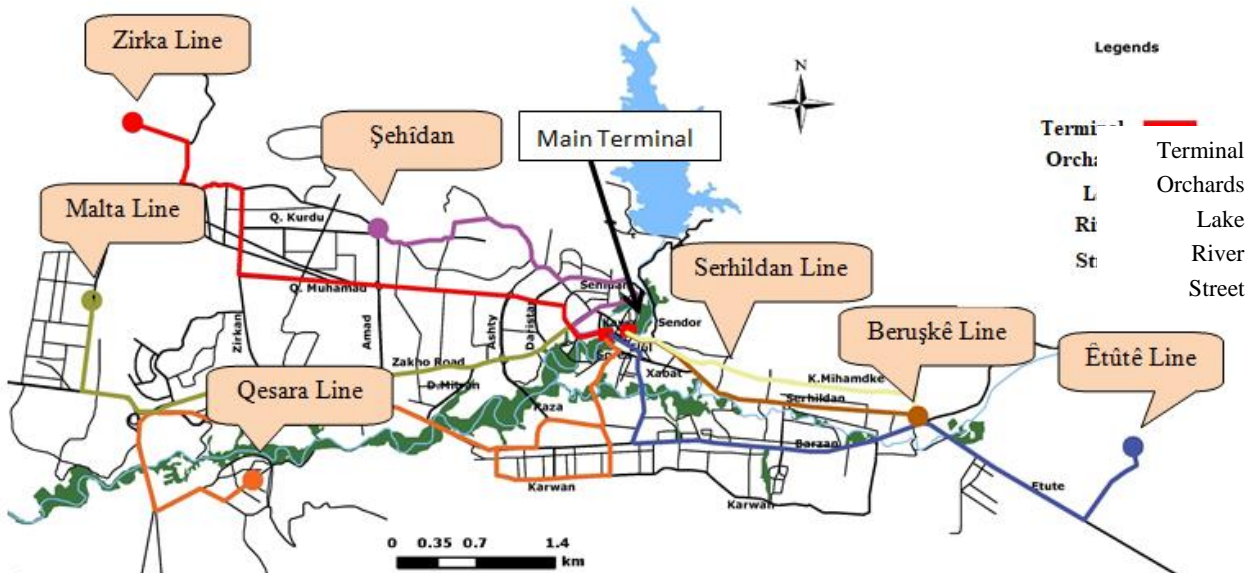


Figure 11-18: Main public transportation routes and terminals in the city of Duhok
 Source: Own construct based on surveys; Directorate of Constructive planning in Duhok, 2015; satellite images; updated master plan of Duhok, 2015

²⁶ - For estimating the time, the researcher calculated average time with cooperation of the drivers of minibuses in the morning, afternoon and evening for one week between 13th – 20th of Sept, 2014

There are only two terminals in the city centre. All the daily trips outside and inside the city begin at this point. One is situated under the Şoreş Bridge in Noherda neighbourhood feeds the western and southern part of the city for internal and external trips, and Serhildan terminal is situated in the Dasinya neighbourhood and covers the eastern part and only for internal trips. These two terminals are very simple, they lack services, and do not comply with the standards of modern terminals. All the neighbourhoods around to the city centre such as; Şêlê, Xebat, Gelî, Kanixişmana, Nohedra, Asti, Grêbasê and Newroz are not provided by the service of the minibuses, because these neighbourhoods are close to the city centre and citizens can walk.

Traffic congestion and mobility in the city especially in the peak hours in the daytime, is a big challenge facing the planning authorities in the city. This is a daily concern of the residents to transverse between different parts of the city to access necessary services and reach their destinations. The main arterial streets are suffering from random growth of the traffic volume and cross-cutting with pedestrian flow. The following are the main characteristics of the street network in the city:

- 1- Unguided and informal developments have affected the pattern of the streets,
- 2- Loss of the connection between all the parts of the city,
- 3- Narrow streets and limited numbers of lanes,
- 4- Most of the streets are not designed and planned according to traffic engineering and planning standards, there are no fixed bus stops.
- 5- Absence of public transportation in the city of Duhok, Private-cars and taxies are the main means of transportation in the city,
- 6- Not encouraging walking, biking,
- 7- Shortage of car parks in the city centre,
- 8- There are no modern terminals in the city and fixed timetable for arrival and departure, and
- 9- Absence of sound street furniture such as sidewalks, shoulders, ditches, landscaping and on-street parking... etc.

11.3. Population Density

The city population has reached 355193 inhabitants in 2014 at the growth rate of 18.97 %, and at the annual rate of 3.16%. The total developed area has increased to cover 5763 hectares in 2014 at an annual growth rate of 3.54%. The gross population density registered 78.67 persons per hectare in the sixth morphological stage, while currently has dropped down to 61.63 persons per hectare displaying a sharp decline in the amount.

The total number of population of the city of Duhok is distributed between 48 neighbourhoods. In general, population density is not evenly distributed. The density in many neighbourhoods has changed towards more densification especially in the neighbourhoods of Bazar, Şêlê, Xebat, Beruşkê and Serhildan. Many migrants settled in these neighbourhoods who came from other cities in Iraq (Directorate of Statistics of Duhok, 2015). The neighbourhoods in the city of Duhok differ in terms of their size, population, density. The

gross density of neighbourhoods (GDN)²⁷ in the city of Duhok shows clear differences - see Table 11-7 and Figure 11-19.

Table 11-7: The number of neighbourhoods and their population in the city of Duhok

No.	Neighbourhoods	Area (Hectare)	Population (Persons)	Gross Density (Per./hect.)
1	Aşti	61.85	6530	105.58
2	Azadî	30.03	4843	161.27
3	Avrocîy	140	8507	60.76
4	Behdînan	119.53	3282	27.46
5	Beruşka Bakur	12.27	3456	281.66
6	Beruşkê	115.89	33135	285.92
7	Besîre	69.87	4066	58.19
8	Bazar	5.5	570	103.64
9	Bintuka	23.9	4685	196.03
10	Botan	105.52	4694	44.48
11	Bîrayetî	6	987	164.50
12	Dasînya	39.93	704	17.63
13	Dîyarî	50.17	9994	199.20
14	Êtutê	431.85	6549	15.16
15	Gelî	41.1	9084	221.02
16	Geverkê	28.98	2918	100.69
17	Grêbasê	23.71	4569	192.70
18	Kanîxîşmana	22.67	4885	215.48
19	Kanîmehmedkê	62.87	15341	244.01
20	Kevelan	64.26	2954	45.97
21	Malta Jorî	349.22	16962	48.57
22	Malta Jerî	161.09	11729	72.81
23	Masîka Rojava	46.11	6472	140.36
24	Masîka	79.1	8568	108.32
25	Mazî	160.19	4324	26.99
26	Mîdiya	80.55	5462	67.81
27	Mîhabad	29.5	5427	183.97
28	Nawroz	25	3476	139.04
29	Nohadra	22.5	2504	111.29
30	Nîzarkê	284.7	10569	37.12
31	Pêşangeha	129.27	466	3.60
32	Pîşzasî	23.91	465	19.45
33	Qesara	142.45	6512	45.71

²⁷ - Gross Density Neighbourhood is the number of persons, Households, dwellings unit per hectare of the total Neighbourhood area.

34	Reza	169.99	10980	64.59
35	Ronahî	95.23	9733	102.21
36	Serhildan	143.76	39519	274.90
37	Sêgirka	41.58	5664	136.22
38	Serbestî	72.11	2589	35.90
39	Şehîdan	24.25	2696	111.18
40	Şaxkê	107.78	10363	96.15
41	Şindoxa	122.4	10797	88.21
42	Şêlê	26.91	9363	347.94
43	Şoreş	42	6355	151.31
44	Tanahî	290.53	10981	37.80
45	Xabat	30.5	10657	349.41
46	Zanko	311	1609	5.17
47	Zirka	151.13	9035	59.78
48	Zozancity	35.34	163	4.61
49	Others	1109	0	0.00
Total		5763	355193	61.63

Source: Own construct based on statistics of the population from Directorate of Statistics of Duhok, 2015; satellite images; plans from the Municipality of Duhok, 2015

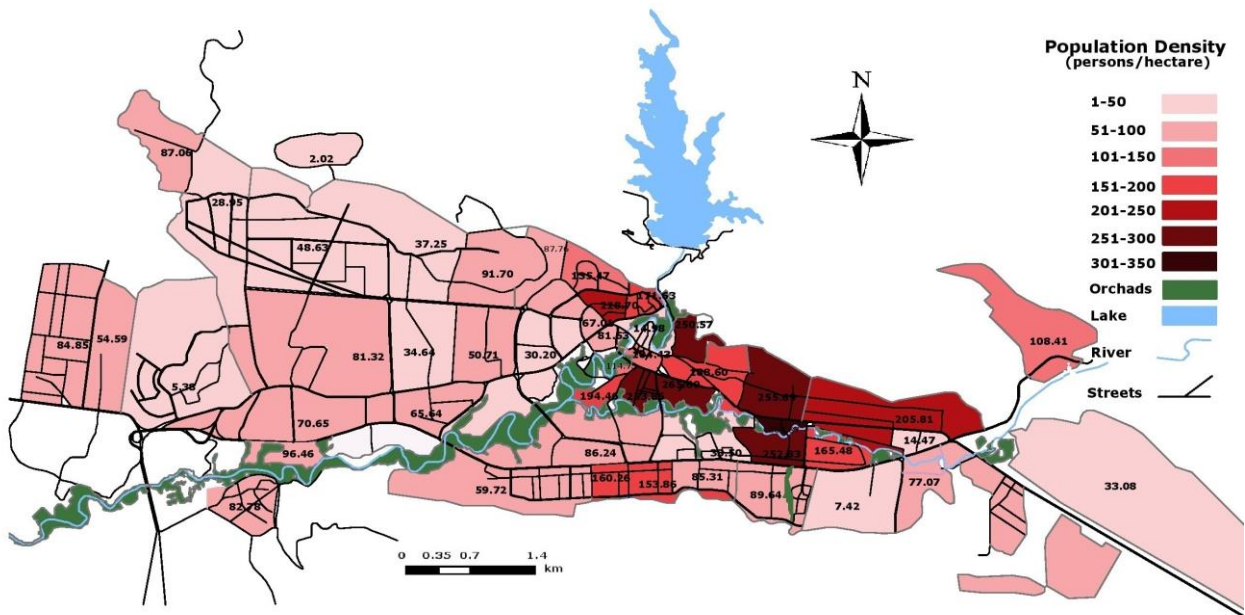


Figure 11-19: Distribution of gross density neighbourhoods (GDN) in Duhok

Source: Own construct based on survey and plan analysis; Directorate of Statistics of Duhok, 2015; Directorate of Constructive Planning, 2015; Satellite image, 2014

11.4. Families Size²⁸, Household Size²⁹ and Occupancy Rate³⁰

The estimated average size of the family in the city of Duhok is 6.9 persons per family (Directorate of Statistics of Duhok). The average is compatible with the Iraqi average family

²⁸ - Family size is the number of population over number of families

²⁹ - Household size is the number of families over number of houses

³⁰ - occupancy rate is the number of persons over the number of houses

size referring that Duhok relatively keeping big families' size (Iraqi Living Conditions Survey, 2004). The neighbourhoods which display 6.0-6.9 persons per family dominate other families' sizes. The calculations show that neighbourhoods with big family sizes are concentrated in the eastern part of the city and around the city centre; these neighbourhoods are Şêlê, Xebat, Gelî near to the city centre and Beruşkê, Beruşka Başur, Kanimehmedkê and Serhildan in the northeastern part, while the neighbourhoods in the western part show fewer family sizes. Overall, the families with high and medium incomes concentrate on the western and southern parts of the city, while medium and low-income concentrate in the eastern part of the city (Directorate of Statistics of Duhok) – see Table 11-8 and Figure 11-20.

Table 11-8: Neighbourhoods' Population in the city of Duhok

No.	Neighbourhoods	Population (Persons)	Number of Families	Number of Houses	Family Size (population/no. of families)	Household Size (family/house)	Occupancy Rate (persons/house)
1	Aşti	6530	1070	1039	6.1	1.03	6.28
2	Azadî	4843	711	697	6.81	1.02	6.95
3	Avrocîty	8507	1359	1359	6.26	1	6.26
4	Behdînan	3282	497	487	6.61	1.02	6.74
5	Beruşka Bakur	3456	497	432	6.96	1.15	8.00
6	Beruşkê	33135	4707	4057	7.04	1.16	8.17
7	Besîre	4066	604	629	6.73	0.96	6.46
8	Bazar	570	85	88	6.68	0.97	6.48
9	Bîntuka	4685	769	687	6.09	1.12	6.82
10	Botan	4694	689	711	6.81	0.97	6.61
11	Bîrayetî	987	126	137	7.81	0.92	7.19
12	Dasînya	704	114	111	6.18	1.03	6.37
13	Dîyarî	9994	1521	1422	6.57	1.07	7.03
14	Êtutê	6549	953	973	6.87	0.98	6.73
15	Gelî	9084	1320	1148	6.88	1.15	7.91
16	Geverkê	2918	428	386	6.81	1.11	7.56
17	Grêbasê	4569	636	600	7.18	1.06	7.61
18	Kanîxişmana	4885	681	625	7.17	1.09	7.82
19	Kanîmehmedkê	15341	2176	1960	7.05	1.11	7.83
20	Kevelan	2954	502	512	5.89	0.98	5.77
21	Malta Jorî	16962	2403	2310	7.06	1.04	7.34
22	Malta Jerî	11729	1671	1591	7.02	1.05	7.37
23	Masîka Rojava	6472	970	1021	6.67	0.95	6.34
24	Masîka	8568	1245	1221	6.88	1.02	7.02
25	Mazî	4324	767	790	5.64	0.97	5.47
26	Mîdiya	5462	797	805	6.85	0.99	6.78
27	Mîhabad	5427	699	624	7.76	1.12	8.69
28	Nawroz	3476	521	537	6.67	0.97	6.47
29	Nohadra	2504	389	423	6.44	0.92	5.92
30	Nîzarkê	10569	1438	1396	7.35	1.03	7.57
31	Pêşangeha	466	68	70	6.88	0.97	6.67

32	Pîşzasî	465	73	68	6.38	1.07	6.83
33	Qesara	6512	1003	947	6.49	1.06	6.88
34	Reza	10980	1619	1514	6.78	1.07	7.25
35	Ronahî	9733	1664	1486	5.85	1.12	6.55
36	Serhildan	39519	5443	4994	7.26	1.09	7.91
37	Sêgirka	5664	852	767	6.65	1.11	7.38
38	Serbestî	2589	323	313	8.02	1.03	8.26
39	Şehîdan	2696	436	411	6.19	1.06	6.56
40	Şaxkê	10363	1495	1452	6.93	1.03	7.14
41	Şindoxa	10797	1551	1477	6.96	1.05	7.31
42	Şêlê	9363	1381	1233	6.78	1.12	7.59
43	Şoreş	6355	964	918	6.59	1.05	6.92
44	Tanahî	10981	1634	1513	6.72	1.08	7.26
45	Xabat	10657	1563	1395	6.82	1.12	7.64
46	Zanko	1609	194	200	8.31	0.97	8.06
47	Zirka	9035	1073	1095	8.42	0.98	8.25
48	Zozancity	163	27	27	6.09	1	6.09
Total		355193	51730	48660	Average 6.81	Average 1.04	Average 7.08

Source: Own construct based on Document analysis; Data from Directorate of Statistics in Duhok, 2015

The average household size in the city of Duhok is 1.04 family/house indicating a shortage of housing affordability which is estimated at 3070 units to cover the needs of the population. The neighbourhoods which are under development show less household average. The minimum average household size is (0.92 families per house) registered in the Brayetî neighbourhood. This neighbourhood is the old city core witnessing transformation towards commercial use and has many houses occupied by commercial services and no more useable houses for residential services. The maximum average household of 1.16 families per house is shown in the Beruşkê neighbourhood.

The minimum average family size in the city is (5.64 persons per family) registered in the Mazi neighbourhood as one of the sparsely populated areas. This neighbourhood is dominated by other uses and high-rise residential buildings. The maximum average family size is (8.42 persons per family) shown in the Zirka neighbourhood. This neighbourhood dominated by big plot sizes of 300 m² and it is one of the newly developed areas in the city of Duhok.

The average occupancy rate in the city is 7.08 persons per house. Basically, the occupancy rate depends on the size and the type of dwellings and the number of rooms, therefore, it varies from 1 person per dwelling to more than 11 persons per dwelling (Ministry of Planning in Iraq, 2008). Most of the high rate occupancy neighbourhoods are located in the eastern part of the city. These neighbourhoods suffer from overcrowding, especially, Beruşkê, Beruşka Başur and Kanimehmedkê – see Figure 11-21.

In recent years, many housing projects have been implemented to overcome the housing shortage in the city, but these projects were not able to offer houses at a low price to the public. The high cost of single-family houses and apartments in these newly established housing projects (e.g. Avrocity, Dabin and Kayar) has restrained low-income families to possess (Board of Investment in Duhok).

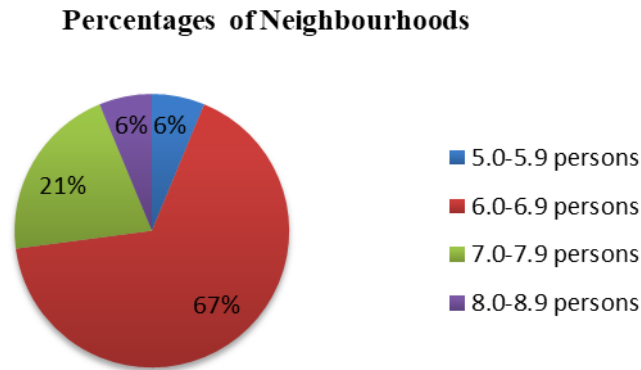


Figure 11-21: Percentages of the neighbourhoods in relation to the size of families in Duhok
 Source: Own construct based on analysis of documents from General Directorate of statistics in Duhok, 2015; Duhok municipality plans, 2015; Directorate of Constructive Planning in Duhok, 2015

11.5. Conclusion

To understand a particular urban form in an urban area needs a previous understanding of the physical characteristics of the context. Every urban context exposes different urban forms and structures at different times. Urban form and structure of Duhok have been characterised by many features reflecting the effect of rapid development. The physical characteristics of the Duhok city manifest a changing pattern of the dynamic urban development reflecting the socio-economic and political trends in the context.

There is a clear transformation from the local pattern of open-plan pattern towards the close-plan. High-rise residential housing is relatively new in the context of Duhok, while the low-rise residential housing is predominated and highly contributed to the city sprawling. The unguided developments and informal housing are big challenges in bringing sustainability to the city, it needs to be dealt with through elaborated framework and strategies to promote urban sustainability.

Commercial uses in the city of Duhok are mainly concentrated in the city centre and along to the arterial roads. The pattern and the type of the commercial uses have radically changed in recent years. Commercial activities in the city are highly dependent on the transforming of the residential uses to the commercial uses in the streets which have certain width instead of creating commercial nucleus in the neighbourhoods and sub-centres in other districts in the city.

Vertical mixed use of residential and commercial uses is prevailed and mainly located along the arterial and main streets. The horizontal mixed uses in the neighbourhoods are promoted through the mixing of residential, educational, health and green spaces.

Industrial activates in the city are concentrated in the two zones. The first zone is providing car repairing and maintenance services and located in the eastern part of the city. The second zone is a mix of small factories and cold stores and car shows.

The amount of green open spaces and their types in the city which characterised by inefficient management have great impacts on the city environment. Most of the natural green

structures all over the city have been destroyed, although the green structures provide recreational, aesthetic and ecological advantages to the city.

The city is highly dependent on private cars as the main means of mobility. The city lacks a modern transportation system; the current system of hiring mini-buses for mobility is not effective.

Distribution of the population density showing that the neighbourhoods around the city centre and eastern part of the city demonstrate high density. The moderate density displays in the neighbourhoods in the south and west part of the city. The low density manifests in the newly developed neighbourhoods. The high percentages of big families, occupancy rates and household size concentrate around the city centre and east and south part of the city. In general, the city needs a balanced case of density distribution to support any future programmes to promote public transportation system.

The characteristics of the city reflect the fact that various criteria are interrelated. The land use pattern is related to the distribution of the various zones with the availability of open green spaces. Likewise, the mobility and accessibility of the residents are highly concerned with the availability of an effective public transportation system in the city.

Chapter Twelve: Performance of the Urban Form and Structure of the city of Duhok

12.1. Introduction

To assess the physical performance of the city of Duhok through using various indicators helps to develop guidelines for future physical development. The defects and the weaknesses in planning and managing have affected the function and the performance of the urban form and structure of the city. These imperfections manifest through the emergence of a range of problems in the urban form and structure of the city. The following sections try to assess the functional and spatial aspects relating to compactness, density change, proximity to services, availability of open green spaces, the efficiency of public transportation and diversity in the city of Duhok.

12.2. Compactness and Sprawling

In some phases city of Duhok yielded to its old spatial outline and in others captured the surrounded rural area imposing certain characteristics and aspects to the new spatial expansion which easily could be distinguished and identified. One of the main natural determinants of the urban growth in the city of Duhok is the topographic features of the location of the city, leading the development to a longitudinal shape instead of circular or concentric shape. Therefore, the new development areas have expanded along to the mountain directions and creating new accesses polling out the commercial and high rent area along to the newly developed streets.

The land use calculations in Duhok in different stages consolidate the prevailing conviction that residential use dominates other uses, which sums about two-thirds on average in early stages with a ratio ranging between 50.48% to 68.26% from the total area. There is a clear indication that the percentages of the area designated for residential use were decreasing year after year, while the amount of residential land increased from 19.52 hectares to 2909.16 hectares in 2014 – see Figure 12-1.

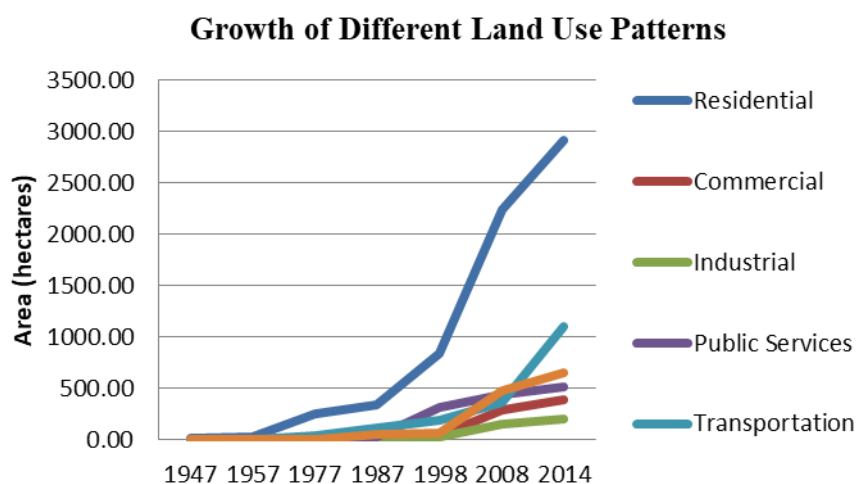


Figure 12-1: Area of different land use patterns in the city of Duhok

Source: Own construct based on Directorate of Constructive Planning in Duhok, 2015; Municipality of Duhok, 2015; Hirori, 2009; Al-Feqeeh, 1999; Al-Janabi, 1985

Increasing the amount of other land uses in the city determined the rising needs of urban services. The percentages of the lands devoted to the different uses were not compatible with the increasing of the residential areas in the city. Therefore, the share of each inhabitant from other uses in various morphological stages oscillated and did not rely on urban planning considerations and the actual needs of the population –see Figure 12-2.

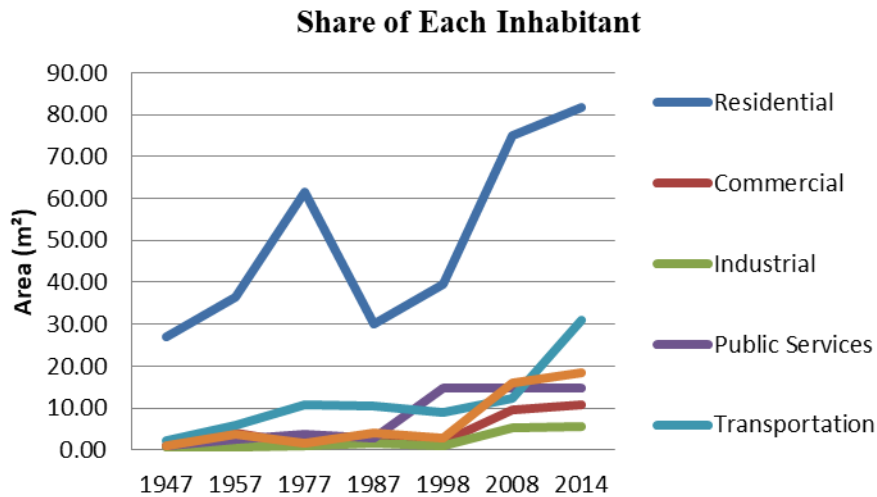


Figure 12-2: Share of each Inhabitant from different land use patterns in the city of Duhok
Source: Own construct based on data from the Directorate of Constructive Planning in Duhok, 2015; Municipality of Duhok, 2015; Hirori, 2009

The city of Duhok in some stages was under excessive pressure leading to unexpected growth– see section 10-2 in Chapter Ten. The period between 1957 till 1987 displayed a high annual rapid urban growth rate reaching 26.78 and later dropped down to 12.32 at the end of 1988. The following years, the city witnessed a slow growth compared to the previous years. After 1991, there was an increase in the annual rate to 17.03 at the end of 2008, and later on registered less value in 2014, which was 3.54. The city has extended to reach its maximum size through occupying all the areas between the mountains depleting agricultural areas around the city with exception to the rocky lands in the steps of the mountains. The remaining rocky lands could be used as a potential for future expansion if there is a rational planning perspective. The rapid and unexpected growth placed planning institutions in the city of Duhok under pressure to offer public services and essential infrastructures.

By comparing the spatial urban growth rate and population growth rate, it is obvious that after the year 1987, the rate of spatial urban growth increased, while the population growth rate declined. The supported calculations display a loss of the compacted pattern in favour of more dispersing and sprawling in recent years -see Figure 12-3.

The share of each inhabitant in the city from all land uses increased from 33.09 m² per inhabitant to 162.25 m² per inhabitant in 2014 reflecting the high rate of land consuming³⁰ in the city. The share of each inhabitant increased five times since 1947. According to the Iraqi Housing standards the maximum person's share from all urban areas in the city is 101.25m²/Person, the current rate is more than what recommended by the planning standards

³⁰ - Land Consuming Rate (LCR)= developed area of the city (hectares) / population (persons), and is a measure of compactness indicating a progressive of spatial expansion of a city

by one and a half, showing that, the municipality of Duhok was not able to rationalise the land consumption and control over the process of urban development to stop encroaching more agricultural land in the city - see Figure 12-4.

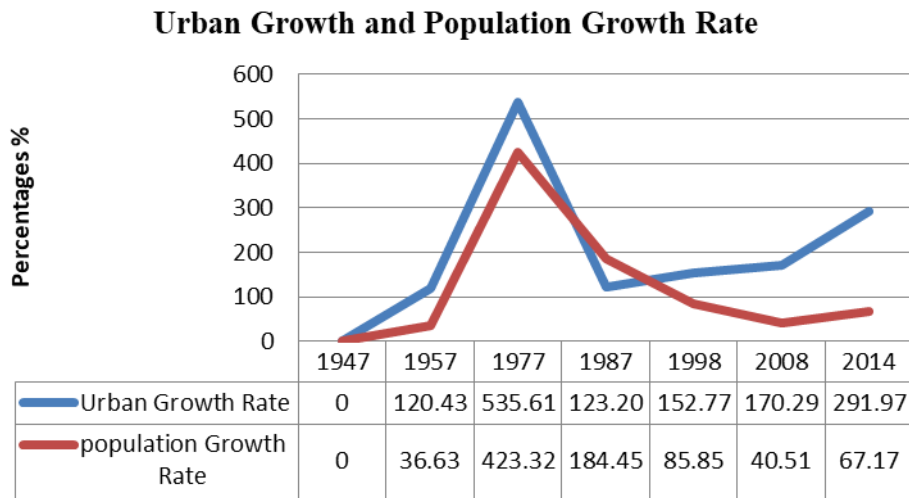


Figure 12-3: Comparison between urban growth rate and population growth rate in the City of Duhok

Source: Own construct based on Municipality of Duhok, 2015; Hirori, 2009; Al-Feqeeh, 1999

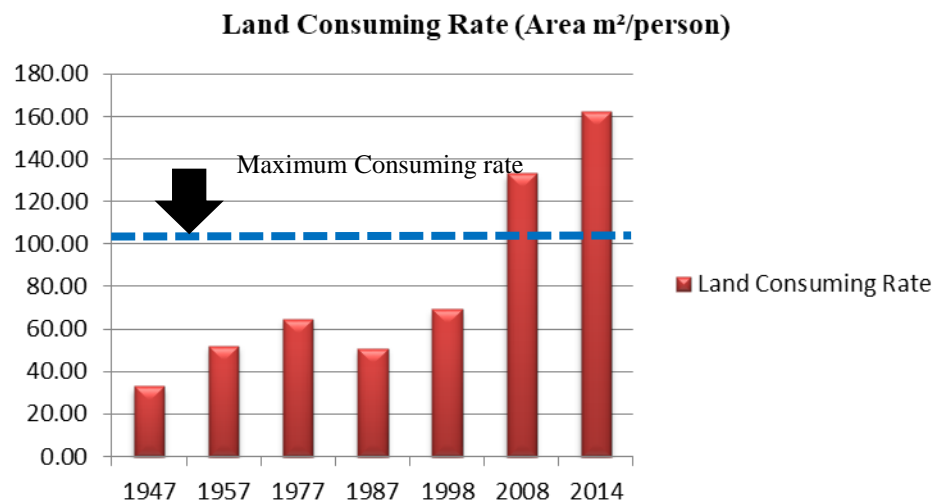


Figure 12-4: Land consuming rate in the city of Duhok

Source: Own construct based on data from the Directorate of Constructive Planning in Duhok, 2015; Municipality of Duhok, 2015; Hirori, 2009; Al-Feqeeh, 1999

The land consumption coefficient is a measure of consumption of the new amount of urban land in each morphological stage in the city of Duhok. The increasing of urban population was noticeable in all morphological stages and significant between 1987 and 2014, therefore, the rate of consuming land was very high leading the development process to invade Sêmêl and Şariya Plains.

The defect for land can be quantified by subtracting the area of the developed land and the area required in theory. The negative result indicates that the developed urban area is highly compacted with reference to the planning standards; therefore, additional land must be provided to fill the deficit. The positive result indicates higher land consumption in the city and the development moves towards spreading and sprawling while the zero displaying balancing state according to the standards and regulations. To measure the amount of the development the following formula can be used:

$$\text{Theoretically Required land} = \text{Number of the population} \times 101.25\text{m}^2 \text{ (a maximum land dedicated to each person according to Iraqi planning Standards)}^{31}$$

$$\text{Defect in the amount of developed land} = \text{Actual developed land} - \text{Recommended in theory}$$

Based on the above two equations the amount of the developed land in the city of Duhok is:

$$\begin{aligned} \text{Theoretically required land} &= 355193 \text{ (currently number of population in Duhok)} \times 101.25\text{m}^2 \\ &= 35963291.25\text{m}^2 \\ &= 3596.33 \text{ hectares} \end{aligned}$$

$$\text{Actual developed land} = 5763 \text{ hectares}$$

$$\begin{aligned} \text{Defect in the amount of developed land} &= 5763 \text{ hectares (actual developed land)} - 3596.33 \\ &\quad \text{hectares (theoretically recommended land)} \\ &= +2193.67 \text{ hectares} \end{aligned}$$

In this formula, the positive value of the defect refers to the overabundant area developed in the city. Based on, the amount of 2193.67 hectares of developed land surpasses the required land by 38 % of the area of the city, demonstrating an unbalanced state which encouraged the pattern of sprawling development. Therefore, the city of Duhok needs to encourage infill development initiatives to enhance the intensification of existing urban fabric or densification through increasing the density to obtain more compacted urban form.

The available satellite images of the city of Duhok between 1990 and 2008 and 2014 showing a clear change in the land use and land cover in the city. The results display that the urban areas are extended and have rapidly grown – see Figure 12-5.

Between the years 1998 and 2014, the area of the city of Duhok has increased four times from 1470 hectares to 5763 hectares within a span of 16 years. The continuously rapid expansion since 1998 caused urban growth to remain disproportional, thereby, reflecting the gradual increase of the urban sprawl pattern – see Section 9.2 in Chapter Nine about more details on driving forces behind city rapid growth.

³¹ - This formula is developed by the researcher

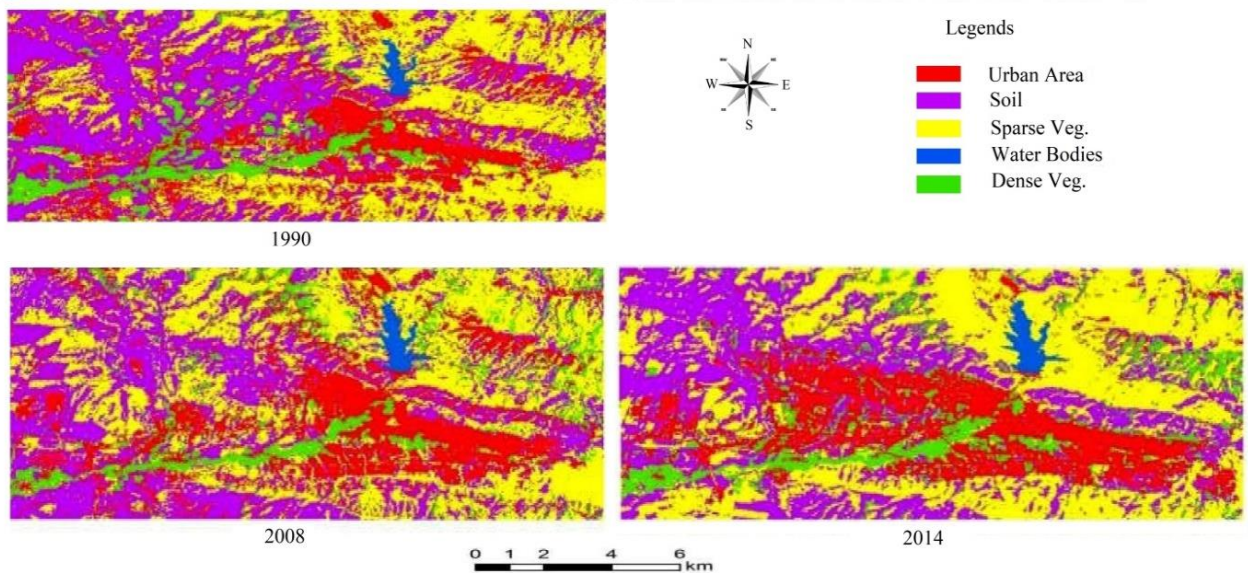


Figure 12-5: Processed satellite images display land use and land cover changes in the city of Duhok between the years 1990 -2014.

Source: Own construct using ArcView10 software

One of the widely used methods for determining urban sprawl growth is the Holden technique. This method helps to understand the rate of sprawl that is related to the declining of population density or rising of per capita land use, and the amount that attributed to population growth. By applying this method, the causes of the sprawl can be specified as being the result of population growth and the extent that of unorganised urban growth (Hekmetnia & Mousavi, 2006 cited in Mobaraki, Mohammadi & Zarabi, 2012). The following formula is used;

$$\begin{aligned} & \text{Ln} \left(\frac{\text{Population at the end of period}}{\text{Population at the beginning of period}} \right) + \text{Ln} \left(\frac{\text{Land gross per capita the end of period}}{\text{land gross per capita at the beginning of period}} \right) \\ & = \text{Ln} \left(\frac{\text{Urban area at the end of period}}{\text{Urban area at the beginning of period}} \right) \end{aligned}$$

The natural logarithm (Ln) of the ratio of the population at the end of the period to the magnitude of the beginning of the period plus the (Ln) of the ratio of land gross per capita at the end of the period to the magnitude at the beginning of period equals to the natural logarithm of the ratio of the urban area at the end of the period to the magnitude at the beginning of the period. By applying the formula to the case of Duhok:

$$\begin{aligned} & \text{Ln} (355193 / 212469) + \text{Ln} (162.25 / 69.19) = \text{Ln} (5763 / 1470) \\ & \text{Ln} (1.6717) + \text{Ln} (2.3450) = \text{Ln} (3.9203) \\ & 0.5138 + 0.8523 = 1.3661 \\ & 0.5138 / 1.3661 + 0.8523 / 1.3661 = 1.3661 / 1.3661 \\ & 0.38 + 0.62 = 1 \end{aligned}$$

The result shows that the physical growth of the city of Duhok from 1998 till 2014, is 38% as a result of the population growth and, 62% is the result of unorganised urban growth which

is related to urban sprawl and horizontal growth. Consequently, the population's gross density decreased and urban land gross per capita increased.

To evaluate the change in this urban land-use area in the city of Duhok, the relationship between the amounts of land and population is applied to measure the land absorption coefficient (LAC)³² which can be calculated through the following formula:

$$\text{Average Land Absorption} = \frac{A_2 - A_1}{P_2 - P_1}$$

The magnitude of the land absorption coefficient for the city of Duhok in different morphological stages from 1947 till 2014 is shown in the following- see Table 12-1.

Table 12-1: The land absorption rate in different stages in the city of Duhok

Morphological Stage	Year	Area	Population	Land Absorption Rate ³³
First	1923-1947	18.6	5621	-
Second	1947-1957	41	7680	108.79
Third	1957-1977	320.6	40191	86.01
Fourth	1977-1987	581.65	114322	32.21
Fifth	1987-1998	1470.25	212469	90.54
Sixth	1998-2008	3973.92	298548	290.86
Current	2008-2014	5763	355193	310.84

Source: Own construct based on calculations from General Directorate of Constructive planning, Directorate of Statistic and Municipality of Duhok, 2015

The calculations display a high rate of land absorption since 1998 which rapidly increased with the remarkable growth of the population in the city of Duhok as previously approved. The development has consumed much land creating horizontal expansion and sprawling the development of the city. The disordered generating development pattern, reduced spatial solitarities and cohesiveness of the urban form and structure.

The consumption rate was high in 2008 and 2014 as per the projected land use; it will further increase if the municipality fails to manage the spatial expansion of the city.

The calculation of the footprint of buildings for different uses in the city of Duhok (residential, commercial, industrial and urban services) is 2687.70 hectares (Municipality of Duhok), while the plot areas are 3810.47 hectares, hence displaying coverage area³⁴ of 46.64 and net build area density of 132.16 p/ha. UN-Habitat (2013a) recommends a minimum average built-up area density of 150 persons per hectare for a sustainable neighbourhood and about 50% of the total area of the neighbourhood should be devoted to residential purposes. The city has an agglomeration of many neighbourhoods. This percentage can work for the city as a whole which depends on the function and the position of the city in its context. The value of the coverage area shows that about 54% of the city is open space consisting of (green open spaces, private house gardens, streets and undeveloped areas) – see Figure 12-6.

³² - Land absorption coefficient (LAC) is a measure of change in consumption of new urban land by each unit increase in urban population (Iraqi Housing Standards, 1986)

³³ -Land Absorption rate refers to the amount of the population growth in given period uptakes by the developed land for urban purposes during same period or it is the share of the increased inhabitants from the newly developed land in the same period.

³⁴ - Coverage area is the ratio of building footprint to the site area.

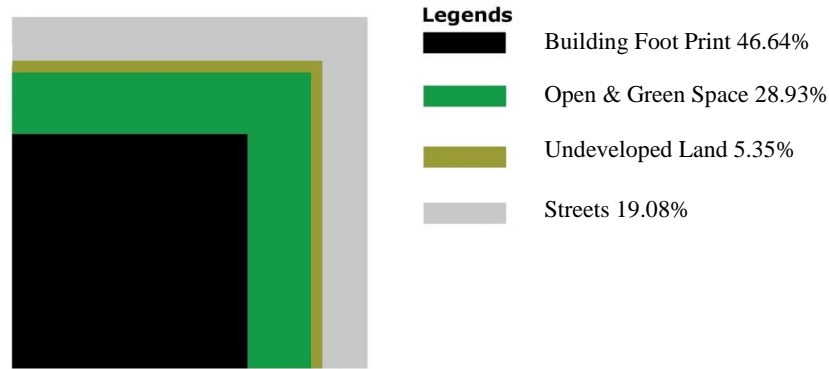


Figure 12-6: Coverage area in the city of Duhok

Source: Own construct based on the analysis of the Updated Master Plan of Duhok, 2012; Directorate of Constructive Planning in Duhok, 2015

The reason behind such a trend refers to the encouraging policies of the low-rise housing which require additional land for implementation. The low-rise residential buildings represent 94.51% from the total area devoted to the residential uses in the city, while the high residential class is only 5.49% and distributed in few pockets in the city of Duhok (calculation using ArcView 10 software) giving indications that the city of Duhok has taken horizontal form rather than a vertical form of spatial growth.

12.3. Changes in Density in the city of Duhok

An analysis of the density in the city of Duhok can support programs of redistribution of densities and draw sustainable development plans, providing services and raising the performance and the efficiency of the functions in the city.

The following formula of the arithmetic model is used for calculating population density:

$$\text{Population density} = \frac{\text{Total number of population (persons)}}{\text{Total area (hectare)}}$$

There is a great differentiation in the gross neighbourhood densities from sparsely populated area 3.60 persons per hectare to an extremely high populated area 349.41 persons per hectare which is very crowded. The sparsely populated neighbourhoods display in Dasinya, Êtûtê, Zanko and Zozan which are 17.63, 15.16, 5.17 and 4.61 persons per hectare respectively. The very crowded neighbourhoods are Serhildan, Beruşka Bakur, Beruşkê, Şêlê and Xebat displaying 274.90, 281.66, 285.92, 347.94 and 349.41 persons per hectare respectively. Only ten neighbourhoods of the city of Duhok are within the range of medium gross density - see Table 12-2. The density in the city of Duhok can be grouped to the following;

Table 12-2: Classification of gross density distribution in the city of Duhok

Density (persons/hectare)	Number of Neighbourhoods	Percentage %
Sparsely Populated (0.00 – 50.00)	15	31.25
Low Gross Density (50.01 – 150.00)	18	37.5
Medium Gross Density (150.01 -250.00)	10	20.83
High residential Density (250.01 – 350.00)	5	10.42
Toat	48	100

Source: Own construct based on analysing the secondary data from Directorate of Statistics of Duhok, 2015; Municipality of Duhok, 2015

The demographic change associated with rapid spatial urban development in the city of Duhok in different morphological stages, shows considerable change in population density. The general trend of gross density³⁵ displays a continuous decline in the value in relation to the increasing amount of spatial extension and population growth. In the first stage the gross density was 302.20 persons per hectare and in the last stage is 61.63 persons per hectare. The net residential density³⁶ in the first morphological stage was 368.59 persons per hectare while currently residential density displays 122.09 persons per hectare –see Figure 12-7.

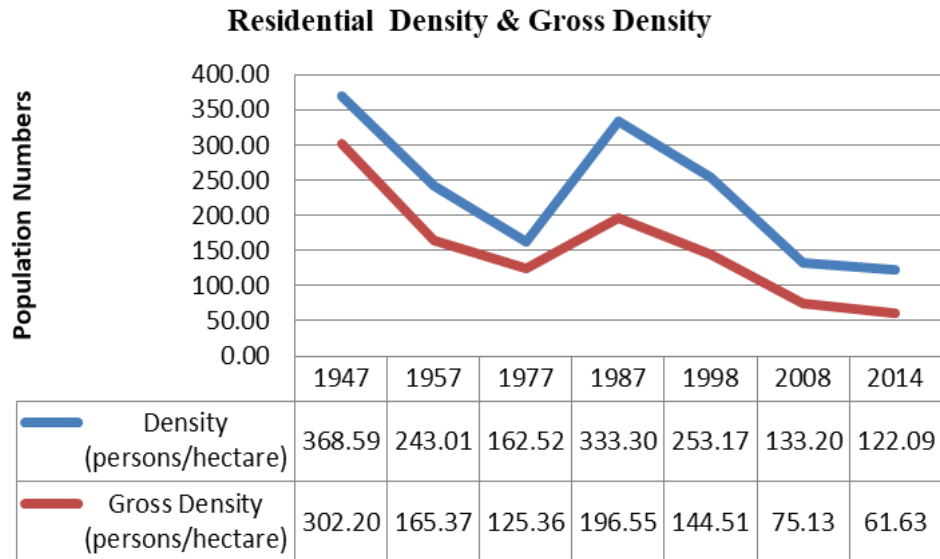


Figure 12-7: Change of gross density and net residential density in the city of Duhok

Source: Own construct based on document analysis from General Directorate of statistics of Duhok, 2015; Updated Master Plan of Duhok, 2012

The Iraqi Housing Standards recommends minimum net residential density to 150 persons per hectare and the maximum density to 300 persons per hectare for high-rise residential housings of four stories, and minimum net residential density 80 persons per hectare for detached houses and single-family, while the maximum density of 250 persons per hectare for attached one and two-row houses. The city of Duhok is predominated by two-row attached housing and the maximum proposed density should be less than 250 persons per hectares. So, the current reading of the density in the city of Duhok is incompatibly reflecting the existence of a wide gap between what has been implemented and what has been recommended by the Ministry of Housing in Iraq for promoting more sustainability.

Through comparing the gross density of the neighbourhoods, the most crowded neighbourhoods are concentrated in the eastern part and around the city centre. The medium density prevailed in the south and north-west part of the city despite the neighbourhoods in these parts were planned according to the city master plans under the supervision of the Municipality.

³⁵ -Gross density is ratio of population (persons) to the entire area of the city in regardless of land use (Dempsey et al, 2010)

³⁶ -Net residential density is the ratio of population (persons) to the total land devoted to residential use (Dempsey et al, 2010)

According to the Iraqi Housing Standards, the optimum size of the population in the neighbourhoods is between 4000 to 6000 inhabitants; these measurements correspond to sustainable development indicators – for more details see Section 3.6 in Chapter Three. The population of the 12 neighbourhoods³⁷ in the city is compatible with the measurements, while the populations of 23 neighbourhoods exceed the range. The rest of the neighbourhoods have the population of five times more than the recommended such as in Beruşkê and Serhiland neighbourhoods which have 33135 and 39519 inhabitants respectively, and the other remaining 13 neighbourhoods have less than 4000 inhabitants- see Figure 12-8.

The following diagram shows that 75% of the neighbourhoods' populations do not conform to the sustainable urban development indicators. The population of most neighbourhoods in the city needs programs for densifications in some neighbourhoods which have a population of fewer than 4000 inhabitants, and reduction of the density of other neighbourhoods to promote more sustainability.

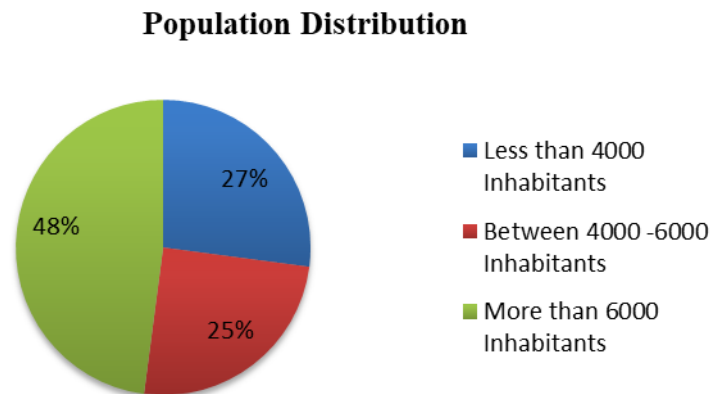


Figure 12-8: Distribution of the Population Numbers in the Neighbourhoods in Duhok
Source: Own construct based on document analysis from General Directorate of statistics of Duhok, 2015; Updated Master Plan of Duhok, 2012

12.4. Accommodation Gross Density

The neighbourhoods which have an average accommodation gross density³⁸ less than 12 dwellings/hectare, are 10 neighbourhoods representing 20.83% from the total neighbourhoods. Whereas the neighbourhoods that have a moderate density between 12.01-32.00 dwellings/hectare; are 17 neighbourhoods representing 35.42%, while the neighbourhoods demonstrating high density from 32.01 to 50.00 dwellings/hectare are 11 neighbourhoods representing 22.92%. The extremely high density of more than 50.01 dwellings/hectare are 10 neighbourhoods representing 20.83% of the total neighbourhoods in the city - see Figure 12-9.

The neighbourhoods which display extreme high dwelling density are; Xebat, Beruşka Bakur, Beruşkê, Serhildan, Kanîmehmedkê, and Kanixişmana holding 90.62, 69.71, 69.36, 68.82, 61.77 and 54.62 dwellings per hectare respectively. These neighbourhoods are located

³⁷ - The population of these neighbourhoods is compatible, while the area and the density are not conforming to standards.

³⁸ - Accommodation density is the number of dwellings to the residential land.

in the eastern part and around the city centre which is predominated by small residential plots ranging from less than 100 m² to 400 m² and at the same time, displaying a high residential population density.

Accommodation Density Distribution %

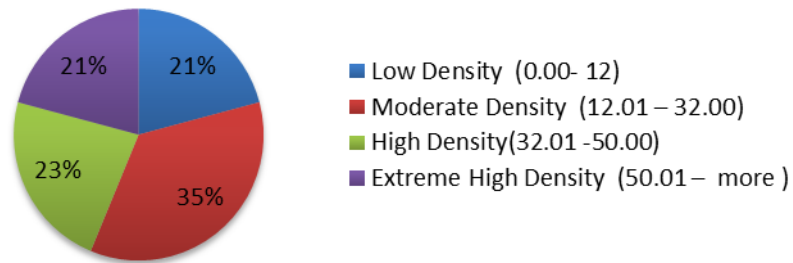


Figure 12-9: Accommodation gross density distribution in the city of Duhok

Source: Own construct based on document analysis from General Directorate of statistics of Duhok, 2015; Duhok municipality plans, 2015

The average accommodation gross density in Duhok shows 16.73 dwellings per hectare of a residential area. The low average indicates that Duhok depends on low-rise housing. The supposed average accommodation density in the city of Duhok has to range from 32 to 40 dwelling per hectare. The low accommodation gross density in many neighbourhoods gives the opportunities for more densification process by encouraging residents to build extra floors and dividing big plots to small residential plots.

12.5. Efficiency of the Street Network in the city of Duhok

Streets occupy a large share of land use in the city. They are the main links that bind and connect different parts of the city and gives a unique form to the urban fabric.

The development policies in Duhok were initially based on the spatial segregation of uses and mainly the segregation between residential uses and administrative, commercial use. This has led to a greater effect on the type of streets and accessibility in the city. Adversely, this has affected the formulation of urban form and structure at both the city and the neighbourhood level which in turn, has affected the accessibility to different activities.

The currently developed land for transportation in the city of Duhok is 19.08% of the total area of the city. The dedicated land for transportation in the city should range between 20 to 30 percent of the total area of the city (Iraqi Housing Standards, 1983) and, 30 to 45 percent of the total area of the neighbourhood (UN-Habitat, 2013a) to increase accessibility to different activities in the neighbourhoods and the city.

12.5.1. Street Network Connectivity

To measure the connectivity of the existing street network in the city of Duhok, the street network is quantitatively analysed using indicators of Detour Index, Beta Index, Eta Index, Gamma Index, and Alpha Index (Gautam, 1992; Turzi, 2003). Detour Index (DI) is used to examine the degree of the straightness of the street network and its efficiency in the city of Duhok, the following formula is used:

$$\text{Detour Index (DI)} = \text{Actual Route Distance (d)} / \text{Straight Line Distance (L)}$$

The following data have been used to determine detour index – see Table 12-3.

Table 12-3: Detour Index measurement for the Street Network in the city of Duhok

No.	The Name of the Street	Number of links	Straight Rout (km)	Actual Rout (km)	Detour Index	Percentage of Increasing %	Increased length (Km)
1	Êtût	2	6323.7	6486.3	102.57	2.57	162.6
2	Barzan	13	12797.3	13530.2	105.73	5.73	732.9
3	Aloka	1	1785.1	2013.5	112.79	12.79	228.4
4	Azadi	1	321.2	665.3	207.13	107.13	344.1
5	Asti	1	1027.8	2113.2	205.60	105.60	1085.4
6	Helgord	2	378.5	378.5	100.00	0.00	0
7	Memuzin	1	956	1062.3	111.12	11.12	106.3
8	Karwan	3	3022.1	5369.4	177.67	77.67	2347.3
9	Kanîmehmedkê	1	3895.1	4149.7	106.54	6.54	254.6
10	Mitran	1	1173.9	1376.6	117.27	17.27	202.7
11	Mihemmedşêxo	1	1194.3	1288.2	107.86	7.86	93.9
12	Qenatikurdu	1	645	2120.3	328.73	228.73	1475.3
13	Kawa	1	767	1696.4	221.17	121.17	929.4
14	Gelî	1	905.2	964.3	106.53	6.53	59.1
15	Qazîmuhemmed	4	4184	4354	104.06	4.06	170
16	Şehîdanîşubat	2	2082.4	2119.6	101.79	1.79	37.2
17	Şimikzera	2	864	899.8	104.14	4.14	35.8
18	Sipi	1	352.2	360.4	102.33	2.33	8.2
19	Serok	1	486	552	113.58	13.58	66
20	Sindor	1	726	758	104.41	4.41	32
21	Sulav	1	1369.3	3225.9	235.59	135.59	1856.6
22	Reza	2	1496	1794.1	119.93	19.93	298.1
23	Zaxo	7	6482.5	7432.8	114.66	14.66	950.3
24	Zirka	5	3779.3	3961.3	104.82	4.82	182
25	Zozan	2	569	891.2	156.63	56.63	322.2
26	Amed	6	4552	4732.5	103.97	3.97	180.5
27	Amêdî	1	741	1154.6	155.82	55.82	413.6
28	Bazar	1	815	879.4	107.90	7.90	64.4
29	Pêşmerge	1	696.1	744	106.88	6.88	47.9
30	Çira	1	495	563	113.74	13.74	68
31	Hajicindi	2	1442	1474	102.22	2.22	32
32	Daristan	1	678	696.4	102.71	2.71	18.4
33	Pîran	4	2258	2598.7	115.09	15.09	340.7
34	Şehîdan	2	1288.2	1437.4	111.58	11.58	149.2
35	Êlul	1	1189.4	1304	109.64	9.64	114.6
36	Şoreş	1	432	456	105.56	5.56	24
37	Cadanwi	1	1675	1684	100.54	0.54	9
38	Şîlan	1	1037	1168.6	112.69	12.69	131.6
39	Serhildan	4	4164.2	4239	101.80	1.80	74.8
40	Kêvilan	1	867.3	2134	246.05	146.05	1266.7

41	Qesara	1	1586	1891.2	119.24	19.24	305.2
42	Adar	2	867	884	101.96	1.96	17
43	Austeralaia	1	453	469	103.53	3.53	16
44	Xezîne	1	502	559.7	111.49	11.49	57.7
45	Silêmanî	1	785	802	102.17	2.17	17
Total		92	84106.1	99434.8	5807.21		15328.7

Source: Own Construct based on the Master Plan of Duhok, 2009; Aerial images by using ArcView 10 and AutoCAD

The overall detour index of the main arterial street network in the city of Duhok registered as 1.18 displaying a deviation of 118.23% from the optimum percentage which is 100%. The closer value of detour index to (1) means more spatially efficient the network, and the more direct route given to access. The result shows, as an overall case, that the main street network in the city of Duhok has high efficiency³⁹ in terms of its straightness. The natural and man-made obstacles are the main reasons for the type of street network deflection in real life. The deficiencies of the networks are the result of inefficient urban design and planning system.

Gamma Index (γ) is applied to know the degree of the connectivity of the street network in the city of Duhok. By applying the formula to the street network of the city of Duhok the following value is computed:

$$\text{Gamma Index } (\gamma) = \text{number of the segments } [e] / 3(\text{number of nodes } [v] - 2)$$

$$\begin{aligned} \text{Gamma Index } (\gamma) &= 92 / 3(72-2) \\ &= 0.44 \end{aligned}$$

This value is expressed as a percentage of the connected network which means that 44 percent of the street network is connected, and 56 percent is not connected. It reveals that the street network in the city of Duhok has less connectivity and the network needs 118 extra segments to be added to the network to reach the maximum efficiency to ease accessibility. The additional segments are measured using the above formula by assuming the gamma index as 1 which holds high connectivity.

$$1 = e / 3(72-2)$$

$$e = 210 \text{ segments}$$

The required segments = proposed segments – existed segments

$$= 210 - 92$$

$$= 118 \text{ segments}$$

The percentage of the connectivity of the street network in Duhok is indicated through the below formula:

$$\begin{aligned} \text{Gamma Index } (\gamma) \% &= e / 0.5(v-1) \times 100 \\ &= 92 / 0.5(72-1) \times 100 \\ &= 2.63 \% \end{aligned}$$

The results assure that the network street in Duhok has very low connectivity which constrains mobility and easy access to the different activities in the city.

³⁹ - The value of detour index showing: from 100 to 124% is a high efficiency, 125 to 137.5% medium efficiency, 138 to 150% low density and more than 150% very low efficiency (Turzi, 2003).

Alpha Index (α) also is used to measure the degree of the connectivity of the street network in the city of Duhok assuming that the current network is a completed and connected network through using the following formula;

$$\text{Alpha Index } (\alpha) = \text{number of the segments [e]} - \text{number of nodes [v]} + 1/ 2v-5$$

To calculate the degree of the connectivity of the street network in Duhok, the following calculation is obtained;

$$\begin{aligned} \alpha &= 92-72+1/ 2 \times 72 -5 \\ &= 0.14 \end{aligned}$$

The result displays a great deficiency in the connectivity of the street network - as a complete network - in the city of Duhok. The current network is working as more than one connected network, thereby, constrains mobility in the city and hinders promoting a sustainable street network in the city of Duhok.

Taken collectively, the number of intersections and junctions that meet with main streets causing many traffic accidents, especially, in the streets which have the allowable speed to more than 60 km/h such as Barzan, Karwan, Qzîmuhemed and Qenati-Kurdu streets. According to the data and information, most of the traffic accidents occur in these streets in the city of Duhok (General Directorate of Traffic in Duhok).

12.5.2. Street Density and Segments Length

Network density (ND) is used to examine the kilometre of the street network to the developed area of the city. To measure the network density in the city of Duhok the following formula is used:

$$\text{Network Density (ND)} = \text{length of the network (km)} / \text{Surface Area of City (km}^2\text{)}$$

$$\begin{aligned} \text{Network Density (DN)} &= 906.91 \text{ km} / 57.63\text{km} \\ &= 15.74 \text{ km/km}^2 \end{aligned}$$

The street coverage in the city of Duhok displays 15.74 km length of the street network per one km² of the area of the city. According to (UN-habitat, 2013) there should be at least 18 km length of streets per one square kilometre of surface area to increase accessibility in the residential areas and produces a sustainable street network. Accordingly, the city of Duhok needs about 130.43 kilometres of extra length of streets to achieve the minimum recommended average density.

The share of each person from the streets in the city of Duhok is 30.95 m² per person. The computed value for Duhok is compatible with the Iraqi Housing Standards which determines 30 m² per person. So the amount of the dedicated land to the transportation in the city of Duhok is not constraining the effectiveness of the street networks. Rather, designing and planning of the street network are the problems.

Beta index (β) is used to determine the link-node ratio (Gautam, 1992), measuring the completeness of the network and the connectivity of the main arterial street network in the city of Duhok. The below formula is used for calculation:

$$\text{Beta index } (\beta) = \text{Number of segments (e)} / \text{number of nodes (v)}$$

The calculation of the network in the city of Duhok reads:

$$\text{Beta index } (\beta) = 92 / 72$$

$$= 1.28$$

The value shows that the ratio of the segments to the number of the nodes in the city of Duhok is spatially high, while the index does not reflect the length of the links in the network. Therefore, the grid with a high number of blocks (1000m) has the same value of grids with (200m) blocks (Dill, 2003). The moderate value of the index shows the spatial distribution of the network in the city and reflects the simplicity of the street networks which is without central nodes.

To measure the average length of the segments in the arterial street network, the Eta Index (η) is used to measure the average length of the segments in the street network; this index is used as a measurement to indicate the speed in the traffic network. The following formula is used:

Eta Index (η) = the summation of the segments L (G)/ the number of segments (e)

$$\begin{aligned} \text{Eta Index } (\eta) &= 99.44 \text{ km} / 92 \\ &= 1.08 \end{aligned}$$

The average length of the segments is 1.08 kilometre, displays very short edges that limiting the traffic speed. The assumption is that the longer the segment is in the network ensures maximum speed of the concerned segment and easy access to the destinations.

12.5.3. Efficiency of the Current Public Transport

As mentioned earlier in subsection 11.2.7 of Chapter Eleven that the city of Duhok has no modern public transportation system. The main public means of transportation in the city of Duhok are mini-buses. These mini-buses are arranged and organised by the municipality and Directorate of Transportation in the city of Duhok and the owners of mini-buses for carrying passengers inside the city to a certain destination.

To measure the efficiency of the available public transportation in the city of Duhok, within the current street network, two indicators have been used for this purpose. They are arrival time and the length of the line. The efficiency can be measured through the relationship between the line and the number of the nodes (Dill, 2003) using the following formula:

Efficiency of the line = $2x$ Time/ length of the line $\times \sqrt{\text{length of the line/ number of nodes}}$

The route of Reza registered high efficiency in both times despite the length and the numbers of nodes of the road, because half of the way between the neighbourhoods of Malta and Qesara have no bus stops and the buses move on the transit road which permits to 80 km per hour. While Serhildan route registered a low degree of efficiency at both times this route is congested most of the day and, the serviced neighbourhoods have a high population density in addition to the increasing number of the optional bus stops on the road. The route has no fixed bus stops to determine the number of stopping the bus which helps to increase the arrival time. The following are the obtained measurements- see Table 12-4.

Table 12-4: The degree of the efficiency of the Public Transportation Routes in Duhok

Name of Line	Efficiency Rate	
	Normal Time	Peak Time
Beruškê	0.288	0.460
Diyari	0.201	0.301
Reza	0.130	0.168
Serhilan	0.426	0.663
Şehîdan	0.349	0.426
Malta	0.234	0.308
Zirka	0.149	0.201

Source: Own construct based on observation; Duhok Municipality Plans, 2015

12.5.4. Proximity to Bus Routes

To identify the area, the services of the buses covers, the proximity measures the closeness of the services to the destination of the people. The catchment area is used to indicate the coverage area of the service to know the efficiency of the current public transportation (Murray & Wu, 2003, Turzi, 2003, UN-Habitat, 2013a). This technique is chosen to measure the area that the service of the buses can reach. The minimum proximity to the bus station is 500 m walk as indicated by Iraqi Housing Standards and other sustainable approaches.

According to this indicator, 42.01% of the areas of the city of Duhok which makes about 2421 hectares, are not serviced by bus routes. About 149206 citizens⁴⁰ of Duhok have to walk more than 600 m to get the nearest bus service, showing a high degree of the deficiency on the available transportation routes in servicing citizens in the city. The bus-line in many areas is about 2000 m far from the residential areas – see Figure 12-10.

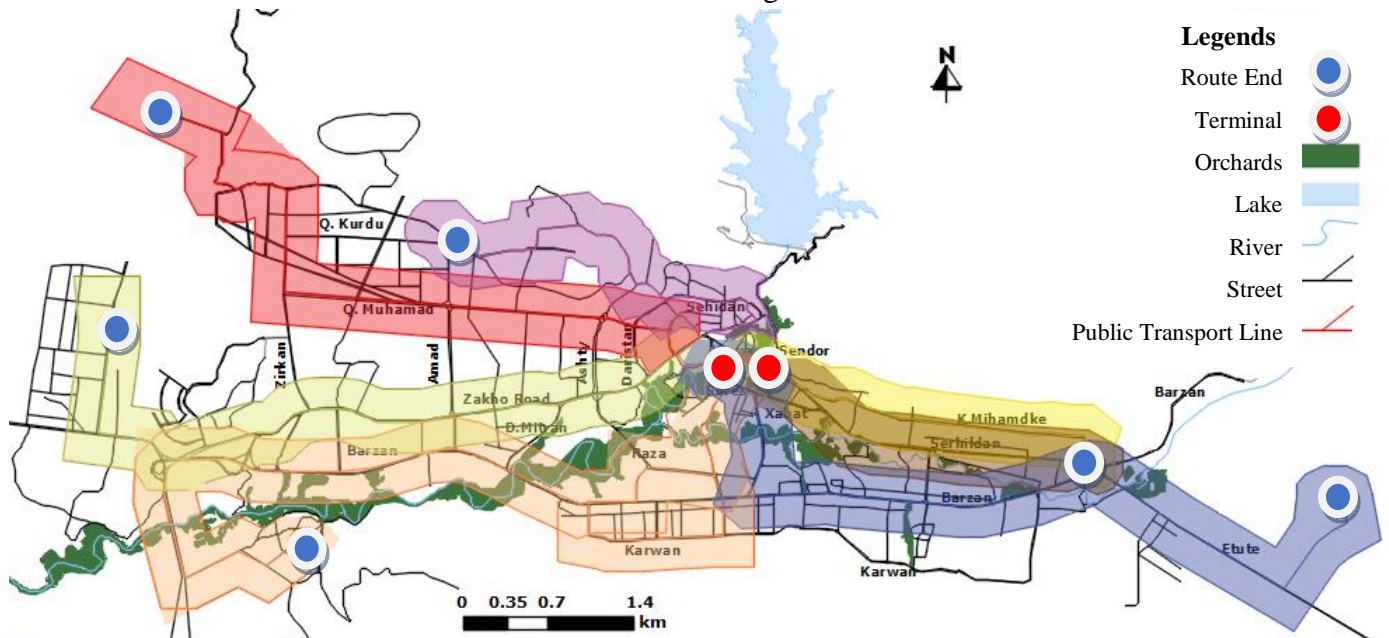


Figure 12-10: Catchment area of the bus routes in the city of Duhok

Source: Own construct based on plans from the Municipality of Duhok, 2015; Directorate of Constructive Planning in Duhok, 2015, using ArcView 10 software

⁴⁰ - By multiplying the excluded area to the average gross population density in the city of Duhok which is 61.63 persons per hectare.

12.5.5. Sidewalks and Plazas

Sidewalks have been constructed to ease the movement of people and separate the flow of vehicles and pedestrians from each other. While in the case of Duhok, all the sidewalks of the commercial streets do not give the right of way of pedestrian's movement. In general, the sidewalks are;

- Improperly designed in terms of width, height, pavement materials and greening,
- The sidewalks did not receive enough attention as a public realm and as a place of interaction between the commercial uses and the flow of the pedestrians in the streets to enhance the liveability.
- In most cases, sidewalks are used by the citizens as their private space.

The concept of the plaza as a public space is not encouraged in the city of Duhok. The people gather in many places; behind the Grand Mosque and in Elul, Kawa and Zozan Streets due to the lack of plazas and other open spaces in the city centre. These gatherings mainly take place on the sidewalks or in the open spaces between the buildings. These places are not suitable for such public gatherings which disturbs the flow of the pedestrian by narrowing the sidewalks and causing the citizens to walk on the streets instead of the sidewalks - see Figure 12-11. Some of the citizens in these gatherings sell handcrafts or other items (e.g. watches, knives, beads) within small auctions groups. The visitors are mainly old men; therefore, these locations attract many people as a social event and a place for the meeting of the old age classes.



Figure 12-11: Gathering of people on sidewalks and between buildings in the city centre
Source: Photo by the Researcher in 2014

General speaking, the existing street network in the city of Duhok has the following characteristics:

- Different morphological stages of the city have influenced the width, length and pattern of the street.
- The street network shows low connectivity according to the indices as an integrated street network.
- The existing bus routes cannot provide good services to the people in the city; about 58% of the area of the city is not serviced by bus routes.
- The street network needs more segments to ease accessibility to the different parts of the city.
- The unguided development and rapid growth of urban areas on the outskirts of the city have generated an inefficient road network.

- Inappropriateness in projecting vehicle traffic demand and the increasing numbers of private cars per population in the city.
- Non-compliance to the effective road design standards such as determining the number of lanes and nodes which can be observed through the quality of the existing streets in the city, and
- Poor streetscape elements such as sidewalks, greenness, signage, ditches, landscaping and on-street parking... etc.

12.6. Open Spaces and Green Area in the city

This section evaluates the green open spaces in terms of the amount of the land devoted to the recreation area and their spatial distribution at the level of the city of Duhok without interfering with issues relating to the management of green areas.

District parks are the main public green open spaces, which are mainly concentrated on the south and west part of the city of Duhok. These parks are the main green structures that are designated as recreational areas inside the city for spending leisure time outside the home. The existence of the green areas and open spaces in the cities is of great importance, because of its environmental, social and economic benefits. Therefore, it is necessary to provide green areas with sufficient space to provide a green environment for the city's residents. These green spaces should be spatially distributed to serve different neighbourhoods in the city evenly.

The rate of areas dedicated to the green open spaces has increased. These areas are distributed between different types of green open space as indicated in the following table. The open green area in the city of Duhok is 653.12 hectares representing 11.33% from the area of the city. The whole area designated to the public green open spaces for recreational purposes is 284.46 hectares, while the accessible amount of the public green open spaces is 132.4 hectares representing 4.94% from the total area of the city of Duhok. There are different types of green open spaces in the city of Duhok - see Table 12-5.

Table 12-5: Distribution of different types of open space in the city of Duhok

No.	Type of Green Open Space	Area in (hectare)	Percentage %
1	Median of Streets	23.72	3.63
2	Valley of the Duhok River	144.3	22.09
3	Developed Public Green Open Space	132.4	20.27
4	Undeveloped Public Green Open Spaces	152.06	23.28
5	Private Nursery	22.62	3.46
6	Open Area dedicated to Electricity Transmission Line	108.15	16.56
7	Areas Dedicated to Agricultural Research Centre	69.87	10.70
	Total	653.12	100.00

Source: Own construct based on calculations from the plans from Municipality of Duhok, 2015; satellite images by using ArcView 10 and AutoCAD

The share of each person in the city of Duhok is 8.01 m² from the total developed and undeveloped green open space for recreation which sum up to 284.46 hectares, and only 3.73m² is the citizen's share from the accessible developed public green open area. According

to the (Iraqi Housing Standards, 1983), the minimum area for each person from green open space in the city is 6.50m² at the neighbourhood level⁴¹, 3.00 m² at the district level and 5.00 m² at the city level, which the summation makes 14.5 m². This indicator is compatible with what has been suggested by (UNEP- United Nations Environment Programme) which is the minimum area per capita is between 12m² and 16m², and the total amount should not be less than 10% from the total area of the city. The calculations confirm the fact that the percentage of the green open spaces is very low even if compared to the local standards. The green open space has not been distributed according to the population density and the size of the neighbourhoods in a sustainable way to meet the needs of residents. The deficiency in the area of green space is obtained by using the following formula⁴²- see Table 12-6.

$$\text{Defect in the developed amount of open green area} = \text{Actual developed area} - \text{Recommended area}$$

Based on the above calculations, there is a deficiency of 230.58 hectares of accessible green areas in the city of Duhok. There is a lack of even and fair spatial distribution of green open areas in the city. The available green open spaces are not utilised as public green open spaces or as natural assets to enhance the city's environment. Only 20.27% of the total green open space in the city, which makes about 2.30 % of the total area of the city, is usable and accessible as recreation areas inside the city. This shows a huge deficiency in planning and managing green open space. The city of Duhok has many potentials for developing green open spaces inside the city due to the mountainous nature and the flowing of the two small rivers through the city namely; Duhok River and Hişkeru.

Table 12-6: Amount of green open spaces in the city of Duhok

Level	Developed Area (hectare)	Undeveloped Area (hectare)	Total Area (hectares)	Required area according to Iraqi Indicators	Deficiency in Area (hectare)	Percentage of Deficiency %
At Neighbourhood Level	86.57	37.56	124.13	230.88	106.75	86.00%
At District Level	45.83	30	75.83	106.56	30.73	40.52%
At City Level	0.00	84.5	84.50	177.60	93.10	110.18%
Total	132.4	152.06	284.46	515.04	230.58	81.06%

Source: Own construct based on calculations from the plans from Municipality of Duhok, 2015; Directorate of Constructive Planning in Duhok, 2015; satellite images by using ArcView 10 and AutoCAD

Based on the Iraqi Housing Standards (1983), the minimum size of the District's Park is 10 hectares and, for Community Parks is from 2 to 6 hectares. It should be noted that these standards are easy to be applied to the new planned subdivisions than to the existing and old

⁴¹ - Green open areas include all green open spaces devoted to different purposes such as; children play fields, sport fields and gardens at neighbourhood level.

⁴² - The same formula of indicating defect in the amount of developed land is used- see section 12.2.

developed areas. In most cases, the land in the already developed areas is not available; therefore, the provision of new green open spaces at the neighbourhood and district level, falls short of the effective standards. Therefore, it is necessary to build strategies such as the removal of the residential area or exploiting vacant areas to increase the number of green areas, as well as to improve standards that can be adapted to meet the desired level of services in the old developed areas. The number and the size of the developed community and district parks with the average area per capita in the city of Duhok is shown below – see Table 12-7.

Table 12-7: Number of green open spaces and area per capita in the city of Duhok

No.	Type of Parks	Number	Area (h)	Size of the Park	Recommended Size (h)	Share (m ² /person)
1	Community Parks	256	86.57	0.3 -3.8	2 to 6	2.44
2	District Parks	8	45.83	2.0 -10.86	Min. 10	1.29
3	City parks	0.00	0.00	0.00	0.00	0.00
Total			132.4			3.51

Source: Own construct based on calculations from the plans from Municipality of Duhok, 2015; Directorate of Constructive Planning in Duhok, 2015; satellite images by using ArcView 10 and AutoCAD

The rate of the green open spaces which dedicated to the residents varies from one neighbourhood to another and is mainly dependent on the stage of the establishment of the neighbourhood and the planning approach. The range of the public green open spaces covers from 0.00 m²/person in neighbourhoods of Bazar and Birayetî to 12.09m²/person in Kêvilan neighbourhood and 144.17 m² in the gated community of Zozncity. The calculation displays very a low rate when compared to the local and international standards - see Table 12-8.

Table 12-8: Area of Developed Community Parks and District Parks in the city of Duhok

No.	District	Neighbourhood	Area (Hectare)	Population (Persons)	Community Parks		District Park	
					Area (h)	Inhabitant Share m ² /person	Area (h)	Inhabitant Share m ² /person
1	Malta	Aşti	61.85	6530	1.4	2.14	0	1.44
2		Avrocity	140	8507	5.12	6.02	0	
3		Behdînan	119.53	3282	3.35	10.21	2.00	
4		Botan	105.52	4694	1.67	3.56	0	
5		Grêbasê	23.71	4569	0.79	1.73	0	
6		Kevelan	64.26	2954	3.57	12.09	0	
7		Malta Jori	349.22	16962	5.18	3.05	0	
8		Malta Jeri	161.09	11729	3.09	2.63	0	
9		Masîka Rojava	46.11	6472	6.61	10.21	2.98	
10		Masîka	79.1	8568	3.59	4.19	2.11	
11		Mazî	160.19	4324	3.42	7.91	9.49	
12		Mîdiya	80.55	5462	2.89	5.29	0	
13		Nawroz	25	3476	0.23	0.66	0	
14		Nohadra	22.5	2504	0	0.00	0	

15		Şehîdan	24.25	2696	0.59	2.19	0	
16		Şaxkê	107.78	10363	2.16	2.08	0	
17		Şindoxa	122.4	10797	1.42	1.32	0	
18		Şoreş	42	6355	2.57	4.04	0	
19		Tanahî	290.53	10981	2.4	2.19	0	
20		Zanko	311	1609	0.34	2.11	0	
21		Zirka	151.13	9035	6.46	7.15	3.84	
22		Zozancity	35.34	163	2.35	144.17	0	
23	Nizarî	Azadî	30.03	4843	4.46	1.42	0	2.36
24		Bintuka	23.9	4685	2.05	4.38	6.70	
25		Diyarî	50.17	9994	1.78	1.78	0	
26		Geverkê	28.98	2918	0	0.00	0	
27		Mihabad	29.5	5427	1.21	2.23	0	
28		Nizarkê	284.7	10569	3.45	3.26	0	
29		Pêşangeha	129.27	466	0	0.00	0	
30		Qesara	142.45	6512	2.67	4.10	0	
31		Reza	169.99	10980	3.68	3.35	10.86	
32		Ronahî	95.23	9733	2.43	2.50	0	
33		Sêgirka	41.58	5664	2.06	3.64	0	
34		Serbestî	72.11	2589	1.26	4.87	0	
35	Beruşkê	Beruşka Bakur	12.27	3456	0	0.00	0	0.59
36		Bazar	5.5	570	0	0	0	
37		Beruşkê	115.89	33135	0.48	0.14	0	
38		Besire	69.87	4066	2.09	5.14	0	
39		Birayetî	6	987	0	0.00	0	
40		Dasinya	39.93	704		0.00	0	
41		Gelî	41.1	9084	3.85	1.66	7.84	
42		Kanîxişmana	22.67	4885	0	0.00	0	
43		Kanîmehmedkê	62.87	15341	0	0.00	0	
44		Pîşzasî	23.91	465	0.2	4.30	0	
45		Serhildan	143.76	39519	1.81	0.46	0	
46		Şêlê	26.91	9363	0	0.00	0	
47	Xabat	30.5	10657	0	0.00	0		
48	Êtutê	Êtutê	431.85	6549	0	0.00	0	0.00
		Others	1109	0	0		0	
		Total	5763	355193	86.57	2.44	45.83	

Source: Own construct based on calculations from the plans of Municipality of Duhok, 2015; satellite images by using ArcView 10 and AutoCAD

The spatial expansion of the city of Duhok has been at the expense of its agricultural periphery areas and natural green open spaces. Natural green open areas in the city's periphery have dramatically decreased since 1977. Agricultural green areas surrounding the city have been changed and destroyed (e.g. orchards and wheat fields). The estimated damage is about 4100 hectares. This damage all the vine orchards in the villages of Êtutê, Nizarkê, Şindoxa, Şaxkê and Masîkê, as well as hundreds of hectares of wheat fields in Malta villages. According to the data from the (Directorate of Agricultural in Duhok, 2015), the natural green assets have decreased by 75% which is estimated at 3250 hectares since 1990.

One of the most irresponsible practices in the city of Duhok, is the destroying of natural green fingers and transforming of the green open spaces to residential or other uses, despite the acute shortage in the designation of land for recreation purposes. During the last five years, many of the green open areas within the neighbourhoods have been divided as plots and changed to residential or mixed uses in many neighbourhoods (e.g. Ronahî and Behdînan). According to an officer of the Department of Controlling Master Plan in the municipality of Duhok, changing of green open spaces to residential has happened under the pressure of offering more residential plots inside the city. The authorisation of changing the land use from green to residential was obtained and approved by the City Council without the participation of the affected communities. The owners of the houses which overlook these open spaces stated that the Municipality of Duhok has not considered their opinion about changing the function of these green open spaces which adversely affected them⁴³. These houses have lost their value and privacy. However, the location of green space inside the neighbourhoods encourages the citizens to buy houses in these neighbourhoods more than the neighbourhoods without green areas. Normally, in the city of Duhok, the residential plots which face open green spaces are more expensive than plots that do not face open green spaces, in the same neighbourhood because of their location. The properties (houses and plots) around the green spaces are worth up to 15% to 20% more than the price of other properties in the same neighbourhood⁴⁴. Changing these open spaces to residential has increased the built-up area and traffic flow within the neighbourhoods that affected all the community members.

Looking at the city's plan the following remarks can be noted;

- The distribution pattern of the recreation areas shows – with exception to few cases- that they have been randomly distributed without having a certain strategy or urban planning concepts for designing and distributing green areas.
- The developed lands which have been devoted to recreation purposes are not compatible with the size and the density of the population of the neighbourhoods.
- The designated areas are rather residuals (leftovers) of the lands have been appointed as green area after finishing the process of divisions and subdivisions of the land – see Figure 12-12.

⁴³ - Personal interview with twelve of the owners of these houses in Mihabad, Sêgirka neighbourhood on 21 Sept. 2013.

⁴⁴ - Interview with managers of the local real estate bureaus (Wareen, Pirs and Mediya) in the city of Duhok on 5 Sept. 2013.

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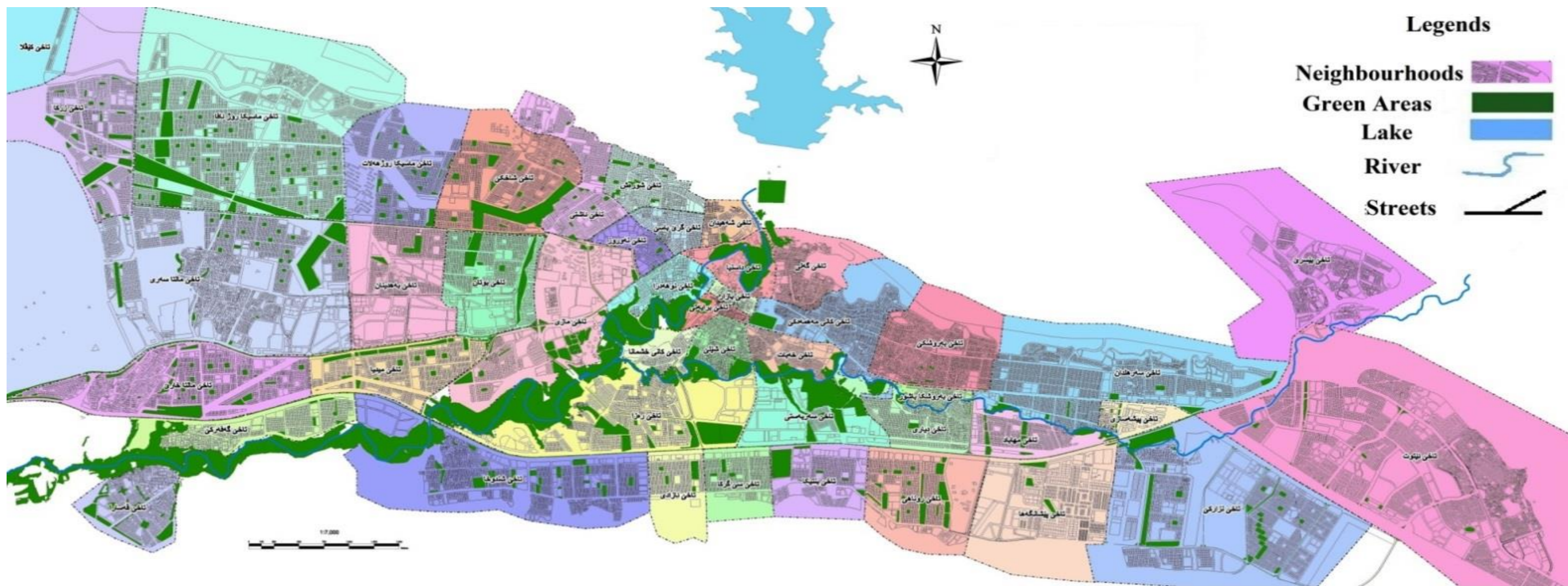


Figure 12-12: Distribution of green open spaces in the city of Duhok
Source: Municipality of Duhok, 2015

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12.7. Spatial Distribution of Urban Services

The total areas dedicated to developing the urban services inside the city of Duhok have grown year after year showing a noticeable increase in their amount. The calculations justify that the percentages of the public services were less especially in the early stages, because of the adopting compacted forms in the residential areas in the old centre of the city of Duhok.

The developed land for the urban service remarkably increased during the implementation of the fourth master plan between the years 1987 and 2008. After that, the percentages of the urban services were decreased compared to the huge expansion of the city which computed to 9% of the total area of the city⁴⁵ - for more details see Subsection 10.3.6 in Chapter Ten. The area of the urban services is 242.67 hectares represents 4.21% of the total area of the city. Increasing the population number and residential areas in the city was not compatible with the amount of affordable urban services. Currently, there is great pressure on the existing urban services in the city which can be clearly observed through over-loaded and inability of urban facilities (e.g. educational and health institutions) to perform their tasks in a proper way⁴⁶ due to the deficiencies in allocating and provided the amount of the services.

The following sections only investigate educational and health facilities in terms of their amount and spatial distribution as two essential services in the city, while other services will not be investigated.

12.6.1. Educational Facilities

The city of Duhok lacks the available amount of educational services. According to the General Directorate of Education in the city, there is a great deficiency in the sector of education in terms of offering the number and size of the schools and their spatial distribution. Sharing of more than one school in the same building based on two learning shifts (morning and afternoon) has created problems for the process of education in the city, and is operating in all the schools in the city of Duhok. Therefore, there is a crucial need for constructing additional numbers of education facilities in the neighbourhoods. The shortage of available land for this purpose within the already developed neighbourhoods has constrained the process of developing new educational facilities in these neighbourhoods– see Table 12-9.

Table 12-9: Deficiencies in the area of the educational facilities in the city of Duhok

Educational Activities	Existing Area (hectares)	Area according to Iraqi Indicators (h)	Deficiency in Area (h)	Percentage of Deficiency %
Kindergarten	6.16	28.42	22.26	361.36%
Primary Schools	66.19	99.45	33.26	50.25%
Preparatory Schools	24.52	71.04	46.52	189.72%
Total	96.87	198.91	102.04	105.34%

Source: Own construct based on Information from Directorate of Education

⁴⁵ -The percentage of the area of urban services is not reflecting the real amount of the developed area for urban services in the city of Duhok, for example, the area which has occupied by the campus of the University of Duhok is 311 hectares and only about 35 hectares are occupied by different buildings as built-up area and the remaining is undeveloped area. The actual amount of educational services (including the universities) is 151.77 hectares.

⁴⁶ - Other factors influence the performance of the educational and health institutions to present their services to the citizens in a proper way, which related to the structure and managing of the institutions.

The following formula is used to determine the pattern of the spatial distribution of the activities of the education in the city of Duhok by using Standard Distance⁴⁷ formula (Wong & lee, 2005);

$$SD = \sqrt{\frac{\sum (X - X')^2 + \sum (Y - Y')^2}{N}}$$

SD = Standard Distance
 (X, Y) = Feature Coordinates
 (X, Y') = The Mean centre of the features
 N = Number of features

The computed results are shown in the following table.

Table 12-10: Standard distance for educational facilities in the city of Duhok

Educational Activities	Standard Distance value (m)	Percentage of activities with the circle	Area of the circle (h)	Percentage of serviced Area of the city
Kindergarten	2800	72.5	2562.68	44.47
Primary Schools	3250	71.4	3418.8	59.32
Preparatory Schools	2750	70.08	2384.5	41.38

Source: Own construct based on Information from Directorate of Education, 2015 by using ArcView 10

From the above results, the following remarks can be noted:

- Primary schools are more scattered in the city followed by kindergarten and preparatory schools.
- Kindergartens are concentrated in the area of 2562.68 hectares representing 44.47% from the area of the city which mainly located in the western newly developed neighbourhoods in the city.
- Primary schools are serving 3418.8 hectares representing 59.32% of the total area of the city.
- Secondary and preparatory schools are serving the area of 2384.5 hectares represented by 41.38% from the total area of the city.

It is clear that about 50% of the area of the city is not served by the education facilities.

To examine the distance between the educational services in the city of Duhok, Nearest Neighbour Index⁴⁸ (NNI) is used to measure the distance between each educational activity, and then the proximity of these activities is quantified using ArcView 10 software to identify the average distances (Nagle & Spencer, 2000).

$$\text{Nearest Neighbour Index (R)} = \frac{2 \times \text{Mean nearest neighbour distance (D)} \times \sqrt{\text{number of events (n)}}}{\text{Area of region (A)}}$$

⁴⁷- Standard Distance (SD) measures the degree to which features are concentrated or dispersed around the geometric mean centre (Wong & lee, 2005). The standard distance provides a single summary measure of features distribution around their centre.

⁴⁸ Nearest Neighbour Index (NNI) is a measure of the spatial distribution of points and is derived from the average distance between each point and its nearest neighbour. The figure is then compared to computed values which states whether the pattern is: Regular (NNI =2.15) or clustered (NNI =0) or random (NNI=1.0) (Nagle & Spencer, 2000)

The value of the pattern of distribution can be compared to the following neighbour indexes-see Table 12-11 and Figure 12-13, 12-14 and 12-15.

Table 12-11: Neighbour Indexes

Index value	Distribution Pattern
0.00-0.09	Regular
0.10-0.49	Near to clustered
0.50-0.99	Near to random
1.00-1.19	Random
1.20-2.15	Dispersed

Source: Own construct based on the calculation of (NNI)

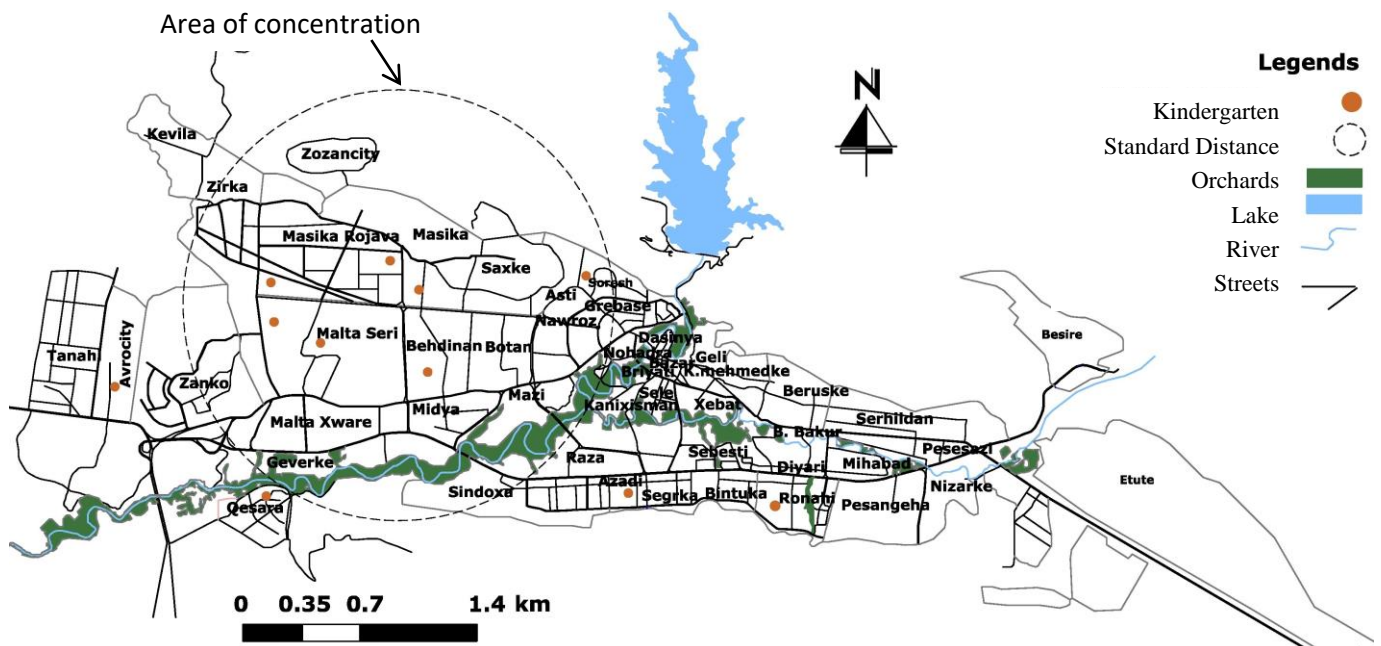


Figure 12-13: Distribution of kindergartens in the city of Duhok

Source: Own construct based on satellite images; plans from the Municipality of Duhok, 2015; Directorate of Constructive Planning in Duhok, 2015

The above calculations show that:

- The standard value of the kindergarten displays a random pattern of distribution.
- The standard value of the primary and the preparatory schools displays clustered distribution pattern towards scattering to the north and west direction.
- NNI value of kindergarten shows a random distribution. Most of the kindergartens are located in the western neighbourhoods of the city, while there is a shortage in other neighbourhoods. The value of NNI for primary and preparatory schools displays a random distribution of the schools. These facilities are concentrated around the city centre and are dispersed in the north and south parts of Duhok.

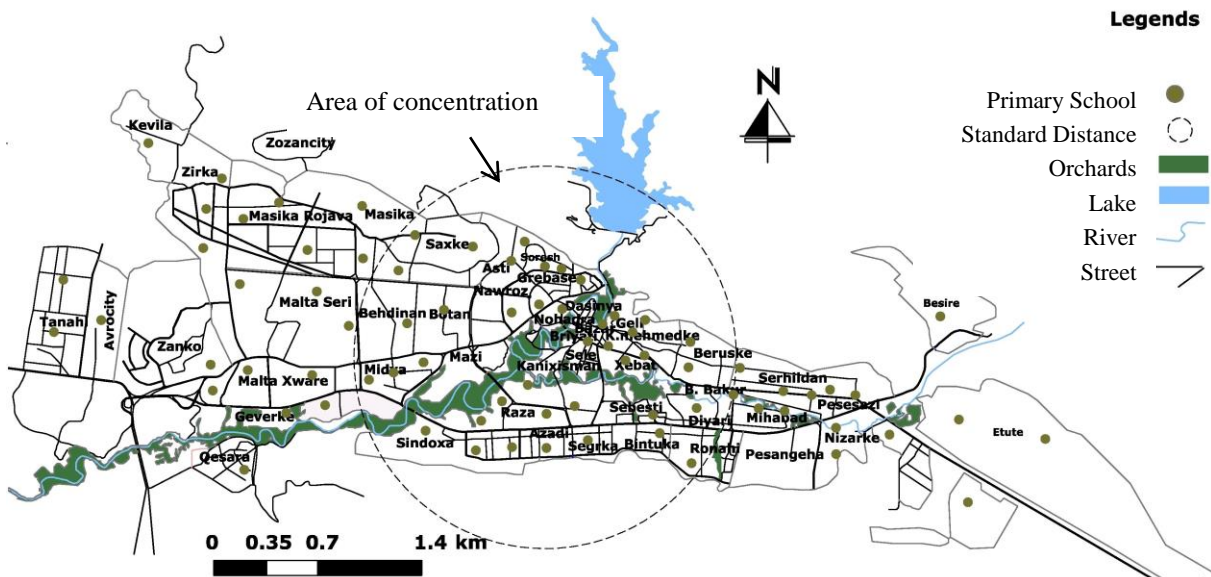


Figure 12-14: Distribution of primary schools in the city of Duhok
 Source: Own construct based on satellite images; plans Municipality of Duhok, 2014;
 Directorate of Constructive Planning in Duhok, 2015

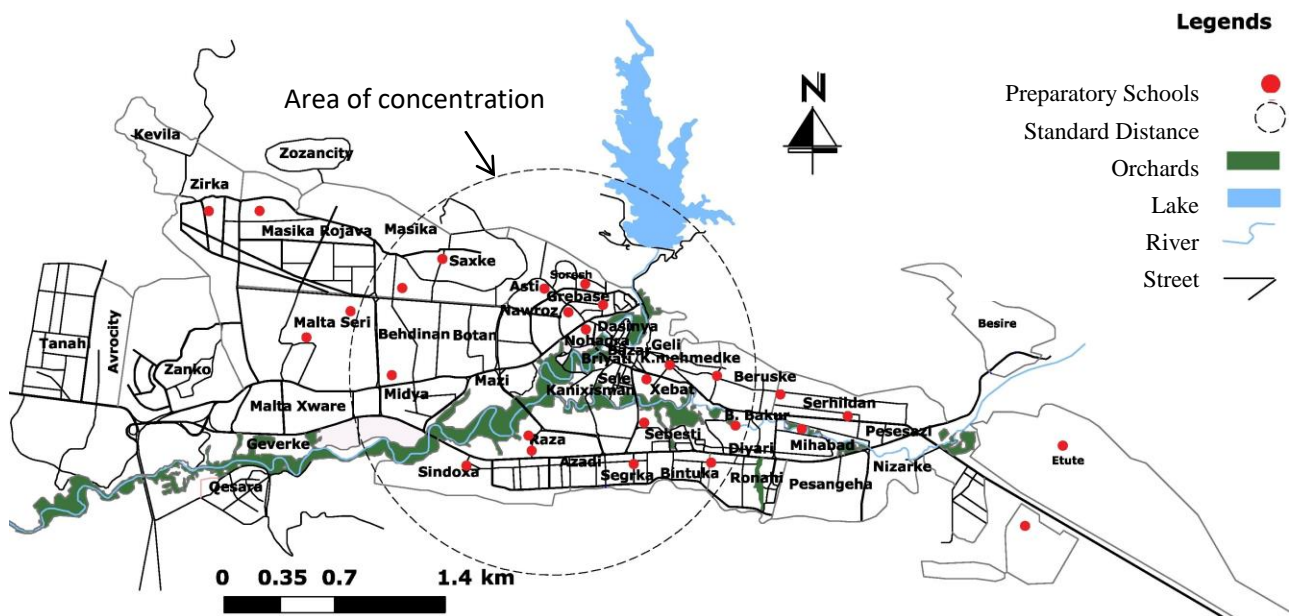


Figure 12-15: Distribution of preparatory schools in the city of Duhok
 Source: Own construct based on satellite images; plans Municipality of Duhok, 2014;
 Directorate of Constructive Planning in Duhok, 2015;

Based on the gathered information from the General Directorate of Education in the city of Duhok, there is a concentration of the primary schools in the eastern part- Beruşkê Sector⁴⁹ -of the city especially in the Kanixişmana, Kanîmehmedkê, Serhildan, Beruşka Bakur, Beruşkê, Şêlê and Xebat neighbourhoods. As described earlier that these residential neighbourhoods which are in the eastern part of the city established and developed under

⁴⁹ - The municipality has no official classification for dividing the city into sectors. These labels are localised by the inhabitants to bring the areas closer to mind, despite the fact that the Hişkero River is a natural border of the division of the city of Duhok to sectors.

certain circumstances without having proper planning and strategies for developing them. In the southern part -Nizarî Sector- of Duhok despite that most of the neighbourhoods of this part have been developed according to the third master plan, there is a great deficiency in the spatial allocation of the educational services in this part of the city. There is a shortage of school buildings in the western part which developed after 1998, the situation is not better than the south part. These neighbourhoods have been developed according to the fourth and fifth master plan in the sixth morphological stage. The residents are striving to find out the nearest school to attend their children.

Coverage area 'catchment area' is used as a simple mathematical method for analysing the area covered by the education and health services. Many factors affect the distribution and accessibility to these services such as population density and the street network pattern. The coverage area depends on the degree of proximity and contiguity of the circles of coverage area to each other.

According to the regulations, the radius of the circle of the coverage area for kindergarten, primary school, intermediate and secondary schools should not exceed to 250m, 500 m and 800 m respectively, and for higher education and colleges, the distance is from 2 to 3 km (Directorate of Constructive planning in Duhok, 2013; General Organisation of Housing in Iraq, 1986). Iraqi regulation indicates that every 2500 inhabitants need one primary school. However, the low density neighbourhoods and scattered settlements do not fulfil this criterion, and for the intermediate and secondary schools, every 5000 inhabitants need one school (Directorate of Constructive Planning in Duhok, 2013). Calculations show that these criteria are not properly applied in planning, designing and allocation of the educational facilities in the city of Duhok.

The coverage area shows a sparsely overlapping and remaining of the huge area of the city outside of the coverage circles. The area of the city which is served by the educational facilities is about 35% of the total area and 65% of the area is un-served, displaying that these services are not afforded to the city's residents within the reachable distance - see Table 12-12.

Table 12-12: Served and Un-served area of the city by Educational facilities in Duhok

Educational Activities	Served Area (h)	Percentage of served area %	Un-Served Area (h)	Percentage of Un-Served Area
Kindergarten	2199.74	38.17	3536.26	61.83
Primary Schools	2040.10	35.40	3722.90	64.60
Preparatory Schools	1455.73	25.26	4307.27	74.74

Source: Own construct based on Directorate of Constructive Planning in Duhok, 2015 by using ArcView 10 and AutoCAD

The calculations confirm that the educational services in the different parts of the city do not ensure applying the urban planning regulations by the municipality. Many spatial indicators have not been taken in regard such as; differentiation in population density and, in the distances between the neighbourhoods in allocating educational services in the city.

Spatial allocating of the colleges and other higher education centres such as; University of Duhok and Nowruz in the city of Duhok, has not considered many criteria such as

accessibility, the offering of the public transportation and car parks. Normally these facilities bring more traffic flow of pedestrians and vehicles than the schools to a certain area.

12.6.2. Health Facilities

In general, health facilities in the city of Duhok can be classified according to their spatial distribution and the types of services offered to the citizens:

- Specialised public hospitals, these hospitals mainly concentrated in the neighbourhoods of Serbestî near to the city centre, Newroz and Xebat.
- Specialised public health centres, these 19 centres are scattered in the city ,
- Specialised health laboratories are presenting different lab testing to the citizens,
- First Aid centres are treating initial cases, 16 centres scattered throughout the city,
- Private Pharmacies and drugstores are concentrated in the city centre of Duhok in the neighbourhoods of Bazar and Brayetî,
- Private-Owned Hospitals, these types of hospitals appeared after 2003, there are about 10 hospitals, mainly located in the neighbourhoods near to the city centre.
- Private-Owned Clinics, they are concentrated in the city centre and sparsely in other places. These clinics are one of the main sources of bringing the flow of traffic and pedestrians to the city centre (Municipality of Duhok and Directorate of Traffic).

Most of the health facilities- except primary health centres- present their services to the city's citizens and the city's regional citizens. The zone which is dedicated to the health facilities is located in the south-eastern part of the city near to the city centre, the place where the Azadi General Hospital is located. This zone encompasses important health facilities in the city of Duhok. All the city's inhabitants, in addition to the inhabitants of the Duhok province, mainly depend on these facilities for serious and intractable cases. Therefore, this zone is overcrowded and bring much traffic flows of pedestrians and vehicles to the area –see Figure 12-16.

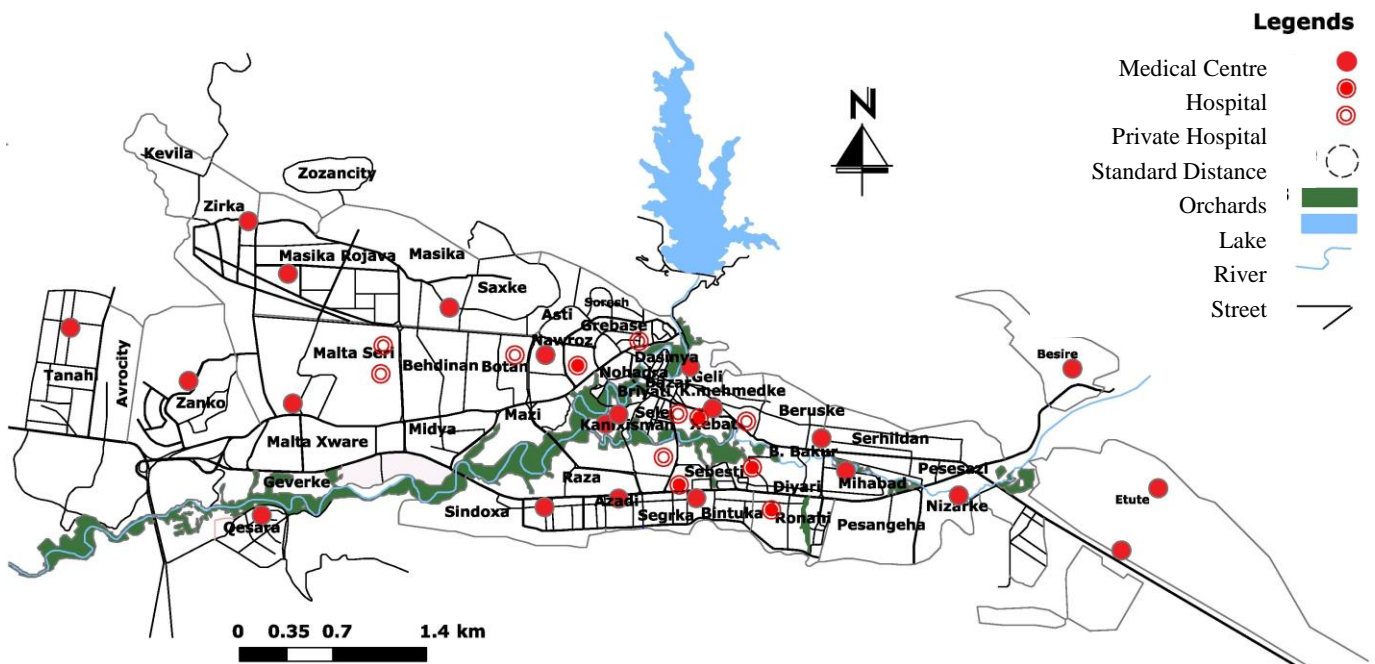


Figure 12-16: Spatial distribution of health facilities in the city of Duhok

Source: Own construct based on data from General Directorate of Health and Guidance and Information Centre in Duhok, 2015; Directorate of Constructive Planning in Duhok, 2015

The radius of the coverage area for health centres is 800m (Directorate of Constructive Planning in Duhok, 2013; General Organisation of Housing in Iraq, 1986), and each centre serves from 5000 to 8000 inhabitants. There are no indications in real-life that these measurements have been adopted for allocating health centres in the city of Duhok even in the newly developed area.

Using the Near Neighbourhood Index (NNI) method to determine the spatial distribution of the health centres in the city of Duhok, the calculations show that:

- The standard value for the health centres is between the critical value +2.58 and -2.58, displays that the pattern of distribution is randomly allocated in the city without following proper strategies for distribution.
- The value of (NNI) 1.244580 indicates that the health centres are scattered in the city, there are many neighbourhoods without health facilities.
- Distribution of these facilities is forced by the rapid growth of the city.

The results of the Standard Distance (SD) method display that the value of (SD) is 4212m and the drawn circle shows the concentration of services in the middle of the city around the city centre. About 69.2% of the health centres are covered by the circled areas, showing that the distribution of these centres does not follow certain spatial criteria such as; population density, distance between the neighbourhoods and the area of the neighbourhoods- see Figure 12-17.

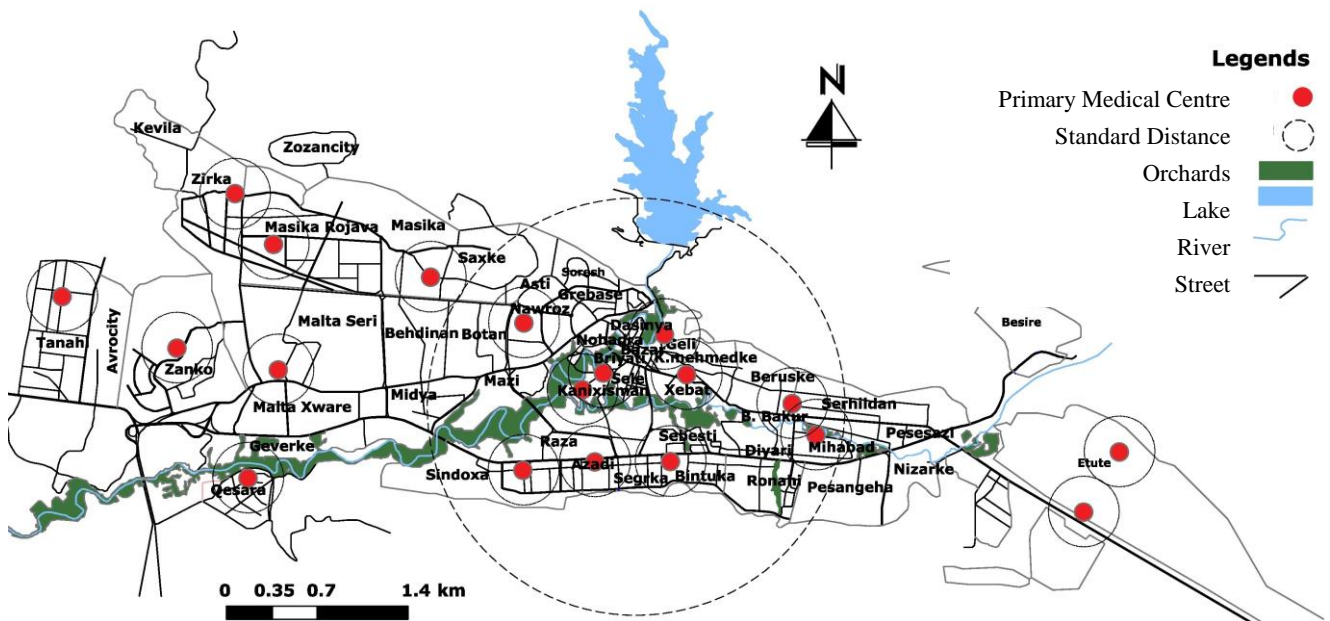


Figure 12-17: Spatial distribution of the primary health in the city of Duhok

Source: Own construct based on data from General Directorate of Health and Guidance and Information Centre in Duhok, 2015; Directorate of Constructive Planning in Duhok, 2015

Using catchment area techniques 800 meters as maximum radius according to the Iraqi Urban Planning Standard, the results show that 2532.62 hectares of the city are not served by these facilities. The unserved area is about 43.95% of the total area of the city and 87.06% of the total land designated to the residential area. Some of the neighbourhoods have full service while other neighbourhoods in the western and northern part are partially or permanently not

covered by these facilities. The longitudinal shape of the city and the existence of large neighbourhoods have negatively affected the distribution of health services.

12.8. Amount and Allocation of the Commercial Uses

The commercial services in the city of Duhok at the neighbourhood and city level, have witnessed essential changes in their function and structure during the last decades of the city's spatial evolution. The deficiency in the spatial distribution of the commercial uses in the city has affected the ability of the commercial facilities to meet the needs of the residents within a walking distance of 500 meters. Most of the daily and weekly shopping takes place in the city centre as the conducted interviews with the residents of the neighbourhoods confirmed. Thus, the shopping experience in the core city is tedious for citizens. At the same time, is adding extra cost to the services and brings an influx of pedestrians and vehicles to the city centre. The absence of the decentralised-concentration concept in distributing commercial facilities in the city of Duhok, is the main reason for overloading and the increase in the traffic flow of pedestrian and vehicles in the city centre of Duhok.

The share of each resident in the city⁵⁰ from different commercial uses, is 3.00 m² per person including the area of the city centre (Iraqi Housing Standard, 1986). The defect in the amount of developed land can be quantified by subtracting the area of the developed land and the area required in theory- see formula below (ii). The negative result indicates that the developed commercial area is low with reference to the planning standards; therefore, additional land must be provided to fill the deficit. The positive result indicates that the commercial area is high and surpasses the recommended amount. Compare the available commercial land with the standards by applying the following formula;

(i) Theoretically recommended Area = Number of the population x 3m² (a maximum area dedicated to each person according to the Iraqi Planning Standards)

(ii) Defect in the amount of Developed Land = Actual developed Area – Recommended Area

Based on the above two equations the amount of the required land in the city of Duhok is:

$$\begin{aligned} &= 355193 \text{ (currently number of population in Duhok x 3m}^2\text{)} \\ &= 1065579\text{m}^2 \\ &= 106.56 \text{ hectares} \end{aligned}$$

$$\begin{aligned} \text{Defect in Amount of developed land} &= 186.12 \text{ hectares (developed area) – 106.56 hectares} \\ &\text{(recommended area)} \\ &= 79.59 \text{ hectares} \end{aligned}$$

It could be said that the area of the commercial uses is not compatible with the number of the population. About 80 hectares of the commercial land surpasses the needs of commercial services in the city. Increasing the commercial services has negatively affected the economic state of the retails on the commercial streets. There is a large number of vacant shops that can be seen in the commercial streets, being offered for rent. The Municipality of Duhok was not able to estimate the actual requirement of commercial land because of depending on land

⁵⁰ - This standard is not applicable to the cities which have a commercial function and depending on trading and also all the commercial services of regional activities are excluded.

transformation from residential to commercial in these streets (Interview with the President of the Municipality of Duhok). Therefore, the amount of the transformed land to commercial has not been in accordance with the city's requirements for commercial facilities. Mainly, the transformation process depends on the size and the length of streets and the decision of the City Council regarding final approval. Usually, the Municipality receives proposals from the owners of the residential plots to transform the pattern from residential to commercial uses in certain streets – see Figure 12-18. Then, the proposals are submitted to the city council for final approval.



Figure 12-18 Transformation of residential uses to commercial and mixed uses in Karwan Street (left) and Şoreş Street (right)

Source: Photo by the Researcher in 2014

The previous master plans of Duhok did not identify the areas adjacent to both sides of the streets, which are subject to the transformation process from residential to commercial or mixed uses. Rather, the land use along the streets are indicated as residential use. Transforming residential land use on streets to commercial land use became a planning culture in the Kurdistan Region. All the commercial streets in the city of Duhok were not previously planned or designed for commercial activities, but they transformed from residential to commercial use. The transformation process was enforced by the plot owners to increase their property's value. The process was not successfully managed and controlled by the Municipality because of the lack of sound strategies and mechanisms in promoting mixed uses in the commercial streets. Changing residential use to commercial as the main strategy for promoting new commercial land use, has created many problems in the city such as;

- Sprawling of commercial services along main streets and creating a long journey to obtain essential services by residents,
- Generating congestion and lack of the accessibility, shortage of on-street parking, narrow street width and sidewalks of the transformed streets,
- Fragmenting city skyline due to the uncontrolled building heights, and
- Reducing property values of residential units and plots which are located behind the commercial ribbons in the same urban block (Interview with residents) – see Figure 12-19.

According to the Municipality regulations, the residential houses which are directly located behind the commercial ribbon, are not allowed to transform or add more than two stories. Thus, the commercial ribbons with high-rise buildings block sunlight, wind and natural ventilation to these houses. In addition, disturbs the privacy of the residents. The

transformation process can be observed in all main arterial streets (e.g. Qazîmuhammad, KRO, Beruşkê, and Serok) and other main collectors.

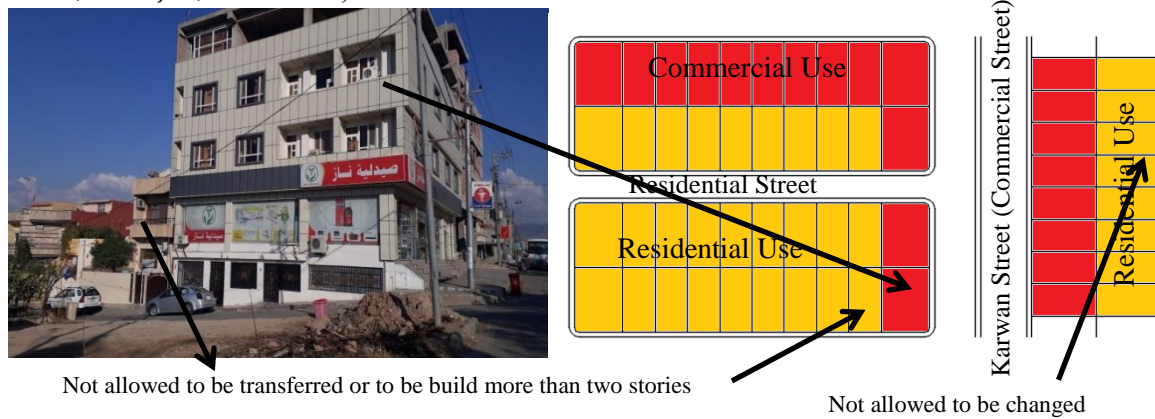


Figure 12-19: Transformation of residential uses to commercial in Karwan Street
 Source: Own construct based on observation and data from Directorate of Constructive planning in Duhok, 2015

12.9. Spatial Diversity in the city

Diversity as one of the important criteria for promoting sustainability in the city, has not been adopted as a strategy by the Municipality of Duhok. Iraqi Housing Standards mentioned housing diversity implicitly in the provision of ranges of housing choices, to respond to the needs of the citizens of different groups within the residential neighbourhood.

Diversity here, refers to mixed land use as an act of putting different land use (e.g. residential and commercial or residential and institutional...etc.) in proximity to one another at the neighbourhood and or city level. Diverse development patterns generate a sizable population and commercial base for supporting public transport and consolidate liveability and vitality to the areas in the city.

In order to assess the diversity of the land use in the city of Duhok, the Land Use Mix (LUM) indicator is applied for testing the existence of the variety of land uses. In this regard, six categories of land uses have been chosen. These are essential to the sustainability of any city, namely; low-residential housing, high residential housing, commercial facilities, light industries, urban services and recreational facilities.

The indicator of Land Use Mix (LUM) examines the variety of land uses (Frank, L.D et al, 2006). The value of this index ranges between (0) and (1) as non-mixed and completely mixed area respectively. The full ranges of human activities within a certain area reflects the perfectness of the land use diversity. The following formula has been applied to determine the diversity of the land use in the city of Duhok:

$$\text{Land use mix} = -A / (\ln(N))$$

Where area =

$$A = (b_1/a) * \ln(b_1/a) + (b_2/a) * \ln(b_2/a) + (b_3/a) * \ln(b_3/a) + (b_4/a) * \ln(b_4/a) + (b_5/a) * \ln(b_5/a) + (b_6/a) * \ln(b_6/a)$$

a = total land for all six land uses present in buffer

b1 - b6 measure areas of land use for:

b1= single-family residential, b2= multifamily residential, b3= Commercial, b4= Light Industrial, b5= Urban Services, b6= Recreational and N= number of six land uses with area > 0, Duhok area=5008 hectares⁵¹.

By applying the formula, the result is:

$$\begin{aligned}
 A &= (2759/5008) * \ln (2759/5008) + (150/5008) * \ln (150/5008) + (186.12/5008) * \ln \\
 &(186.12/5008) + (196.52/5008) * \ln (196.52/5008) + (518.67/5008) * \ln (518.67/5008) + \\
 &(97.98/5008) \\
 &* \ln (97.98/5008) \\
 &= - 0.698 \\
 \text{Land use mix} &= - (- 0.698 / (\ln (6))) \\
 &= 0.39
 \end{aligned}$$

The result shows that the city is less diversified because the value is closer to (0) than to (1). There are many neighbourhoods and quarters in the city that are known by their prominent characteristics in terms of social and tribal background (Nomads, Gypsies, Mizori)⁵², professional (Doctors, lawyers, Cadres, Academies), income (Millionaires) and types of housing (Shuqa). This social trend in naming areas reflects the predominant single characteristic of a certain area which lacks mixed use and diversity in these neighbourhoods.

The Municipality of Duhok and Directorate of Constructive Planning, have encouraged spatial non-diversity through the processes of unified land subdivisions, types of linear urban block, and the type of houses in these neighbourhoods. Interestingly, there are attempts to promote diversity in the newly developed neighbourhood of Êtûtê which was established in 2011. However, the neighbourhood is still under development and has not yet been completed. Êtûtê Neighbourhood – despite many deficiencies - it is a good example in the city of Duhok as a diversified neighbourhood in terms of; plot sizes which range from 225m² to 600m², urban block types, length and sizes, a mix of low and high rise housing and recreational areas. Unfortunately, the neighbourhoods which have been developed after 2011 hold the same characteristics of the previous non-diversified neighbourhoods such as Kêvilan, Hawşkê neighbourhoods.

The City Centre of Duhok before one decade, was more diversified than today due to the existence of a mixture of residential, commercial, handcrafts and institutional buildings. The Municipality has undertaken some strategies to decongest the City Centre by moving all the Government offices to the southern part of the city along Barzan Street and industrial zone in Nizarkê.

⁵¹ - The total area of the city of Duhok is 5763 hectares, for the purpose of scrutiny the area of the orchards and the area of land under high transmission line subtracted which is 755 hectares.

⁵²- These names are still applicable especially in the old centre and old informal neighbourhoods in the city of Duhok.

12.10. Conclusion

The pattern of the land use, mode of the transportation system, degree of density and the compactness, percentages of open spaces and other social aspects in the city are critical aspects of the quality of the urban environment. Evaluation of these aspects provide indications regarding the performance of the urban form and structure of the city and points out the degree of sustainability in the city.

The city of Duhok has transformed from compacted settlement to more sprawling. The population density is not evenly distributed, and there is a huge gap in population density between the neighbourhoods in the city. Many neighbourhoods have a high population density and a high accommodation gross density. These neighbourhoods are mainly located in the eastern part of the city, and other neighbourhoods are sprawled and have low population density and accommodation gross density.

The calculations confirm that the spatial urban growth and population growth are not compatible and there is a high rate of land consumption for development purposes. The excessively used land shows a high rate of land depletion in the city. Despite the high consumption rate, there is still impropriety in utilising the land for different facilities and an imbalance between land use patterns in the city.

The city of Duhok has an inefficient street network in terms of the number of nodes and the connectivity of the street networks. The street network in the city works as an incomplete and unintegrated network. More segments need to be added to the city's network to increase accessibility and mobility. The city of Duhok has a very simple and inefficient public transport system which is not evolving to reflect a modern urban transport system.

Despite the availability of green open space in the city of Duhok, the developed area for recreation purposes is not utilised and not spatially distributed to serve the residents in the city. There is a deficiency in offering green space in the city.

Other urban services (e.g. educational and health facilities) in the city of Duhok are not spatially distributed and there is a great deficiency in the amount and the proximity of these services. There are some areas in the city experiencing a concentration of the services while other areas suffer.

The process of transforming residential uses on the main arterial streets to commercial and other uses, has generated many spatial and functional deficiencies such as; congestion, loss of residential property value, sprawling of commercial uses and generating long journeys.

Chapter Thirteen: A Comparative Outlook for the Sustainability of Neighbourhoods

13.1. Introduction

This chapter analyses segments from the eight neighbourhoods as sub-cases representing the urban form and structure at micro-level inside the city of Duhok. The selection of these sub-cases is based on the criteria presented in section 7.2 in Chapter Seven. The sub-cases are selected as units from different neighbourhoods for a more detailed investigation about the sustainability of the urban form and structure-see Figure 13-1. To assess urban form and structure in these segments many indicators have been used for the evaluation process- see Section 6-6 in Chapter Six.

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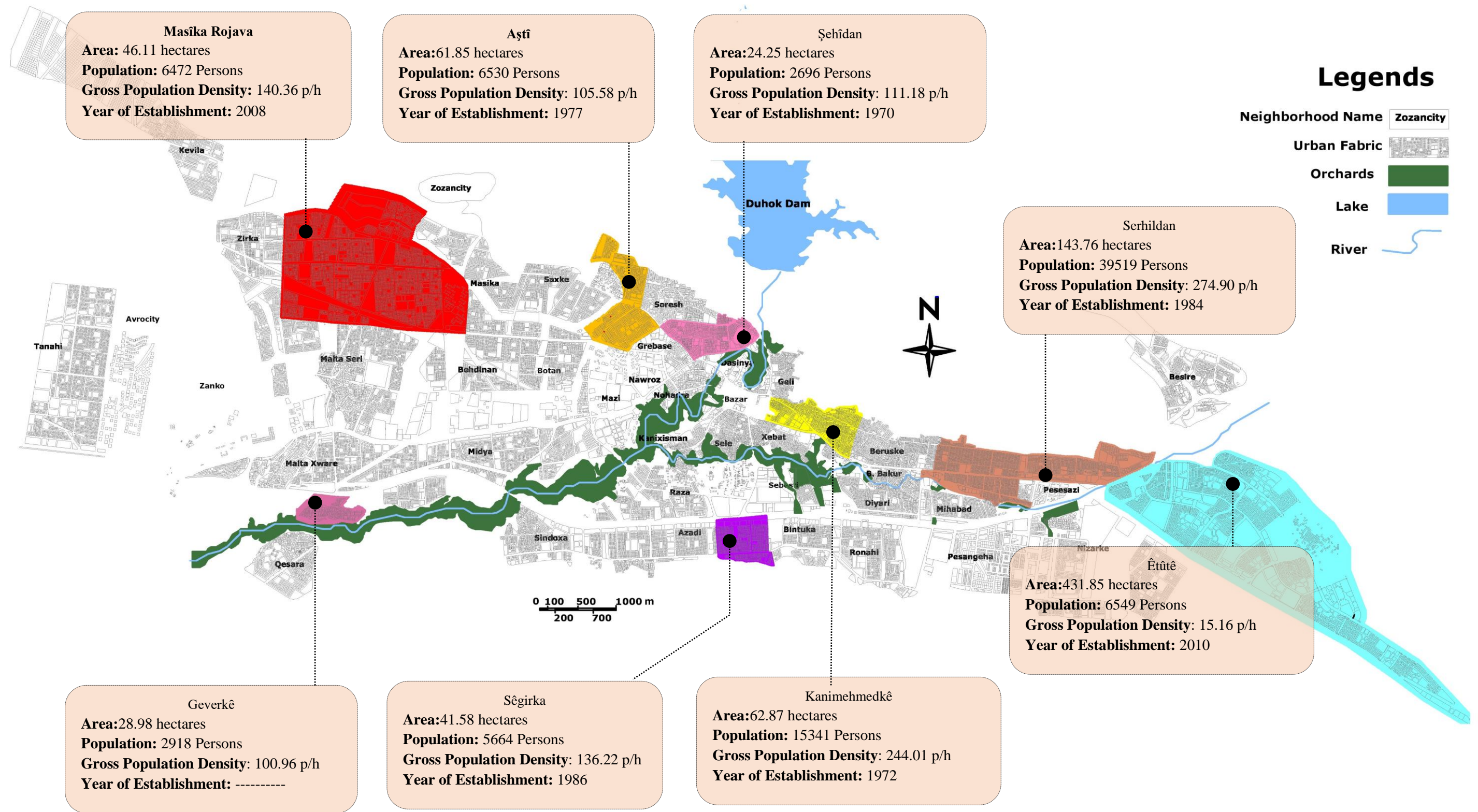


Figure 13-1: Location of the selected neighbourhood segments in the city of Duhok
 Source: Own construct based on the neighbourhood plan of the Municipality of Duhok and document analysis

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13.2. General Descriptions of the selected neighbourhoods

In this section, the basic features of the selected neighbourhoods are presented in order to draw a clear image of the spatial characteristics of the selected neighbourhoods.

13.2.1. Aşfi Neighbourhood: The best designed and planned in 1978

Aşfi neighbourhood was established in 1978 as one of the modern planned neighbourhood in the city of Duhok at that time. It is situated in the north-western part of the city. The land was granted to government employees by the local government in the city of Duhok at a subsidised price (Duhok Governorate, 1987). The residents of the neighbourhood were public employees from different government sectors. The neighbourhood was designed by the General Directorate of the Constructive Planning in Baghdad- North Region/Iraq in 1977. The development of the neighbourhood was a part of the Third Master Plan agenda of the city of Duhok (Municipality of Duhok).

The size of the neighbourhood has increased by annexing the eastern part of the Şaxkê village to the neighbourhood in 1998, to form a new neighbourhood boundary between two different periods of development. Only the original part of the neighbourhood has been investigated because the new linked part does not differ from the other newly developed neighbourhoods in Duhok (e.g. Masîka Rojava) - see Figure 13-2.



Figure 13-2: General observation of Aşfi neighbourhood

Source: Own construct based on surveying and plans form the Municipality of Duhok, 2015

In general, the neighbourhood characterised by the following attributes:

- The large part of the neighbourhood boundary is surrounded by the arterial loop of 20m width bisecting the neighbourhood into two disconnected parts, which constrains the pedestrian movement and the connectivity of the neighbourhood,
- Two-row houses, the semi-attached type, dominates the neighbourhood,

- The concept of the neighbourhood is clear with the existence of a community centre,
 - Some of the essential daily services can be found in the neighbourhood (e.g. shops, primary school, kindergarten and religious centre) which are located in the centre of the neighbourhood with a maximum distance of 500 m,
 - Absence of the concept of clear street hierarchy. The typical width of the street is 7.50 m, while narrow alleys are 5.00 m,
 - One storey and two-storey houses are prevalent,
 - All the houses have a minimum setback of 2.50m,
 - The neighbourhood has relatively large plots ranging from 300m² to 450m²,
 - The neighbourhood has diverse block length ranging from 60 m to 200 m, and block depth ranging from 20 to 56.5 m,
- Few small community gardens exist, there are play areas for youth and children.

13.2.2. Êtûtê Neighbourhood: The new planning approach

Êtûtê is one of the biggest planned and newest neighbourhoods in the city of Duhok. The neighbourhood also consists of two parts; the old part is represented by the village of Êtûtê and the newly developed part of the neighbourhood along the main Erbil and Duhok transit road- see Figure 13-3. Currently, the neighbourhood is under development and has not yet been completed. According to the former director of the Constructive Planning in Duhok, there is no encouragement from the owner’s side for development due to the restrictive regulations imposed by the Municipality. The people have since been acquainted with the restrictions and enforcement. For example, subdivisions and unification of the plots have been prohibited in this neighbourhood with restrictions on leaving minimum setback of 4.00m from the front and 2.00 m at the rear.



Figure 13-3: General observation of Êtûtê neighbourhood

Source: Own construct based on observation and plans from the Municipality of Duhok, 2015

A new design and planning approaches have been adopted to develop this neighbourhood which is different from the old fashions of the developments. The neighbourhood has the following spatial characteristics;

- The concept of the communities can be observed,
- All the planned urban community services are in proximity of 600 metres ensuring the concept of decentralised-concentration in distributing services,
- The hierarchy of street networks is clear,
- Creating a loop street around the neighbourhood as urban growth boundary to constrain any future informal development beyond the loop,
- The linear and curvilinear urban blocks with one row of attached houses are dominant,
- Attached houses have two open faces; one on a residential street and the other on a pedestrian way,
- A mixture of high rise and low rise residential housing,
- Different lengths of the linear block with a fixed width of 27.00m
- Diversity of plot sizes from 254 to 600 m² exist, and
- Providing many open green spaces within the plan.

13.2.3. Geverkê Neighbourhood: The organic form of urbanised village

Geverkê is one of the former villages annexed to the city of Duhok during the sixth morphological stage of the city development. It is situated in the south-west corner of the city of Duhok. The village has urbanised and is considered as one of the neighbourhoods in the city of Duhok in 2009- see Figure 13-4.



Figure 13-4: General observation of Geverkê neighbourhood

Source: Own construct based on observation and plans from the Municipality of Duhok, 2015

The neighbourhood has the following characteristics:

- The neighbourhood reflects the characteristics of the village,
- The neighbourhood has no centre of services. The essential urban services are not available except one primary school,
- Dominating of traditional open planned houses, while there is a clear transformation towards the closed-plan,
- Clear transformation of the residential uses to the commercial on the main arterial and collector streets,
- Existence of organic street pattern with narrow and winding alleys, the width ranges from 5.85 m to 13.40m. The developed and the paved residential streets also have no sidewalks,
- The houses are attached and semi-attached,
- Dominating of low rise buildings of one-storey buildings,
- Relatively the plots are irregular. The sizes range from 118.50m² to 933.70m²,
- The neighbourhood has irregular urban blocks with different spatial shapes, their length range from 30m to 202m and width from 10m to 40m,
- There is no public green space; children playground and other entertainment.

13.2.4. Kanîmehmedkê Neighbourhood: The upgraded informal settlement

Kanîmehmedkê neighbourhood is located in the north-east part of the city of Duhok. It was an informal development established between the years 1970- 1994 in the vicinity of the city as one of the informal settlement pockets (Municipality of Duhok). It was upgraded in 1996 by implementing paved roads and essential infrastructure facilities (e.g. water, electricity) – see Figure13-5. The majority of the residents are migrants from the villages of the province of Duhok searching for job opportunities and safety.



Figure 13-5: General observation of Kanîmehmedkê neighbourhood

Source: Own construct based on observation and plans from the Municipality of Duhok, 2015

The characteristics of the informal settlement are observed through many features:

- There is no neighbourhood centre and clear boundary for the neighbourhood, it can't be distinguished from other attached neighbourhoods of Beruşkê and Gelî,
- It is one of the crowded neighbourhoods in the city,
- All the urban services are not available,
- The organic street network consists of the main direction of north to south due to the slope of the area, the minimum street width is 6.40m and maximum is 19.80m,
- Cars can't access many of the streets due to the sharp incline of the area,
- The two-row attached and the semi-attached pattern is dominant, with one-row houses,
- The open-plan dominant with the clear transformation towards closed-plan type,
- One story buildings are more prevalent than of two-storey buildings,
- The irregular shape of urban blocks is prevalent, the longest is 207.40 m with a depth of 41.00 m, and
- The plots interlock with each other, the smallest plot size is 98.85 m and the largest is 497.40m, there are no green open spaces and other recreation facilities.

13.2.5. Masîka Rojava Neighbourhood: The new trend of buildings' type

The neighbourhood established in the late of 2005 and almost 85% completed in 2014. The land is granted by the government to public employees from different sectors. Masîka neighbourhood consists of two different parts, the old village and the new Masîka neighbourhood which named Masîka village. The old village is annexed to the city of Duhok. The old village of Masîkê is characterised by its organic form and irregular street networks. It becomes a part of the new Masîka neighbourhood. The newly developed part of the neighbourhood is characterised by its regular and ironic street network- see Figure 13-6.



Figure 13-6: General observation of Masîka Rojava neighbourhood

Source: Own construct based on observation and plans from the Municipality of Duhok, 2015

The neighbourhood has also two complexes of high rise housings situating in the north part of the neighbourhood. In general, it is characterised by the following attributes:

- Despite that the neighbourhood is new, there is no neighbourhood centre and clear neighbourhood boundary,
- The available daily services are mostly located on the main arterial streets, except one primary school which is within the 5 minutes' walk distance,
- Regular and gridiron street network are prevalent. The residential streets are 8.00 m width with sidewalk 1.00m each side. Two perpendicular collector streets exist with 15.00m and sidewalks of 2.00m at both sides,
- Two-row attached housing is abundant,
- Low residential housing is prevalent with one, two and three stories,
- All the houses are attached on three sides back-to-back and side-to-side; leaving small courtyards,
- The neighbourhood has a typical plot size of 200.00m² and 250.00m² except for corner plots (300.00m²),
- All the urban blocks are of the linear type, the longest block is 150.00m and the shortest is 60.00m. The typical depth of the block is 40.00m,
- Lack of green spaces, the available green open space can only service a few houses around the space.

13.2.6. Sêgirka Neighbourhood: The uniform plot size

The neighbourhood was established between the years of 1983 till 1986. Residential plots were granted to the relatives of the martyrs of the Iraq-Iran war, in addition, they were offered building loans (Municipality of Duhok). The location of the neighbourhood was originally vineyards on the outskirts of the southern part of the city of Duhok – see Figure 13-7.



Figure 13-7: General observation of Sêgirka neighbourhood

Source: Own construct based on observation and plans from the Municipality of Duhok, 2015

The Sêgirka Neighbourhood was the first neighbourhood established in the southern part of the city and was the first leapfrog development initiative. The main characteristics of the neighbourhood are:

- The neighbourhood does not have a centre nor clear boundaries to be distinguished from the neighbours,
- Regular street network with straight roads are abundant, the residential streets are 7.50 m paved with sidewalks of 1.50 m and the collector has 10.00m width with sidewalks of 2.00m width,
- Two-row attached houses are the main feature. Old buildings are transformed using new building patterns,
- Low rise housing of one and one-and-half and two stories housing are prevalent,
- The front setback is between 2.00m -6.00m, and side setback and rear setback is from 1.00m – 2.00m,
- The sizes of the plots are uniformed with an area of 200.00 m² as well as the corner plots,
- All the urban blocks are linear pattern, the length of the longest one is 200.00m and shortest is 70.00 m. The depth of the blocks is 40.00m, and
- At the level of the neighbourhood, there is a lack of green open spaces and other recreational areas.

13.2.7. Şehîdan Neighbourhood: Early development initiatives for low-income families

The neighbourhood was established in the latter part of 1973 and formally developed - see Figure 13-8. The land was awarded to the relatives of martyrs of the Kurdish Revolution (Municipality of Duhok). The neighbourhood is situated in the north-west part of the city.

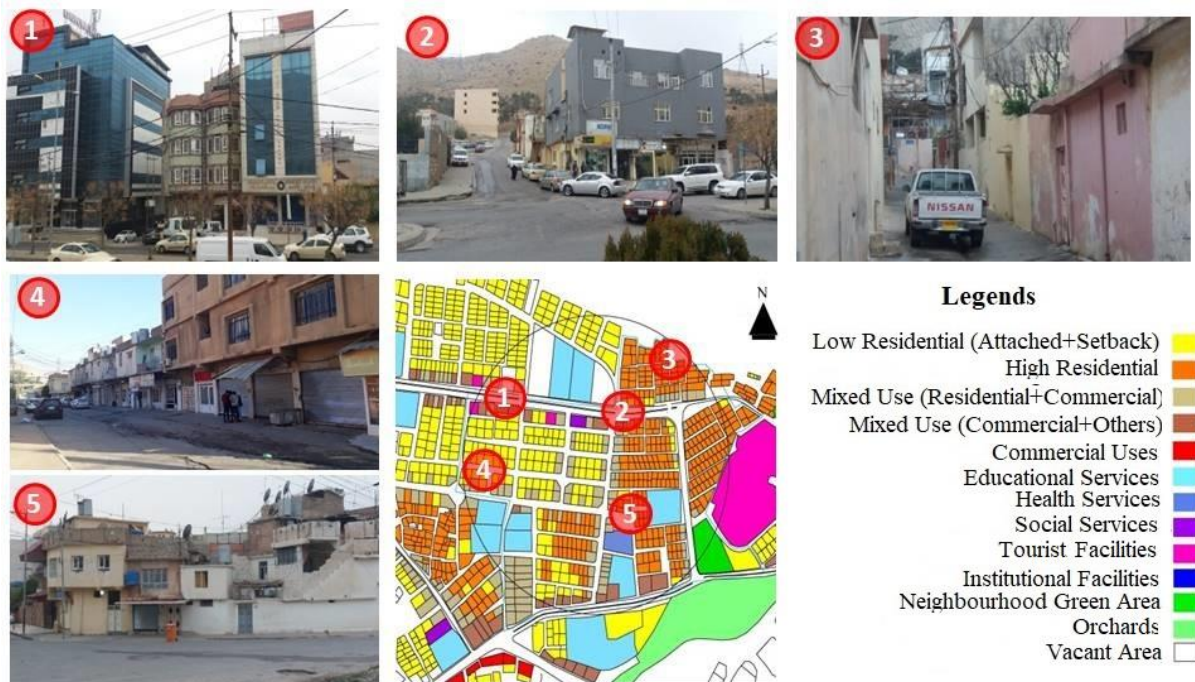


Figure 13-8: General observation of Şehîdan neighbourhood

Source: Own construct based on observation and plans from the Municipality of Duhok, 2015

Main characteristics of the neighbourhood are:

- The neighbourhood has no clear boundary nor a centre of services.
- The educational facilities exist within the proximity of 5 minutes' walk,
- The neighbourhood hosts one of the main hotels of the city,
- Some of the houses are illegally developed in the upper northern part of the neighbourhood with very narrow alleys with 4.00 om width without sidewalks,
- Loose iron grid of street network is abundant. The main arterial street of Şehîdan passes from the west to east.
- The neighbourhood is currently transforming from residential to mixed uses,
- Two-row attached and semi-attached houses are prevalent. The houses are mostly of open-plan (eastern style),
- All of the houses are low with one and two stories,
- The dominant plot size is 150.00 m² and 200.00m²,
- Different block width and lengths are many,
- Plots of 150.00m² are mainly of open-plan type without a setback, while plots of 200.00m² have different setback measurements from 1.00 m to 6.00m, and
- The neighbourhood lacks planned green open spaces.

13.2.8. Serhildan Neighbourhood: The one-row attached houses pattern

The neighbourhood was established in the latter part of 1985 - see Figure 13-9. The plots in the neighbourhood were granted to low-income families of the public sector in the city of Duhok. It is situated in the north-eastern part of the city.



Figure 13-9: General observation of Serhildan neighbourhood

Source: Own construct based on observation and plans from the Municipality of Duhok, 2015

The main characteristics of the neighbourhood are:

- The neighbourhood consists of three different planning approaches and designs which established in different periods from 1982 till 2012,
- The neighbourhood has no clear boundary and community centre,
- The neighbourhood has a longitude shape stretching from the west to the east,
- Many of the informal houses exist in the steps of the mountain in the north,
- The services are scattered all over the neighbourhood without having a clear concept for distribution,
- Narrow streets with 8.00 m width without sidewalks can be found in most parts of the neighbourhood above the main arterial street of Sehildan, while the upper north-east part is predominated by the iron grid, the street width is 8.00m with sidewalks of 1.00m on both sides. The lower part of the neighbourhood has streets of 6.00m in width with sidewalks in both shoulders of 2.00m.
- Two-row back-to-back and side-to-side attached and semi-attached houses pattern is prevalent. In the west-north part of the neighbourhood the open-plan type is dominant while in the east-north part is the closed-plan type which built after 2010. In the south part, one-row attached houses pattern prevails,
- Low residential housing with one and two stories are dominant, except on the main street,
- The dominant plot size is 150m² in the west-north part and 200m² in the east-north and south part,
- Linear urban blocks are dominant with different lengths and widths, the longest block is 185.00m having the width of 20.00m and the shortest is 60.00m having 40.00m depth, and
- No green open spaces and entertainment facilities.

13.3. Spatial Characteristics of the Selected Segments

This section evaluates the spatial characteristics of urban form and structure at the neighbourhood level in the city of Duhok. More detailed investigations have been carried out for the selected segments within five minutes' walk. The first section investigates socio-economic aspects of the neighbourhood segments, while the second section investigates physical aspects of the neighbourhoods.

13.3.1. Socio-economic Characteristics

Information regarding socio-economic aspects is obtained by conducting direct interviews with residents in the neighbourhoods. The first group of the questions targets the socio-economic conditions of the families and the other group of questions are related to the residents' satisfaction. The interviewees are members of the houses within the neighbourhood segments.

The main targeted houses are of single-family households, and the targeted apartments are located in the commercial streets within the neighbourhood boundary. In the commercial streets, the apartments are located on the upper floors while ground floors are occupied by different commercial activities. Thereby, the percentage of the surveyed single-family households which were interviewed was 93.90% of the total surveyed households, while the

percentage of apartments was 6.10 %. High rise housing buildings are normally implemented through investment projects⁵³ and located in some pockets in the city of Duhok such as Dabin, Zeriland and Avrocity apartments. These projects are usually gated communities. These apartments are not within the research ambient.

13.2.1.1. Owner -Occupation

Owner occupation in the neighbourhoods differ from one neighbourhood to another- see Figure 13-10.

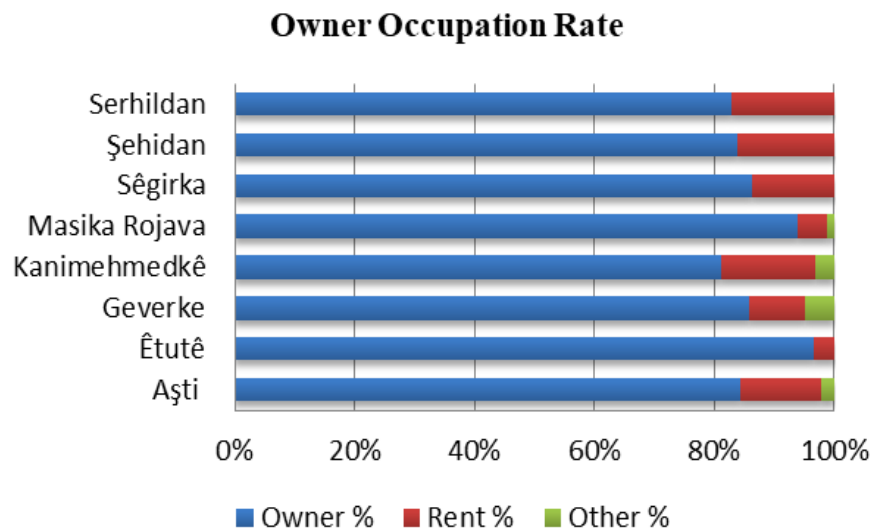


Figure 13-10: The owner house occupation in the neighbourhoods
Source: Own construct based on interviews with the residents

The percentage of rented houses in Serhildan, Şehîdan, and Kanîmehmedkê neighbourhoods are high (17.05%, 16.07% and 15.63%) respectively. Small size households and low monthly rent which range between \$ 200-350 United State Dollars, have encouraged the people to rent the houses in these neighbourhoods. While the neighbourhoods of Segirka and Aşti register 13.64% and 13.33% as the renting rate. These two neighbourhoods were developed at the beginning of 1980, which became old neighbourhoods, and the nearness to the city centre has attracted many renters with medium-income to settle. The houses in these two neighbourhoods are in old fashioned and have large-sized plots from 200.00m²-450.00m². Monthly rent ranges from \$300-600 United States Dollars. Many residents prefer settling in these two neighbourhoods because the basic services are available on the arterial roads and the proximity to the city centre that is about 2000m, which encourages walking (Interview with residents).

In the case of Geverkê neighbourhood, the rate of rentals is 9.52%. This low rate allows the neighbourhood to keep the features of the normal villages and is located in the vicinity of Duhok far from the city centre which does not encourage renting.

⁵³ - The municipality of Duhok had no full authority in controlling and supervising the investment housing projects, which the investors in many cases did not comply with regulations.

Êtûtê and Masîka Rojava neighbourhood display the less average rent. These two neighbourhoods were developed recently after 2005 and are mostly occupied by their owners. Besides, the rents in these two neighbourhoods are very high, which ranges between \$ 600-1200 United States Dollars per month.

Some of the families settle in the houses of their close relatives without paying rents. The rate of these families is high in Geverkê, Kanîmehmdkê and Aştî, which ranges between 4.76%, 3.13%, and 2.22% respectively.

13.2.1.2. Household Size

The household size differs from one neighbourhood to another – see Figure 13-11. Kanmehmedkê neighbourhood registers 1.17 families per dwelling. The high rate of the rents in this neighbourhood has caused the size of the household to increase. Most of the surveyed tenants are only renting out one floor (ground, first or second) which means more than one family resides in the same house due to financial incapability or keeping large families. Şehîdan and Aştî neighbourhood manifest the second and third rate of 1.13 and 1.11 respectively. The neighbourhoods of Serhildan, Êtûtê, Geverkê and Masîka Rojava display the same average of 1.10 household sizes. Sêgirka exhibits the lowest rate of 1.09. The average household rate of all the surveyed neighbourhood is 1.12 (families/House) giving a clue to the degree of the housing affordability in the city.

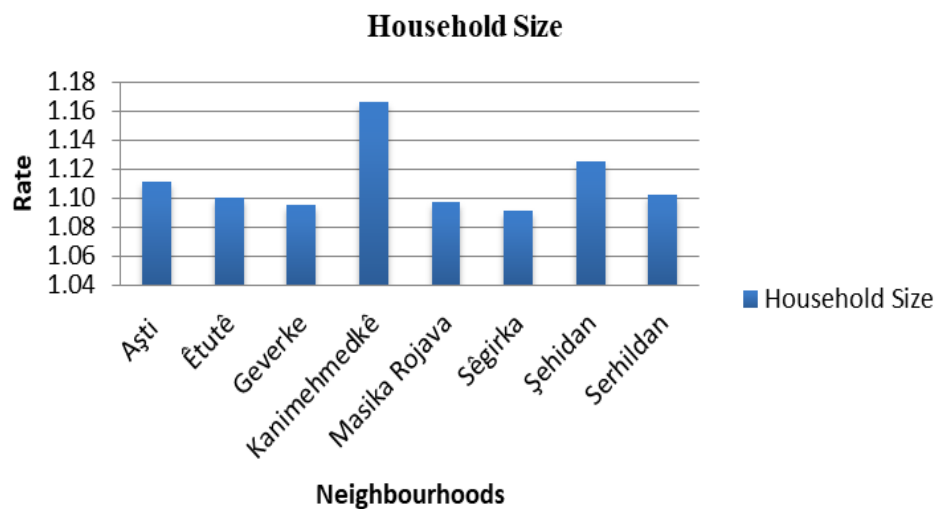


Figure 13-11: Household sizes in the neighbourhoods
Source: Own construct based on interviews with residents

13.2.1.3. Family Size

The survey shows that 51% of the families have an average of 6-9 members and 40% have 2-5 members and 9% have 10 or more members – see Figures 13-12 and 13-13. The total average size of the surveyed neighbourhoods displays 7.06 persons per family, while the average family size of the city of Duhok as documented by the Directorate of Statistics of Duhok is 6.9 persons per family⁵⁴. The highest percentage in Geverkê, 7.87 persons in the family, is back to the traditional trend in keeping large families. As mentioned before, this

⁵⁴ - According to the officials in the Directorate of Statistics the reported average of the family size is not based on surveying, but on statistical estimation.

neighbourhood was a village annexed to the city of Duhok. Serhildan, Kanîmehmedkê and Şehîdan neighbourhoods also display the highest average size of the family 7.49, 7.43 and 7.13 persons per family respectively. Aşti, Êtûtê, Masikê and Sêgirka neighbourhoods register the less average family size of 6.36, 6.52, 6.68 and 6.78 persons respectively. Perhaps the fewer rates in these neighbourhood traces back to the high rate of educational qualifications in these neighbourhoods as the survey shows.

Percentages of Family Size

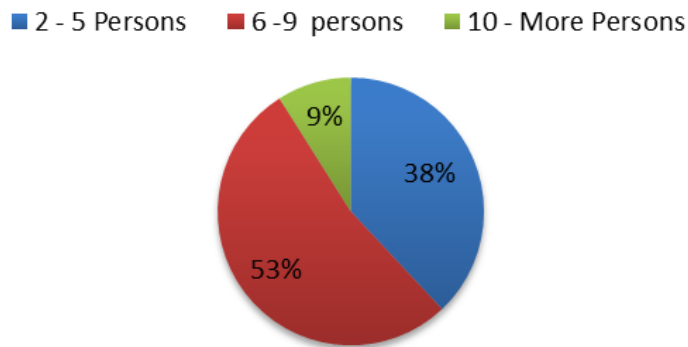


Figure 13-12: Distribution of average family sizes in surveyed neighbourhoods
Source: Own construct based on interviews with residents

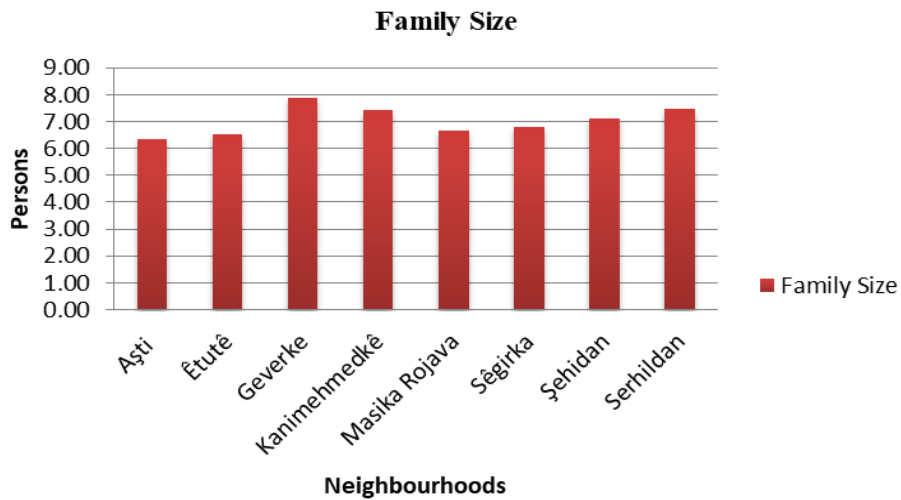


Figure 13-13: Average family size in the surveyed neighbourhoods
Source: Own construct based on interviews with residents

13.2.1.4. Family-Income

The less income average displayed in Kanimehmedkê, Serhildan and Şehîdan, and \$ 320, 369 and 398 United State Dollars respectively. Most of the low-income families inhabit the eastern part⁵⁵ of the city in the neighbourhoods with the exception of Şehîdan which also has

⁵⁵ - This confirms what the Directorate of Statistics has recorded about the concentration of most low-income families in eastern part of the city.

predominantly low-income families - see Figure 13-14. About 30% of the families reported that they have no fixed monthly income⁵⁶.

The highest average income registered in Aştî, Masîka Rojava, and Êtûtê \$ 809, 652 and 612 United State Dollars, and the neighbourhood of Sêgirka and Geverkê displayed \$ 538 and 440 United State Dollars, respectively. The neighbourhood of Kanimehmedkê registered the lower incomes \$320 United State Dollars while Aştî \$810 United State Dollars showing a clear disparity between areas of high and low incomes in the city.

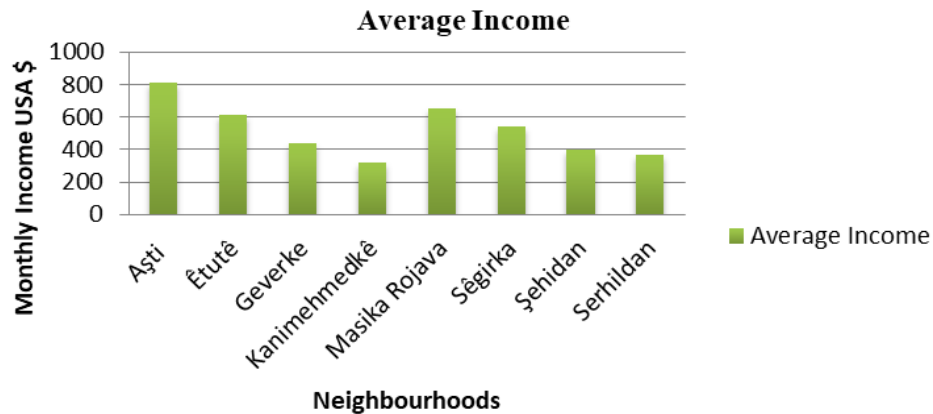


Figure 13-14: Average family's income of the neighbourhoods
Source: Own construct based on interviews with residents

13.2.1.5. Occupancy Rate

The Kanîmehmedkê neighbourhood displays the highest occupancy rate of 8.67 persons per dwelling. Geverkê, Serhildan and Şehîdan neighbourhoods manifest an average of 8.62, 8.26 and 8.02 persons per dwelling, respectively. The rest of the neighbourhoods are keeping the average under 8 persons per dwelling such as; Sêgirka, Masîka Rojava, Êtûtê and Aştî 7.70, 7.57, 7.17, 7.07 persons per house respectively. The lowest average is in Aştî neighbourhood- see Figure 13-15. Kanîmehmedkê neighbourhood hosts relatively large family sizes and the lowest-income families. Also, Êtûtê neighbourhood relatively displays a high rate of 7.17 persons/ dwelling. The Êtûtê neighbourhood has spacious houses and becomes the focus of large families to settle there. According to the Iraqi Housing Regulations, the acceptable household average in the residential area for single-house (attached and detached) is 6.00 persons/dwelling. In all the surveyed neighbourhoods the average is over the recommended rate from 144.5 to 117.34%.

⁵⁶ - Most of the families do not declare their real monthly income; therefore, it is very difficult to document the actual incomes.

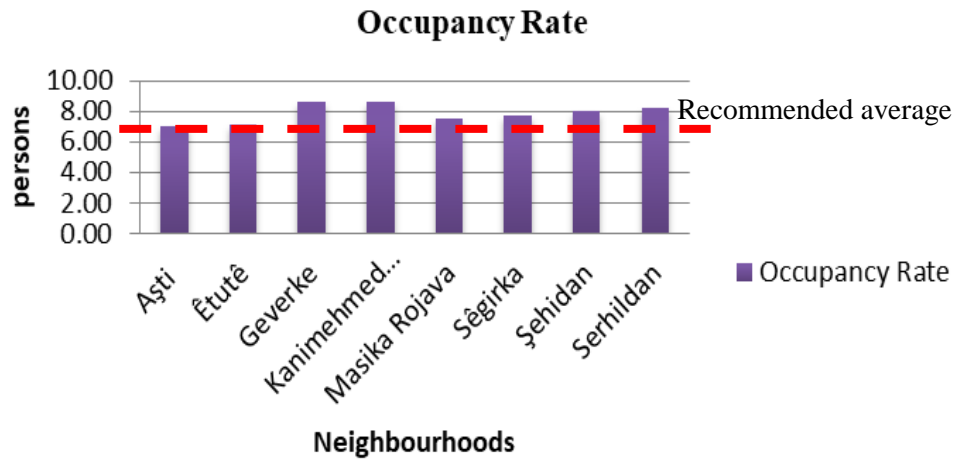


Figure 13-15: Occupancy rate in the neighbourhoods
Source: Own construct based on interviews with residents

13.2.1.6. Duration of Residing

The duration of living in the neighbourhood among the families vary from one family to another and even between the neighbourhoods. The duration of families living in the neighbourhood has divided into three periods⁵⁷ ; from 1-10 years, 11-20 years and 21-more years – see Figure 13-16 and 13-17. The new neighbourhoods which developed after 2005 host families who have resided at the beginning of the development of the neighbourhood such as Êtûtê and Masîka Rojava.

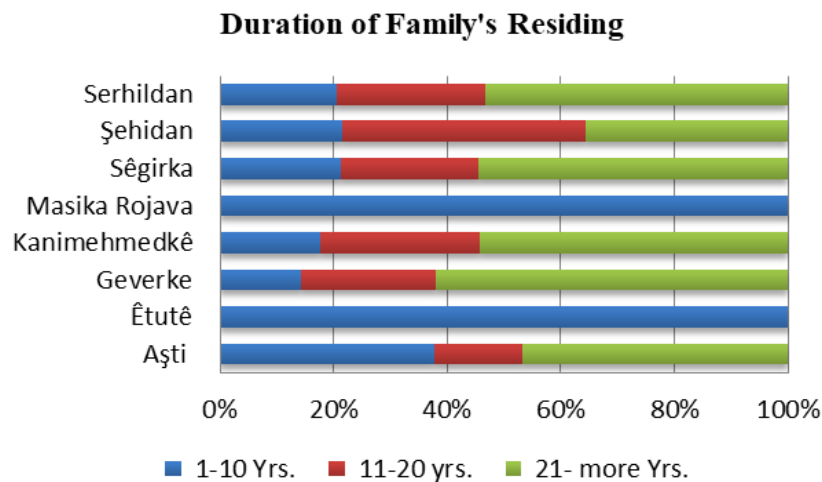


Figure 13-16: Duration of the family residing in the neighbourhoods
Source: Own construct based on interviews with residents

The old established neighbourhoods host families who have lived in the neighbourhood for more than 20 years. The number of these families is more than the sums of families who stayed for less than 20 years such as neighbourhoods of Geverkê, Kanîmehmedkê, Sêgirka

⁵⁷ - The spans of the periods are compatible with three different events in Kurdistan Region; campaign of demolishing villages by Ba'ath Regime from 1980-1990, Safe Haven area 1991-2003 and Economic boom 2004-2014.

and Serhildan. This indicates that within the span of 20 years more than half (60%) of the neighbourhood population have changed and settled in other neighbourhoods in the city of Duhok.

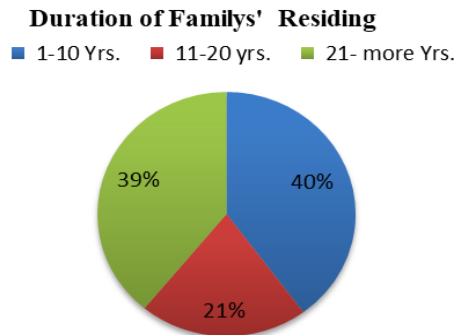


Figure 13-17: The average duration of the family residing in the neighbourhoods
Source: Own construct based on interviews with residents

The neighbourhoods of Aştî, Sêgirka and Şehîdan have witnessed a significant change in the duration of families living between 1 to 10 years. This traces back to the fact that these neighbourhoods are near to the city centre, the old owners have sold their property or rented and moved to the newly developed neighbourhoods. Normally, the families who cannot afford the means of transportation prefer settling near to the city centre and close to the available facilities. Geverkê neighbourhood has a high percentage of families who have resided in more than 20 years.

13.2.1.7. Source of Population

The matter of migration is a big problem facing the city of Duhok which is the main cause of rapid and unprecedented development. The survey has displayed that the large share 35% of the population of the neighbourhoods has moved to the city of Duhok from outside in the span of 20 years, mainly the old neighbourhoods were targeted for settling- see Figure 13-18.

Soure of the neighbourhood Population

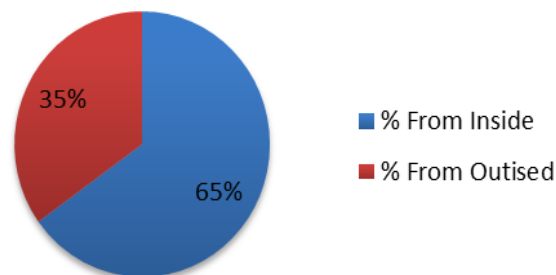


Figure 13-18: The overall-source of neighbourhood population
Source: Own construct based on interviews with residents

The calculations show that the new development areas (e.g. Êtûtê and Masîka Rojava) have fewer families who have come from outside of the city. The migrants compose about 10% of the population in these two neighbourhoods. About 56.98% and 55.93% of the original population in the old neighbourhoods of Serhildan, Şehîdan and Kanimehmedkê are migrants

from the settlements around the city of Duhok and rural areas. They settled in Duhok in the last three decades– see Figure 13-19.

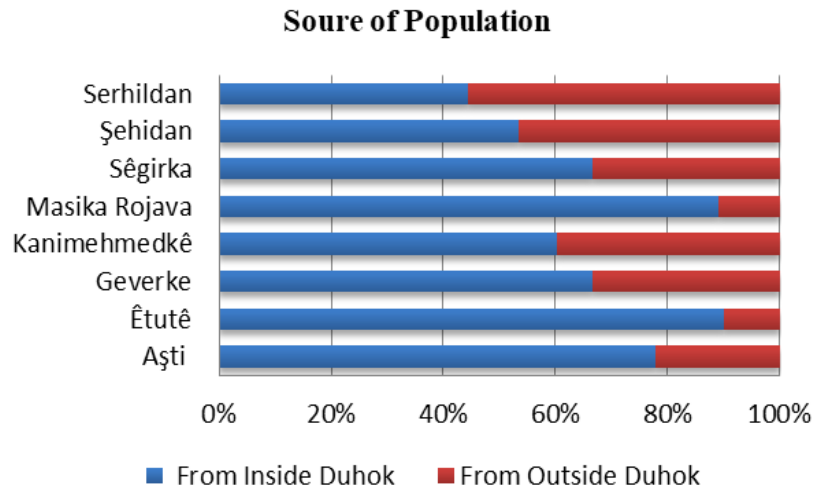


Figure 13-19: Source of neighbourhood population
Source: Own construct based on interviews with residents

13.3.2. Physical Characteristics

Physical characteristics play a great role in bringing sustainability to urban areas. This section analyses the physical characteristics including urban land use, block typology, street networks pattern and open space in the selected segments of the neighbourhoods.

13.3.2.1. Land Use Pattern and Density Characteristics

The pattern of land use for the eight segments from the selected neighbourhoods for scrutiny demonstrates different patterns. The selected segments are on the same scale and size of 25.15 hectares. The area is confined by a circle diameter of 566 meters– see Figure 13-20.

The spatial pattern of the land use at a micro-level is significant to the arguments about the efficiency of the built environment in the neighbourhoods and the city. The land use calculations in all segments confirm the prevailing conviction that residential uses predominate in all neighbourhoods. However, it is important to note that the public lands within these samples are the land used for common uses such as streets, public services (e.g. educational, health and other social and recreational facilities). One can generalise that there is a great deficiency and weakened the functioning of the public-related infrastructure in the neighbourhoods and there is a crucial need for upgrading and improvement.

Kanîmahmedkê neighbourhood displays the highest percentage of residential uses (58.61%) followed by Geverkê, Masîka Rojava, Aşti, Sêgirka, Serhildan and Şehîdan neighbourhoods (53.38%, 51.33%, 50.58%, 47.83% and 38.295) respectively, while the lower percentage is demonstrated by Êtûtê neighbourhood (36.15%). The highest percentage of the residential uses in Kanîmehmdkê neighbourhood is owing to the development pattern as an informal settlement. Thereby, it lacks space for other services and even for any future development initiatives unless programs for redevelopment are implemented - see Figure 13-20(4). Whereas Êtûtê neighbourhood shows less percentage due to the availability of higher percentages of land for urban facilities - see Figure 13-20(3).

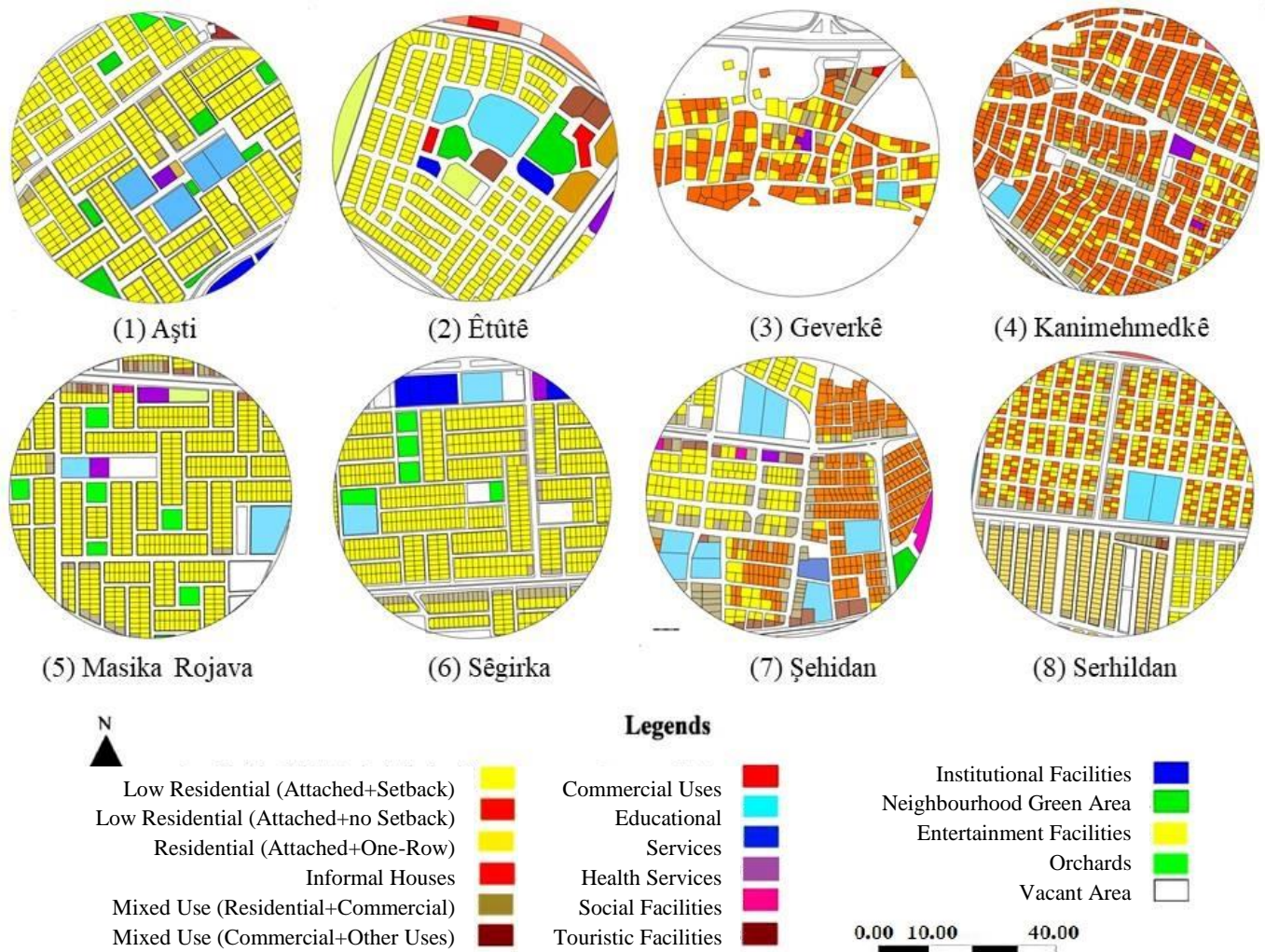


Figure 13-20: Selected segments from the neighbourhoods in the city of Duhok
 Source: Own construct based on survey and plans from Municipality of Duhok, 2015

Şehîdan neighbourhood demonstrates high percentages of public services - see Figure 13-20(7). The focus of educational services is based on the fact that this neighbourhood was witnessing a lot of development initiatives due to its closeness to the city centre. For example, Duhok Preparatory School for Girls is still serving other neighbourhoods such as Nohadra, Grêbasê, Newroz, Brayetî and Bazar.

Low-residential houses are prevailing in all the neighbourhoods. High rise housing within the domain of these neighbourhoods does not exist, if any, it is on the main arterial or collector streets as a mixed use development. Normally, in these high buildings, commercial activities occupy the ground floor, whereas, other activities (e.g. residential, offices, agents or clinics) mainly occupy upper floors of the apartments.

In all the neighbourhoods, commercial activities exist along both sides of the arterial roads which are experiencing a transformation from residential uses to mixed uses (residential with non-residential activities) with the exception of the Êtûtê neighbourhood, in which this trend is restricted according to the specific regulations related to this neighbourhood. Şehîdan neighbourhood displays more transformed residential uses to commercial because the neighbourhood is bisected by one arterial road and two collectors registering the longest length of arterial streets in the segments; this on one hand, and on the other hand, this

neighbourhood has been included within the future extension of Duhok downtown and considered as transformational area towards commercialisation and mixed uses.

The commercial activities are; shops, restaurants, retails and hotels. The vertical mixed use is one of the current phenomena in the high rise buildings on the main arterial streets in the neighbourhoods of Aştî, Geverkê, Masîka Rojava, Sêgirka and Serhildan. These streets become more vibrant attracting citizens to the area for shopping or leisure time. At the same time, the limited widths of the streets and absence of a clear separation between pedestrian and vehicular flow, on one hand, and the nonexistence of on-street and off-street car parking in these streets, on the other hand, causing congestion and obstructing the accessibility in these neighbourhoods. The commercial activities in these streets offer daily needs of the neighbourhoods' residents, despite that in many cases they are not within 5 minutes' walk.

The horizontal activities of commercial uses within the neighbourhoods have not been implemented in any of the neighbourhoods. The existing commercial uses are mixed uses vertically promoted. The mixed use initiatives in the neighbourhoods forced by the market and controlled by the Municipality of Duhok. The percentage of the vertical mixed uses of commercial and residential varies from 1.67% in Asti neighbourhood to 9.74% in Şehîdan neighbourhood as the maximum percentage. The mixed uses of commercial uses and other non-residential uses also exist, the minimum of 0.12% has registered in Kanimehmedkê neighbourhood and the maximum in Şehîdan neighbourhood (2.86%). The percentages vary owing to the locations of the neighbourhoods and their proximity to the city centre as well as to the length and the width of the main streets. The non-residential services such as hotels, private clinics, modern retail spaces, restaurants and agencies are more diversified in terms of types and sizes in Şehîdan neighbourhood than the other neighbourhoods.

Other mixed use developments in the neighbourhood (e.g. schools and health) are horizontally developed. The percentages of the activities vary between the neighbourhoods due to the absence of sound planning programs during the development process. The minimum percentages (7.63%) of the urban services display in Geverkê neighbourhood and the maximum percentage displays in Şehîdan (23.90%) followed by Êtûtê (21.43%)⁵⁸ and Sêgirka (13.92%) - see Table 13-1.

The calculations confirm that most of the neighbourhoods' segments lack services and essential daily facilities within 5-minutes' walk. The available facilities are the primary and secondary schools and places of worship. By comparing the obtained calculations with the Iraq Housing Standards or other International Standards, it is clear that there are deficiencies and shortages in offering urban services.

The less gross residential density displays in Êtûtê neighbourhood (78.69 persons per hectare) and the high gross density displays in Kanimehmedkê neighbourhood (289.29 persons per hectare) followed by Serhildan (265.38 persons per hectare), showing that the gross density in Kanimehmedkê neighbourhood is more than twice the gross density of Geverkê⁵⁹ neighbourhood and three and half times the gross density of Êtûtê - see Table 13-2.

⁵⁸ - Many services are still under development in this neighbourhood.

⁵⁹ - In the case of Geverkê neighbourhood the agricultural area (12.43 hectares) subtracted from the area confined by the circle to give clear expression of the densities and other measurements in the neighbourhood.

Table 13-1: Land use patterns of the surveyed segments

Indicators		Neighbourhoods							
		Aşîf	Êrtûfê	Geverkê	Kanîneh-medkê	Masîka	Sêgirka	Şehîdan	Serhîdan
Net-Residential Area	High Rise	0	0.54	0	0	0	0	0	0
	Low Rise	12.91	8.55	6.94	14.67	13.1	12.72	9.63	12.08
Net-Commercial	Shops & Retails	0.33	0.74	0.04	0	0	0	0	0
	Supermarkets	0.02	0	0	0	0	0	0	0
	Malls	0	0	0	0	0	0	0	0
Mixed Uses	Commercial+ Resid.	0.42	0	0.67	1.5	0.65	0.89	2.45	1.36
	Commercial+ Non-Resid.	0.25	0	0.11	0.03	0.25	0	0.72	0.05
	Institutional+ Residential	0	0	0	0	0	0	0	0
Education Services	Kindergarten	0.3	0	0	0	0	0	0.46	0.38
	Primary School	0.35	0.6	0.16	0.26	0.4	0.92	0.64	0.2
	Secondary School	0.3	0.8	0	0	0.46	0	0.16	0.4
	Preparatory School	0.3	0	0	0	0	0	0	0
	Other Educational Centres	0.3	0	0	0	0	0	0.5	0
Health Services	Primary Clinic	0	0.26	0	0	0	0	0.25	0
	Advanced Clinic	0	0	0	0	0	0	0	0
	Hospitals	0	0	0	0	0	0	0	0
Social Services	Worship (Mosque.....)	0.12	0.13	0.94	0.2	0.38	0.25	0.1	0
	Cultural Centre	0	0	0	0	0	0	0	0
	Youth Centre	0	0	0	0	0	0	0	0
	Library	0	0	0	0	0	0	0	0
	Tea House	0	0	0	0	0	0	0	0
	Restaurants & Casino	0	0	0	0	0	0	0	0
Recreational	Outdoor Sports	0	0.97	0	0	0	0	0	0
	In-door Sports	0	0	0	0	0	0	0	0
	Parks	0	0	0	0	0	0	0	0
	Community gardens	0.41	1.04	0	0	0.89	0.58	0.22	0.31
Institutional	Governmental Offices	0.01	0.18	0	0	0	0.86	0.51	0
	Local Administration	0	0	0	0	0	0	0	0
Utilities	Police station	0	0	0	0	0	0	0	0
	Post Office	0	0.67	0	0	0	0	0	0
	Fire Brigade	0	0	0	0	0	0	0	0
	Filling Station	0	0	0	0	0	0	0	0
	Car Services	0	0	0	0	0	0	0	0
Street Area	All Streets & Sidewalks	9.11	10.67	3.86	8.49	7.75	7.96	8.16	10.37
Agricultural		0	0	12.43	0	0	0	0.16	0
Touristic Services	Hotels	0	0	0	0	0	0	0.77	0
	Motels	0	0	0	0	0	0	0	0
Vacant Area		0.02	0	0	0	1.27	0.97	0.42	0
Total Area		25.15	25.15	25.15	25.15	25.15	25.15	25.15	25.15

Source: Own construct based on survey and plans from the Municipality of Duhok, 2015; Directorate of Constructive Planning, 2015

Table 13-2: Features of the neighbourhoods' segments

Indicators	Neighbourhoods							
	Aştî	Êtûtê	Geverkê	Kanimeh-medkê	Masîka	Sêgirka	Şehîdan	Serhildan
Build-Up Area	10.91	7.82	4.36	13.62	13.59	10.37	8.70	10.95
Gross Residential Density ⁶⁰ (population)	119.84	78.69	142.52	289.29	230.76	198.64	164.02	265.37
Net Residential Density (pop.) ⁶¹	210.36	197.97	233.61	437.09	416.63	375.20	379.03	481.26
Gross Build Coverage Ratio ⁶²	0.68	0.56	0.53	0.81	0.78	0.61	0.68	0.74
Floor Area Ratio ⁶³	0.95	1.11	0.58	0.94	1.05	0.87	0.82	0.85
Street Network Density	0.36	0.44	0.30	0.35	0.31	0.32	0.32	0.41
Urban road per capita (m ²) ⁶⁴	30.22	55.88	21.65	11.20	13.33	15.93	19.78	15.52
Net Neighbourhood Density (dwe.)	33.08	30.36	29.68	58.83	60.38	53.14	53.16	67.05
Mix Land Use Percentages %	12.37	21.43	7.63	7.91	12.05	13.92	23.90	10.74
Land Use balance ⁶⁵	0.51	0.36	0.53	0.58	0.52	0.50	0.38	0.48
Buildings with setback %	100.0	100.0	41.07	18.06	100.p	100.0	45.07	46.67
Buildings without setback %	0.00	0.00	58.93	81.24	0.00	0.00	54.93	27.40
Two-Row Housing %	100.0	0.00	85.30	76.14	100.0	100.0	93.77	73.76
One-Row Housing %	0.00	100.0	14.70	23.86	0.00	0.00	6.23	26.24

Source: Own construct based on survey and measurements and plans from the Municipality of Duhok, 2015

The results of the Net Residential Density (population) display a high value in Serhildan neighbourhood (481.26 persons per hectare) followed by Kanimehmadkê (437.09), Masîka Rojava (416.63), and Şehîdan (379.03) and Sêgirka (375.20). The rest neighbourhoods are Êtûtê (197.97) Asti (210.36) and Geverkê (233.61). According to the Iraqi Housing Regulations, the minimum net residential density for attached row houses is 120 persons per hectare and the maximum is 250 persons per hectare. By comparing the computed results with the recommended densities only three neighbourhoods (Aştî, Êtûtê and Geverkê) are within the accepted average of net residential densities, while five neighbourhoods register above the average.

Masîka Rojava, established in 2005, exhibits a very high net density (416.63 pph) close to the net density calculations of Kanimehemdkê (437.09 pph). So, it can be said that the non-compliance with the regulations by the planning institutions in the case of Masîka, has produced similar results of the informally developed neighbourhood. Requiring more residential plots⁶⁶ by the local authorities in the neighbourhood of Masîka Rojava during

⁶⁰ - Gross Residential Density Neighbourhood is the number of persons, households, dwellings unit per hectare of the total neighbourhood area.

⁶¹ - Net-Residential Density Neighbourhood is the number of persons, households or dwelling unit per hectare of the total area devoted to residential land,

⁶² -Built Coverage Ratio is the ratio of the base area of a building (building imprint) to the plot area.

⁶³ - Floor Area Ratio is the total area of floors to the plot area.

⁶⁴ - Refers to the ratio of the total street area to population.

⁶⁵ - land use balance refers to the ratio of the net residential area to the gross residential area.

⁶⁶ - This conclusion affirmed by the Directorate of Constructive Planning in Duhok.

subdivisions process has increased the number of plots. This has produced high percentages of residential uses and consequently increased the net residential density.

Build coverage ratio shows that Kanimehmdkê has a higher value (0.81), Masîka (0.78) and Şehîdan and Asti (0.68). The lower rate registers in Geverkê (0.53) and Êtûtê (0.56). Iraqi Housing Regulations recommends the maximum built coverage ratio of 0.60 for two-row housing. Based on, six of the selected neighbourhoods have the ratio over 0.60; while only two neighbourhoods are under 0.60- see Figure 13-21.

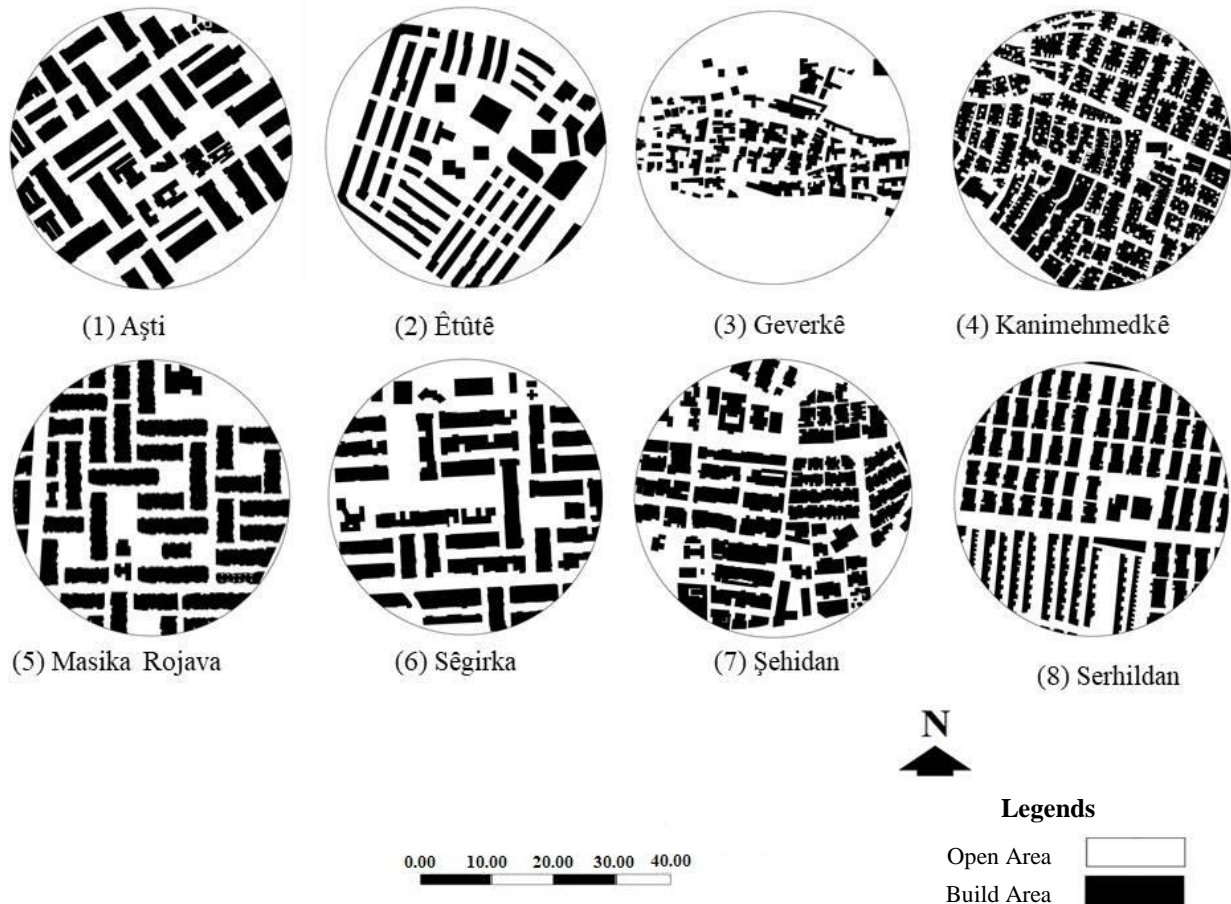


Figure 13-21: Building foot-prints of the neighbourhoods' segments

Source: Own construct based on survey, satellite images and plans from the Municipality of Duhok, 2015

The share of each person from the roads according to the recommend Iraqi regulations is 30.00 m². The neighbourhood of Aşti is displaying the compliance with the regulations. The neighbourhood of Êtûtê shows the high share of each person because it is under development, according to the planned number of the houses and the rate of family size the share will be decreased to 31.00m² which shows compliance with the regulations. Other neighbourhoods display the rate under the recommended regulations.

In Aşti and Şehîdan neighbourhoods building coverage area for the single plot is from 0.55 to 0.81, thus more open space and greenness can be observed in these two neighbourhoods comparing to other formally developed neighbourhoods in the recent years. Neighbourhoods such as Masîka Rojava and Êtûtê have the build coverage area for a single plot from 0.70 to 0.86, thus these neighbourhoods look more compacted than Aşti. According to the

Municipality regulations, the maximum coverage ratio for the residential purposes is 0.65 and 35% remains as open spaces. The percentage of open spaces has been divided into 18% as paved and tiled space, while the remaining 17% as green space in each residential plot.

Kanîmehmdkê neighbourhood shows compacted urban fabric owing to the lack of control during the implementation period, the build coverage area for single plot ranges from 0.65 to 0.90, knowing that, this neighbourhood was one of the unguided development areas in the city.

The higher readings of the floor area ratio (FAR) display in neighbourhoods of Êtûtê (1.11), Masîka Rojava (1.05) and Asti (0.95), because they have the higher number of two-storey buildings. The lower rate of (FAR) has displayed in Geverkê (0.58) corresponding to the coverage area ratio of (0.56) showing very closeness and assuring the dominance of one storey buildings.

The higher value of the land use balance displays in the neighbourhoods of Î (0.58), Masîka Rojava (0.52), Aştî (0.51) and Sêgirka (0.50), while the rest of neighbourhoods display the value under 0.5 and the lower registered in Geverkê (0.27). The minimum value recommended is 0.45- 0.65 for one-family detached and semi-detached low rise housing. Five neighbourhoods (Kanimehmedkê, Masîka Rojava, Aştî, Sêgirka and Serhildan) manifest values within the range of the accepted magnitude. Lower value registers in Geverke, Êtûtê and Şehîdan. Êtûtê as one of the newly developed neighbourhoods, is the subject of criticism by many experts because of low-density and spacious pedestrian ways which have not been carefully planned and designed.

Net Neighbourhood Density (Dwellings) varies between the neighbourhoods. The results show a higher value in Serhildan (67.05) and Masîka Rojava (60.38 dwellings per hectare). Both of these neighbourhoods planned and developed under the authority of the Municipality of Duhok. The lower values display in Geverke (29.68), Êtûtê (30.36) and Aştî (33.08 dwellings per hectare). The recommended density according to Iraqi Housing Regulations is 24-48 dwellings per hectare for attached row-houses and courtyard/atrium houses. The net neighbourhood density in Serhildan, Masîka Rojava, Kanîmehmdkê, Şehîdan and Sêgirka is above the average displaying high compactness.

13.3.2.2. Urban Block Structure, Plot Divisions and House Layout

The characteristics of urban block affect both plots, building patterns and typologies, which in turn affects the neighbourhood sustainability. The neighbourhood segments encompass different lengths, sizes and forms of urban blocks- see Figure 13-22.

Two distinctive patterns of the residential urban blocks can be distinguished; the regular linear urban block and irregular urban blocks. The regular linear blocks are of two types; two rows of semi-detached or attached houses with back-to-back plots and one-row semi-detached or attached houses. The regular residential linear urban blocks of two-row houses prevail in the neighbourhoods of Asti, Şehîdan, Sêgirka, Masîka Rojava and with a part of Serhildan – see Figure 13-23.

Urban blocks of one-row houses are dominant in the neighbourhoods of Êtûtê and part of Serhildan down to Beruşkê Street which is known as Beruşkê Compound.

Irregular pattern is observed in the neighbourhoods of Kanimehmedkê, Geverkê and north-east part of Şehîdan neighbourhoods. These areas were informal development established

during different periods in the city (e.g. Kanimehmedkê and a part of Şehîdan) or organic form of village annexed to the city of Duhok (e.g. Geverkê). Four patterns with different types of the irregular urban block can be observed in these neighbourhoods; the loose shapes of square, triangle, L-shape and linear urban blocks – see Figure 13-24.

The non-residential urban blocks which house other uses are mostly having rectangular or square shape; this can be true for formally developed neighbourhoods.

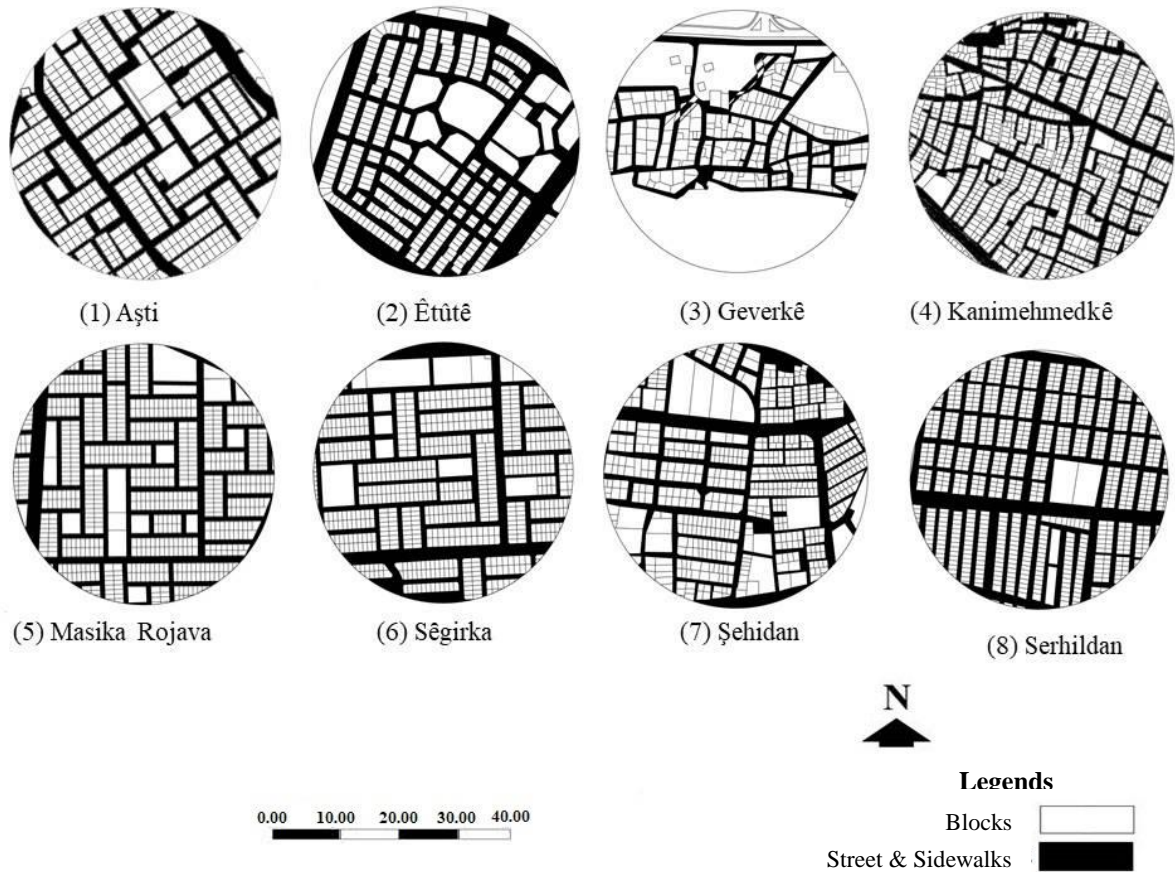


Figure 13-22: Urban block configurations and plot divisions

Source: Own construct based on survey, satellite images and plans from the Municipality of Duhok, 2015

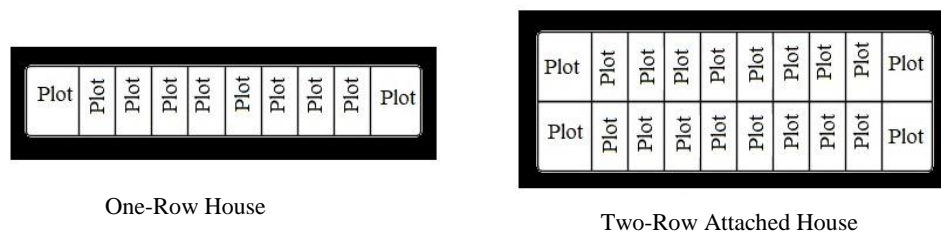


Figure 13-23: Regular linear urban block of one and two-row houses formally developed neighbourhoods

Source: Own construct

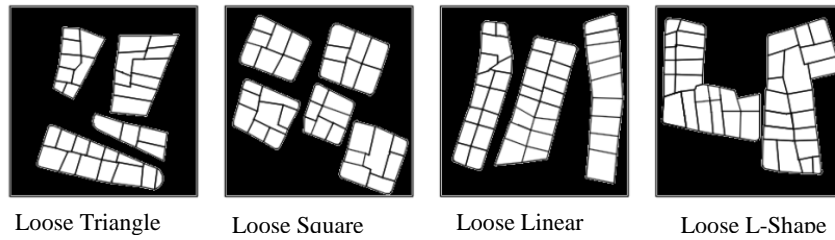


Figure 13-24: Typologies of irregular urban blocks in Kanîmehmedkê and Geverkê neighbourhoods

Source: Own construct based on survey and observation

The longest block (251.81 meters) of two-row-houses is found in Sêgirka neighbourhood and the shortest (45 meters) in Êtûtê neighbourhood. The width of the blocks usually depends on the size of the plots. The surveyed width of urban blocks in the formally developed neighbourhoods varies from 20 to 40 meters. The longest length of the urban blocks of one-row houses is found in Êtûtê neighbourhood 288.20 meters, and the shortest length 24 meters in the same neighbourhood.

Regarding the irregular urban blocks, the longest block 210.80 meters, is observed in Kanîmehmdkê and the shortest one 28.40 meters, exists in the same neighbourhood. The width of the blocks varies from 10 to 42.35 meters, which can be observed in Kanîmehmdkê and Geverkê.

The length of the block plays a great role in creating and shaping the character of the urban grains inside the neighbourhoods and affects the degree of accessibility. Many residents who have been interviewed in different neighbourhoods complained about the length of the urban blocks because the walkability of the neighbourhood is highly related to the length of the blocks. Topography in the city of Duhok is a great factor to determine block length, width and allocation. In real life, the topography has not been considered by the Municipality of Duhok. For example, in the case of Serhildan neighbourhood despite the relatively sharp slope (25%) some of the blocks have 240 m length allocated to accommodate the land slope from north to south resulting in a large difference between the height of the buildings from street level– see Figure 13-25. Normally, the long blocks create neighbourhoods that are disconnected and less permeable and deter the residents from walking, while the moderate-short is more permeable and increase the accessibility in the neighbourhood, but the extreme-short blocks also increase the number of the intersections that limit the accessibility and requires more infrastructure which is always expensive.



Figure 13-25: Improper urban block allocation obstructing accessibility

Source: Photos by the Researcher- 2014

The predominating plot size in the formally developed neighbourhoods is between 150m² to 500 m², the corner lots are normally bigger by 25% to 50% from the other plots⁶⁷. For example, the typical size of the plots (200m²) in Masîka and Sêgirka is predominant in both neighbourhoods with exception to the corner plots which are 300m². Whereas Aştî has three different sizes (300m², 350m² and 450m²) giving more opportunities for citizens. In Şehîdan neighbourhood, there are three distinct types of the plots (150m², 200m² and 300-400m²). In Êtûtê neighbourhood, there are four types of the plot sizes (245m², 324m², 450m² and 550m²) which give more diversity, but in the Kanîmehmdkê and Geverkê neighbourhoods, the sizes of the plots vary from 90 m² to 600 square meters⁶⁸.

Within the neighbourhood or single urban block, the same plot size limits the choice and variations in house patterns and types; therefore, there is a considerable variation between the informal and officially developed neighbourhoods in terms of plot sizes, shapes, ratio and house types. The majority of the plots in Kanîmehmdkê and Geverkê neighbourhoods have irregular and organic shapes and size, reflecting the informal nature of the subdivisions process through which the neighbourhoods' layout has evolved and developed.

As mentioned earlier in Section 11.2.1 Chapter Eleven, that two main structure patterns of residential buildings dominate urban fabric of the city of Duhok; the open-plan (Local Style) and closed-plan (Western Style). The open-plan pattern is the most common in the neighbourhoods of Kanîmehmedkê, Geverkê, and Serhildan and north part of Şehîdan neighbourhoods. In these neighbourhoods, 271 houses have been surveyed - the number of the surveyed houses are identical to the number of interviewees in the neighbourhoods- about 76% of the houses are open-plan with one storey height or (one and a half story)⁶⁹, and the rest are two stories of the closed-plan pattern.

The closed-plan dominates the neighbourhoods of Aştî, Sêgirka, Êtûtê and Masîka Rojava. The open-plan is rarely found. In the neighbourhoods, 213 houses have been surveyed of which 72.5% are of two stories.

House sizes in terms of their built-up have a correlation with the size and area of plots. As the plot size increases correspondingly, the size of the house also increases. This implies that the owners of the big plots tend to build larger houses that led to an increase in plot coverage. The remarkable variation in terms of house sizes and patterns reflects the degree of residents' ability to develop the land.

There is a considerable variation in the allocation of building's mass within the plot permit which takes many positions. There is no restrict regulations to organise the relationship between the neighbours in regards to the building height, gate position, balcony location and attachment to the neighbouring building, with exception to the sides which the neighbours are not allowed to have any opening directly on plot lines unless there is a setback. Several positions can be noticed in the informal and unguided neighbourhoods of Şehîdan, Serhildan, Kanîmehmedkê and Geverkê - see Figure 13-26.

⁶⁷ - According to the regulations, it is obligatory in the case of corner plots to have minimum setbacks of 4.00m and 2.50m in both sides. Despite that there are many abuses.

⁶⁸ - In the case of upgrading informal settlements, the citizens have no right to possess more than 600m² for residential purpose.

⁶⁹ - When the first floor covers area equal to half area of the ground floor, it is locally known as one-half story house.

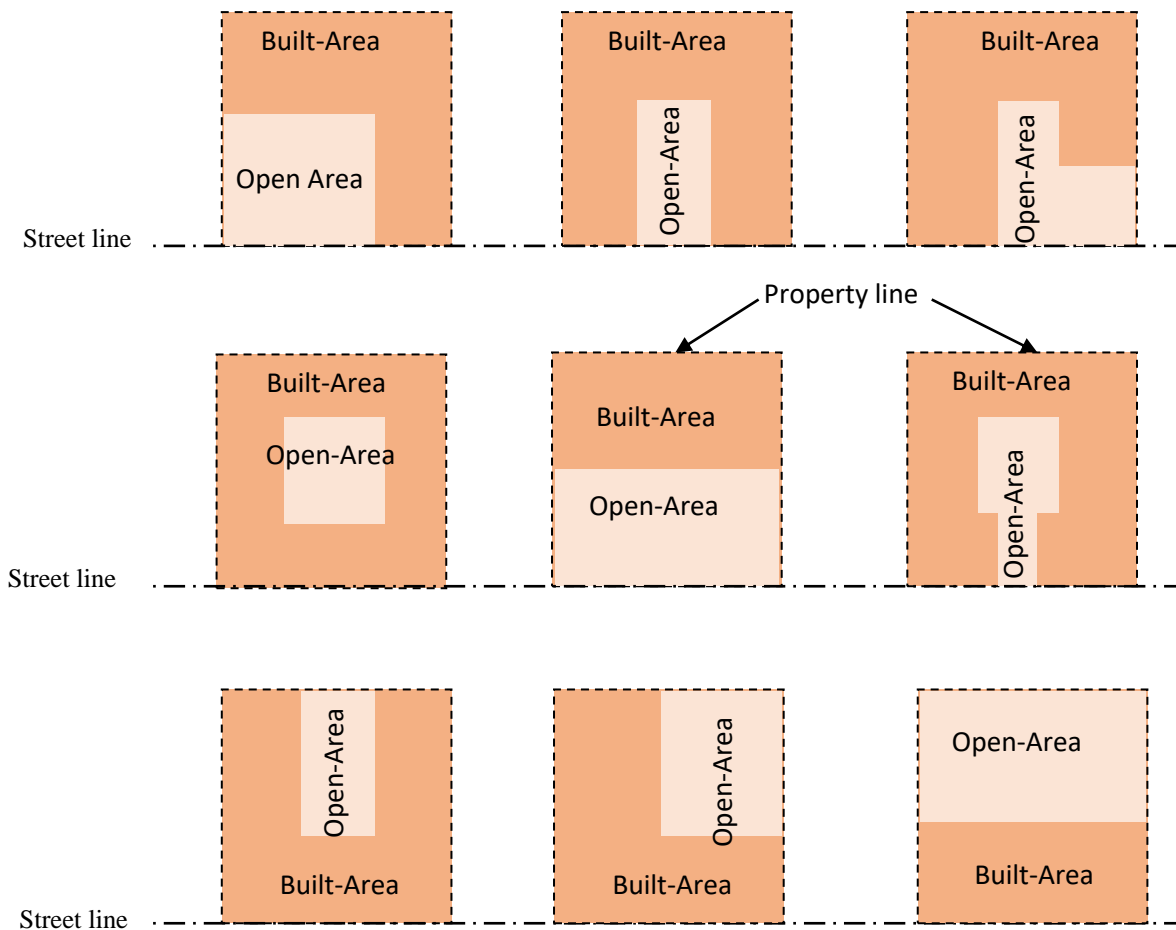


Figure 13-26: Typologies of building-mass allocation for an open-plan house within plot permit

Source: Own construct based on observation and survey

Allocating of the building mass within the plot permit in formally developed neighbourhoods of Aştî, Sêgirka, Êtûtê and Masîka Rojava also takes many positions - see Figure 13-27. Despite that, the allocation is more restricted by the front setback which gives less freedom in selecting diverse positions. Normally, the buildings' masses touch the line of the neighbours' plots in more than one position - for more details see Section 11.2.1 in Chapter Eleven.

Plot setback as an indicator for exposure was commented on by residents during the resident interviews. Most of the residents dislike the plots that have no rear and side setbacks, this evaluation is closely related to the built-up area percentages which give a dense character to the neighbourhood. The formally developed plots with a front setback, ranked highly in terms of dissatisfaction by residents during interviews- see Section 14.5 in Chapter Fourteen.

In the case of the building mass line being on the plotline, this means that no setbacks have been left between the plots. This indicates that the plots do not have exposure and are squeezed from three sides by other plots as the trend is now. This has led many residents to complain about the buildings' exposure especially the ones which face the north. As an indicator of amenity more setbacks from the rear and sides enhance view where inhabitants

inside rooms facing the open side of the plot and increase the view, open space, ventilation and sunlight.

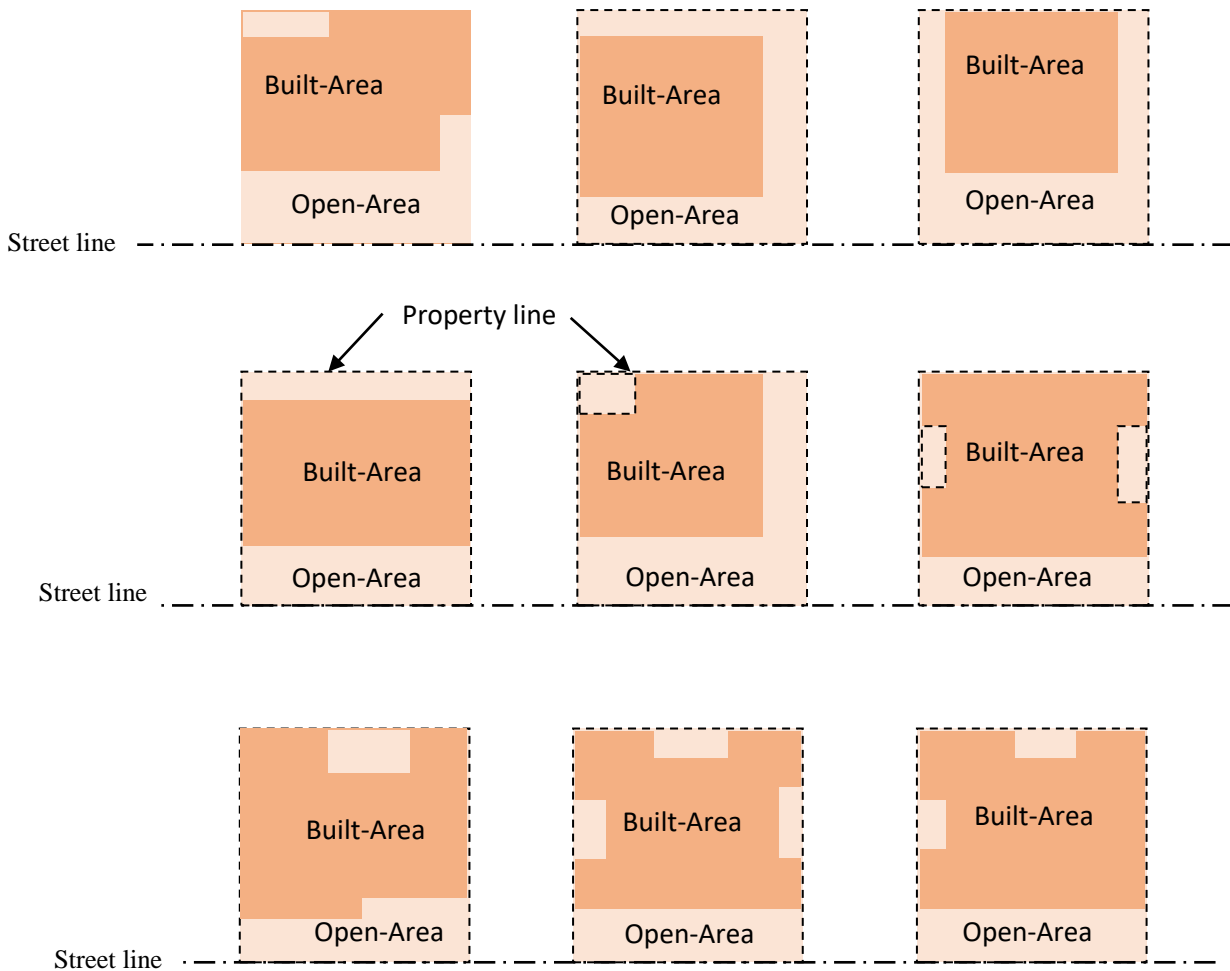


Figure 13-27: Typologies of building-mass allocation for closed-plan houses within plot permit

Source: Own construct observation and survey

13.3.2.3. Street Network and Accessibility

Accessibility and separation of the flow of pedestrians and vehicles are issues highly depending on the ordering of the urban block taking many positions and arrangements. The neighbourhoods' segments give an overall impression of the design and the planning of the street networks in the selected neighbourhoods— see Figure 13-28.

Four patterns of street networks can be identified within these neighbourhoods. The patterns T-Cell and T-Tree are observed in three formally planned neighbourhoods of Aştî, Sêgirka and Masîka Rojava. These patterns have many perpendicular segments and less distributor and collector streets. Despite that, these neighbourhoods were developed in different periods but they carry the same street characteristics. The residential streets have nearly equal numbers of the segments in two directions. The neighbourhoods display close density of junctions and segments in one hectare. Aştî displays 2.78 junctions/h and 4.02 segments/h, Sêgirka displays 2.31 junctions/h and 4.06 segments/h, and Masîka Rojava 3.02 junctions/h and 4.85 segments/h- see Table 13-3.

All the residential streets have the same width of 10.00 meter including the sidewalks. While the differences in the case of Masîka Rojava the sidewalk is 1.00 meter for each side of the street and the paved area is 8.00 meter, in Aştî and Sêgirka the sidewalks are 2.00 meters on each side and the paved area is 6.00 meters. The Aştî neighbourhood has very narrow alleys of 4.00 and 6.00-meter in width. These types of alleys do not exist in other neighbourhoods- see Figure 13-29. The alleys have no sidewalks reflecting traditional characteristics of the old streets in the cities. The street networks in these neighbourhoods resemble a maze, finding the entry and exit way is puzzling. The previous experience of urban development in Sêgirka, with its pros and cons, is obvious in Masîka Rojava neighbourhood despite the intervals of 30 years.

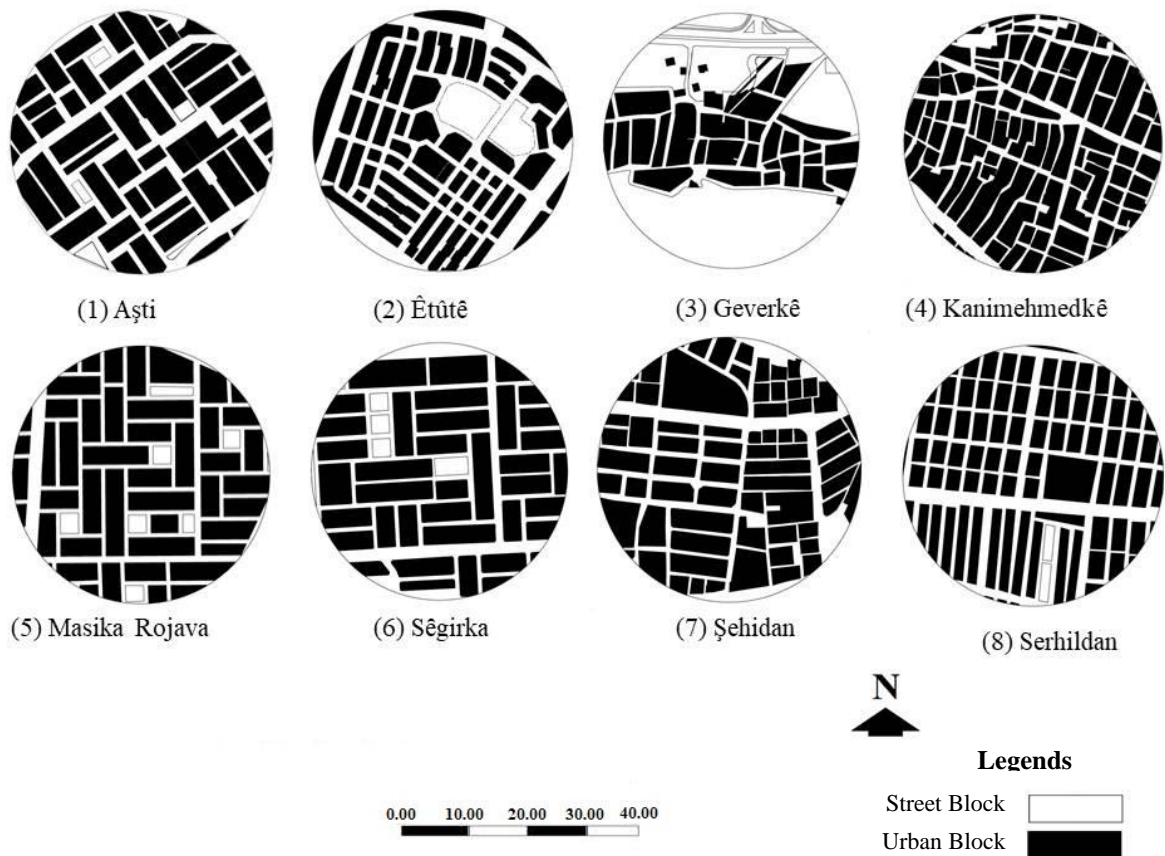


Figure 13-28: Street networks in the neighbourhoods' segments
 Source: Own construct based on plans from the Municipality of Duhok, 2015



Figure 13-29: Narrow streets in Asti neighbourhood
 Source: Photo by the Researcher- 2013

Table 13-3: Calculations of street network features of the neighbourhoods' segments

Indicators		Neighbourhoods							
		Aşfî	Êtûtê	Geverikê	Kanûmeh-medkê	Masîka	Sêgirka	Şehîdan	Serhildan
Street Area (h)	Main Arterial Streets	1.72	1.02		0.66	0.72	0.93	1.48	0.98
	Collector Streets	0.83	1.07	1.07	1.02	0.86	0.41	1.15	0.58
	Residential Streets	4.19	2.53	2.79	6.36	4.68	4.28	4.07	8.25
	Medians	0.05	0.28		0.04	0.07	0.09	0.95	0.56
	Sidewalk	2.32	2.37		0.18	1.42	2.25	0.10	
	Pedestrian Route		3.79		0.34				
	Total Area (h)	9.11	11.06	3.86	8.40	7.75	7.96	8.16	10.37
Street length (m)	Main Arterial Streets	789.3	348.5		678.1	334.2	447.6	823.5	545.3
	Collector Streets	553.7	1023.5	947.8	551.6	877.2	796.5	1152.0	498.6
	Residential Streets	5397	4276.7	3016.2	5541.2	4328.6	3725.9	4956.5	6576.1
	Pedestrian routes		2158.3		609.1				
	Total length (m)	6740	7807	3964	7380	5540	4970	6932	7620
Street Density	Length (km)/ Area km ²	26.96	31.24	30.46	29.52	22.16	19.88	27.72	30.48
Junctions	Junctions per hectare	2.78	3.10	2.70	4.57	3.02	2.31	3.42	3.66
Segments	Segments per hectare	4.02	4.53	2.50	7.28	4.85	4.06	5.09	6.52
Bus stops	Number of Bus-Stops ⁷⁰	2	1	1	2	2	2	2	2
Proximity to Facilities (km)	Bus-Stop	0.45	0.64	1.28	0.35	0.34	0.39	0.30	0.46
	To Schools	0.25	0.33	0.45	0.52	0.27	0.35	0.23	0.28
	To shopping	1.08	2.50	4.32	1.78	0.74	2.34	0.51	0.84
	To health centre	1.65	3.40	4.60	2.37	0.71	0.73	0.62	2.38
	To Recreational Area	5.46	4.89	7.50	6.65	3.10	1.85	5.50	6.42

Source: Own construct based on calculations and plans from Municipality of Duhok, 2015 by using ArcView 10 and AutoCAD

The second pattern of the street network is an oblong and warped parallel pattern which can be observed in Êtûtê and Şehîdan. These two neighbourhoods hold a very close ratio of junctions and segments (2.31 junctions/ hectare and 4.53 segments/ hectare) and (3.42 junctions/ hectare and 5.09 segments/ hectare). The accesses are clearer for gaining entry and exit. Although there are many short numbers of segments in Êtûtê (24 meters and 27 meters) reflecting the existence of small size of urban blocks which have negative impacts through; raising the cost of the infrastructure because of having long streets which also deter the accessibility and traffic flow of vehicles. Many cross-roads are also observed in these two neighbourhoods. The width of the sidewalks in Êtûtê neighbourhood is 2.00 meters for both shoulders and main collectors and distributors are 4.00 meters, while in Şehîdan neighbourhood the width of sidewalks in residential streets is not following certain design scheme. It ranges from 1.00 meter to 3.00 meters, with the existence of many streets which have no sidewalks especially in the north-east part of the neighbourhood. Şehîdan shows longer segments with fewer cross-roads and the existence of narrow alleys. The direction of the main distributor and collectors is clear - see Figure 13-30.

⁷⁰ - There is no fixed bus-stops in the arterial streets, but the buses can stop at any point along to the main streets.



Figure 13-30: Narrow streets in Şehîdan neighbourhood

Source: Photo by the Researcher- 2013

The third pattern of gridiron or square grid network is observed in the neighbourhood of Serhildan. The extreme chessboard design of the streets in Serhildan neighbourhood with existences of short segments of 40 meters, obstructs accessibility in the neighbourhood especially in the north part of Beruşkê Street. Residential streets in this part have no sidewalks with exception to the main collector and Beruşkê main street. Absence of the sidewalks in residential streets has affected the accessibility and safe movement of pedestrians.

The fourth pattern is the organic form of the street network in Kanîmehmdkê and Geverkê neighbourhoods. These neighbourhoods have been upgraded, but there are still many problems in terms of street design and planning. The long and short urban blocks, absence of sidewalks and medians, lack of collector streets, narrow streets are prohibiting both pedestrians' and vehicles' movement. Kanîmehmdkê has the highest number of junctions and segments among the surveyed segments (4.57 and 7.28).

The most common aspect of the neighbourhoods is the penetration of the main arterial streets and bisecting the neighbourhoods into two parts or more causing the neighbourhoods to lose their boundary and connectivity with other parts. Moreover, the difficulty of the acquisition of daily necessities from other parts causes inconveniences and traffic accidents. Given the history of the traffic accidents in the city of Duhok, 88% of the traffic accidents happen in these arterial streets which bisect the neighbourhoods because of the excessive speeding. Most of the neighbourhoods' facilities concentrate on these arterial roads, the lack of the crosswalks from one side, and the non-compliance with traffic regulations and over-speeding on the other side. Usually, the victims are young children, women and elders (Traffic of Duhok, 2015).

Existence of many intersections and speed hampers in short distance disturbing the traffic flow, for example, in Aştî neighbourhood in 1.54 km of the street there are six speed hampers and 25 intersections in both sides with the residential streets and three intersections with other arterial roads of Şaxkê, Daristan and Qzîmuhemed. In practice, serving local street networks in a residential area should have good interconnectivity with each segment in the network and appropriate connection with other arterial roads – see Figure 13-31. The space between the junctions and their numbers should be designed in accordance with the function of the street. For example, the space between the junctions in the local distributor is 90 meter and the major access road is 80 meters (Bentley, Alcock, Murrain, McGlynn & Smith, 1985), while in the surveyed neighbourhoods the junctions and the segment lengths have not followed a certain planning scheme.

According to the UN-Habitat (2013a), to get easy access each square kilometre of the residential area should have 18 kilometres length of residential streets to have sustainable accessibility. By comparing the computed calculations for the segments, all the neighbourhoods have more than the recommended length. The longest lengths are in Êtûtê (31.24 km/km²) and Serhildan (30.48 km/km²), and the shortest is in Sêgirka (19.88 km/km²) and Masîka Rojava (22.16 km/km²). Despite the high rate of street length, the streets are unsustainable, due to inconsistency and inadequate design and planning of the segments, junctions, sidewalks and street widths for carrying traffic and pedestrian flow in the residential areas. The high rates of the street length consume lands; requiring more costs, deteriorating the environment and confusing the traffic flow.

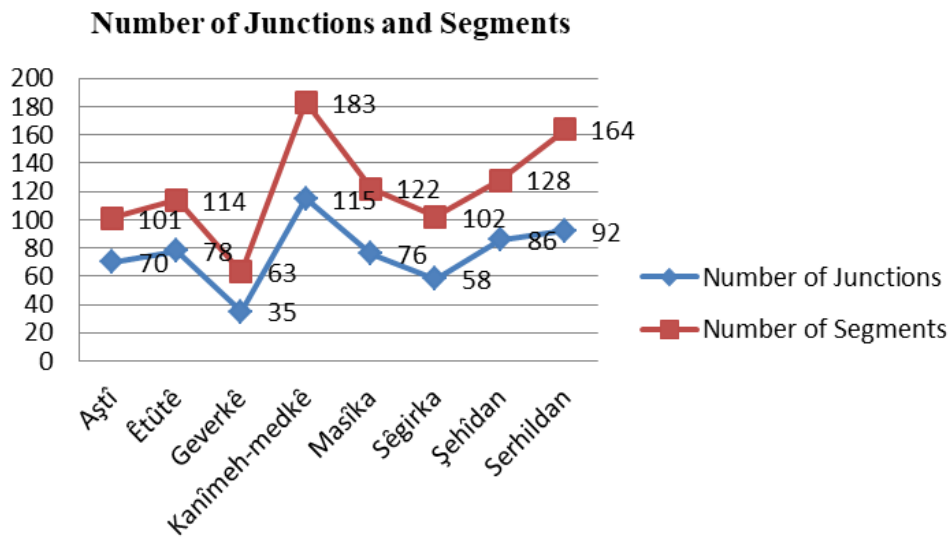


Figure 13-31: Numbers of junctions and street segments in the surveyed samples of the neighbourhood

Source: Own construct based on the survey

The neighbourhoods have excessive numbers of intersections with the arterial streets leading the neighbourhoods to lose their privacy and interconnectivity. The residential streets are directly connected to the main arterial streets without having transitional space. The arterial streets in Duhok are controlled by speed limits of 60-80 km/h, while the speed in the residential streets is limited to 50km/h.

The existence of residential alleys between 4-6 metres width without having sidewalks in both sides Aşti, Kanimehemdkê and Geverkê causes inconveniences to the private car owners in the neighbourhoods. The degree of the motorisation - number of private cars per 1000 persons- was very low (5.4), while currently is 69.11 (Directorate of Statistics in Duhok, 2013). The same concept controlled the width of Kanimehemdkê and Geverkê streets, although, both of them were not guided by planning schemes. The narrow alleys do not encourage people to live in the houses located on these alleys, especially residents who have private cars, with the absence of community car parks in the area.

The exploitation of the sidewalks for private affairs in the residential neighbourhoods is a widespread phenomenon even in other commercial streets. These practices inevitably obstruct pedestrian flow. Even in residential areas, the residents in the surveyed houses are using the

sidewalks for different uses such as; gardening, car park or other uses. The rate of occupancy differs among the neighbourhoods – see Figure 13-32 and 13-33.



Figure 13-32: Occupying Sidewalks
Source: Photo by the Researcher- 2015

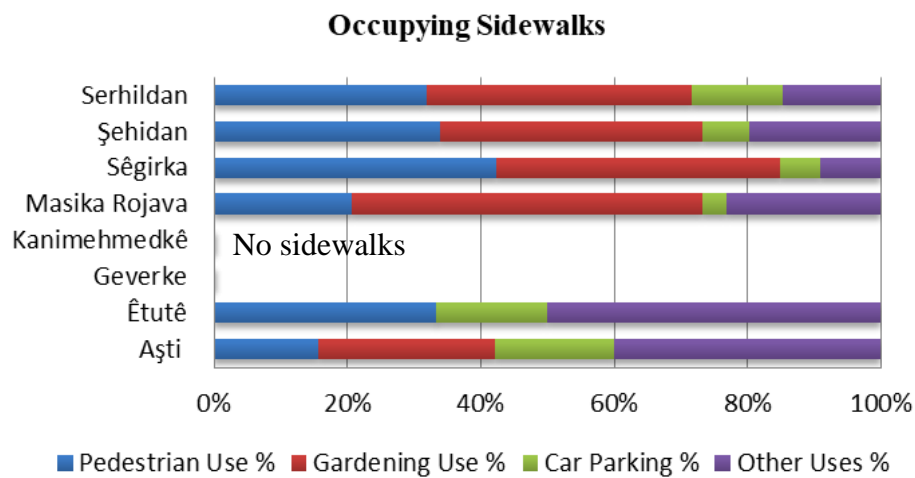


Figure 13-33: Percentages of occupying sidewalks in residential areas for private affairs
Source: Own construct based on survey and observation

13.3.2.4. Public Green Open Spaces

In general, there is an acute shortage of public green spaces in the surveyed neighbourhoods. The formally developed neighbourhoods exhibit better situation than the unguided development. Êtûtê neighbourhood displays the highest rate of 4.14%, followed by Masîka 3.54%, whereas the neighbourhoods of Kanimehemdkê and Geverkê are showing zero percentage of public green open spaces- see Figure 13-34.

The share of public green space for each resident is calculated based on the amount available. According to the Iraqi Housing Regulations, each resident should have 6.50 m² of green open spaces at the neighbourhood level. In the surveyed samples, none of the neighbourhood meets this criterion for offering green open spaces. The high rate of public green open space exhibits in Êtûtê neighbourhood (5.26 m² per person). This is close to achieving the requirement, while in Masîka Rojava is 1.53 m² per person, Aşti (1.36 m² per person) and Sêgirka (1.16 m² per person). Serhildan and Şehîdan display a very low share (0.53 and 0.46 m² per person). In Kanîmehmedkê and Geverkê the share is zero - see Figure 13-35. To find out the shortage of public green open spaces in the neighbourhoods according to the local regulations -see Table 13-4.

Table 13-4: The available public green open spaces and deficiency in the required amount

No.	Neighbourhoods	Population (persons)	Available Area (h)	Deficiency in Area (h)
1	Aştî	3014	0.41	1.55
2	Êtûtê	1979	1.04	0.25
3	Geverkê	1783	0.00	1.16
4	Kanîmehmdkê	7502	0.00	4.88
5	Masîka Rojava	5814	0.89	2.89
6	Sêgirka	4995	0.58	2.67
7	Şehîdan	4125	0.22	2.46
8	Serhildan	6674	0.31	4.03
Total		35886	3.45	19.89

Source: Own construct based calculations from survey by using ArcGIS 10

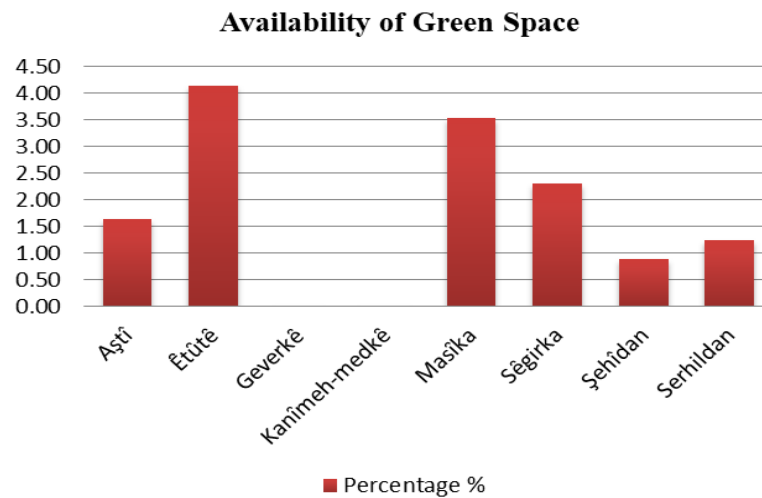


Figure 13-34: Percentage of availability of public green open spaces in the neighbourhoods
Source: Own construct based on survey and observation

The available gardens within the residential areas are poorly managed. The gardens are gated and fenced with concrete block and steel bars presenting an ugly picture of the characteristics of public green open spaces in the residential areas - see Figure 13-36.

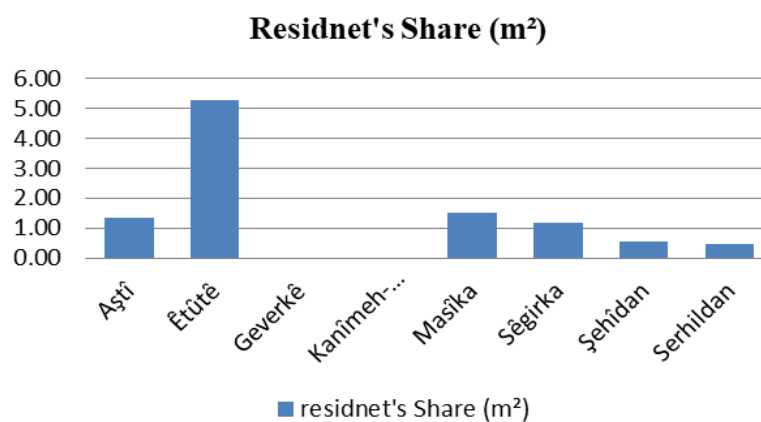


Figure 13-35: The share of each resident from the public green open space in the neighbourhoods

Source: Own construct based on the survey



Figure 13-36: Poor quality of the green open spaces in the neighbourhoods of Aştî, Masîka and Sêgirka

Source: Photo Courtesy of Shivan Kh. Hasan, 2013

13.4. Conclusions

Socio-economic aspects of the selected neighbourhoods' segments display significant disparities between the neighbourhoods in terms of owner-occupation rate, household size, family size, family income, occupancy rate, duration of residing and the source of neighbourhoods' population.

The newly developed neighbourhoods display high percentages of owner house occupation with fewer percentages of tenancy and high rate of rents. Whereas, the old developed neighbourhoods which are close to the city centre have displayed higher percentages of the tenancy and a medium rate of rents. Also, the informally developed neighbourhoods have received high percentages of tenancy which is equal to the percentages of tenancy of the old neighbourhoods but less than half.

The household size in the informally developed neighbourhood has shown a high rate among all neighbourhoods. These neighbourhoods usually host more than one family in one house by occupying different floors and is mainly targeted by low-income families. The new and the old neighbourhoods have shown less rate household sizes because nearly all the rented families have hired the complete house.

The old neighbourhoods and newly developed neighbourhoods in the western and southern parts of the city of Duhok, have manifested less family size than the unguided and informally developed neighbourhoods in the eastern part of the city.

The average monthly family-income varies up to 2.5 times between the neighbourhoods. The highest average incomes have registered in the old neighbourhood of Aştî and the new Masîka Rojava. The effect of the variations of the family's income has reflected on the physical characteristics of the neighbourhoods such as the type of buildings and other architectural features. This implies the existence of significant spatial disparity between the neighbourhoods in terms of population and income distribution.

All the neighbourhoods display of high occupancy rate above the Iraqi Housing Standards. The highest rates have manifested in the two neighbourhoods; informally developed neighbourhoods; Kanîmehmedkê in the eastern part and Geverkê in the western part of the city. The relatively old and newly developed neighbourhoods have displayed less average. The highest average is showing more overcrowded neighbourhoods.

The duration of residents residing in the neighbourhoods shows the degree of population movement between the neighbourhoods and within the city. The more stable neighbourhoods, which have displayed a long duration of staying, are the old neighbourhoods. The percentage of the families who stayed for a long duration (20 years and more) is equal to the short duration of staying (1 -10 years). One could conclude that within the span of the 10 to 20 years many families change their place of dwelling to settle in other neighbourhoods.

Knowing the original source of the newcomers to the residential neighbourhoods is significant for planning authorities to identify and estimate the numbers of migrants from the rural to the city. The survey has shown that one-third of the neighbourhood families are from rural areas who migrated in the span of the last twenty years. This means that the city of Duhok is under threat to offer more land and services for the newcomers in the next years unless there will be equilibrium in developing urban and rural areas.

Evaluating the physical characteristics of the neighbourhoods is essential for determining the level and the degree of the sustainability of physical development in a certain context. Analyses of the land use pattern for the selected segments from the neighbourhoods in the city of Duhok shows great deficiencies in land use allocation and the availability of necessary urban services. The adopted planning approaches to the recently developed neighbourhoods have generated numerous designs and development problems which have deteriorated the sustainability and resulted in worsening the old problems and emerging new ones.

Unfortunately, the earlier developed neighbourhoods in 1978 and 1983 show better results in terms of coverages area, setbacks, urban block dimensions and size, open spaces and street design, than the newly developed neighbourhood of Masîka Rojava in 2006. The problem is most of the recent development initiatives of the residential area, are the copies of the previous development without assessing the sustainability of those developments even in view of the local settings. This means that there is very little response to the sustainability principles and agendas at the local level.

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Chapter Fourteen: Residents' Satisfaction with Urban Form

14.1. Introduction

Satisfaction becomes an important indicator of the sustainability of the neighbourhoods and the quality of urban life. Investigating factors that define the degree of satisfaction provides important inputs to the evaluation and success of the policies for achieving sustainable urban development. Examining the notion of the sustainable urban form and social sustainability is essential through evaluating the impacts of the elements of urban form on the residents' satisfaction as determinants of the neighbourhood sustainability. The Chapter in hand investigates residents' satisfaction with their neighbourhoods in the city of Duhok.

14.2. Interviewees' Background

The selected samples are from the neighbourhoods' segments, which have been identified as units for investigations of urban form and structure at the micro-level. The size of the population sample is based on the average family size⁷¹ of Duhok and the numbers of the houses in each segment - see Figure 14-1. Therefore, the samples of the interview have been selected from the population of the confined area by the circle perimeter with a diameter of 566m. The eight samples are from different neighbourhoods in the city of Duhok namely; Asti, Êtûtê, Kanimehmedkê, Geverkê, Masîka Rojava, Sêgirka, Şehîdan and Serhildan. The methodology of selecting units and the size of population samples are identified in subsection 7.2.2.1 and 7.5.5.2 of Chapter Seven.

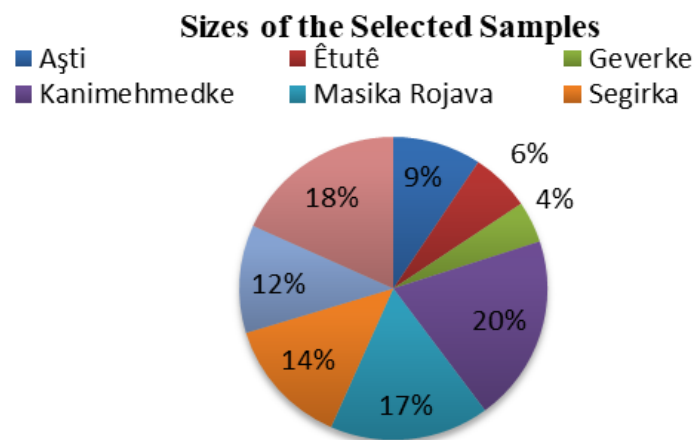


Figure 14-1: The size of the population samples for residents' satisfaction

Source: Own construct

The samples encompass different age group to allow to a wide range of residents to express their opinions and satisfaction about the sustainability of the urban form at the neighbourhood level. Individuals are over 15 years were selected to ensure that they were familiar with their built environment- see Figure 14-2. Gender was also taken into consideration as criteria for sample selection. The percentage of the male and female according to the Directorate of Statistics of Duhok is 51% and 49% respectively, therefore these percentages have been considered in determining the numbers of the males (247

⁷¹ - Initially the size of the population of the selected samples was depended on the reported family size (6.9 persons per family) by the Directorate of Statistics of Duhok in 2013.

persons) and the females is (237 persons) which totals 484 individuals, and also this percentage has been considered in all age groups.

The samples have covered all spectrums of education levels starting from the primary level⁷² to the higher educational level – see Figure 14-3. The reason is to obtain the opinions and perceptions of all the residents with different educational backgrounds. This helps the researcher to ensure that the perceptions regarding the urban form and structure are reflecting all the residents in the neighbourhoods.

Age Class Percentages

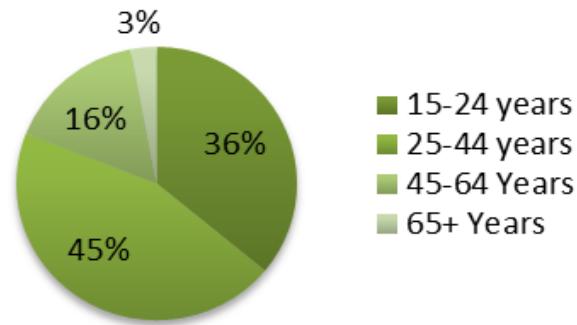


Figure 14-2: The percentages of age groups in the selected population samples
Sources: Own construct

Educational Background

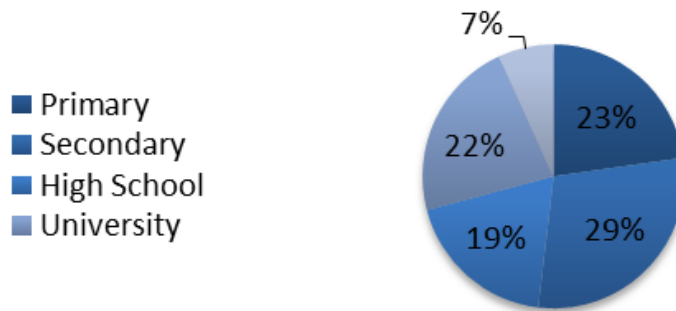


Figure 14-3: Educational background of the selected Samples
Source: Own construct

14.3. Residents' Preferences

The addressed questions investigate the preferences of the residents regarding the best neighbourhood for living and the type of housings which they prefer.

(Question-9): *Do you have a plan to move from your present neighbourhood to another? Why?*

⁷² Most of the selected residents are mature persons, but they have not completed their education.

The directed question tries to investigate whether the residents have the interest to move from the current neighbourhood to another and the reasons behind such desire. There is a notable percentage of residents from all the neighbourhoods, who want to change their dwelling places.

The interviewees in Masîka neighbourhood (84.15%) have less desire to move to another neighbourhood as one of the newly developed neighbourhoods in the city of Duhok, owing to the high value of the property and the availability of facilities- see Figure 14-4.

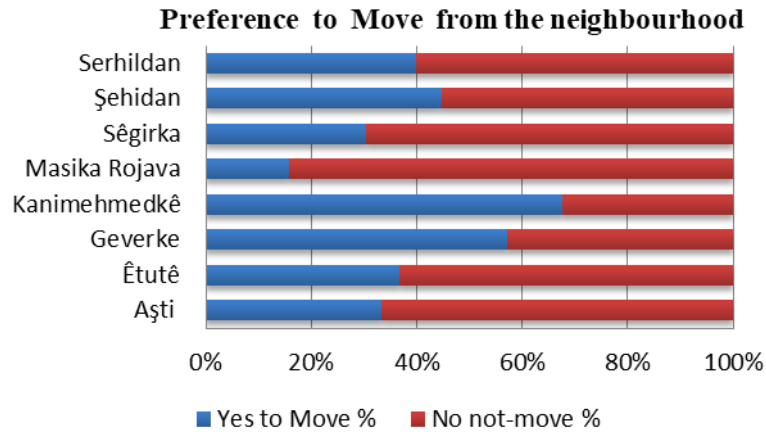


Figure 14-4: Percentages of the residents who desire to stay and move from the current neighbourhoods

Source: Own construct based on interviews with residents

The percentages of (15.85%) who wish to move, complain about the lack of essential daily facilities such as; schools, children play yards, open green spaces.

A remarkable percentage of (67.71%) of the interviewees from Kanîmehmedkê wishes to move from the current neighbourhood because the neighbourhood is very crowded, lacks green space, has old buildings, narrow streets, no sidewalks and children play yards. Whereas the percentage of (32.29%) of the interviewees want to stay in the current settlement in Kanîmehmedkê because of good neighbours, proximity to the main arterial roads, and adaptation to the neighbourhood. Also, the residents in Geverkê show a high desire to move from the current neighbourhood due to the same reasons mentioned by the residents in Kanîmehmedkê. In the other neighbourhoods, the wishes for moving vary.

(Question-10): If you have the chance to move from this neighbourhood, which neighbourhood in Duhok city would you choose? Why?

This question investigates the most preferable neighbourhoods for dwelling in the city of and the reasons for selecting them. The question is correlated to the question-9. The most favourable neighbourhoods the citizens wish to settle are the new neighbourhoods in the western part of the city of Duhok which developed after 2005 – see Figure 14-5.

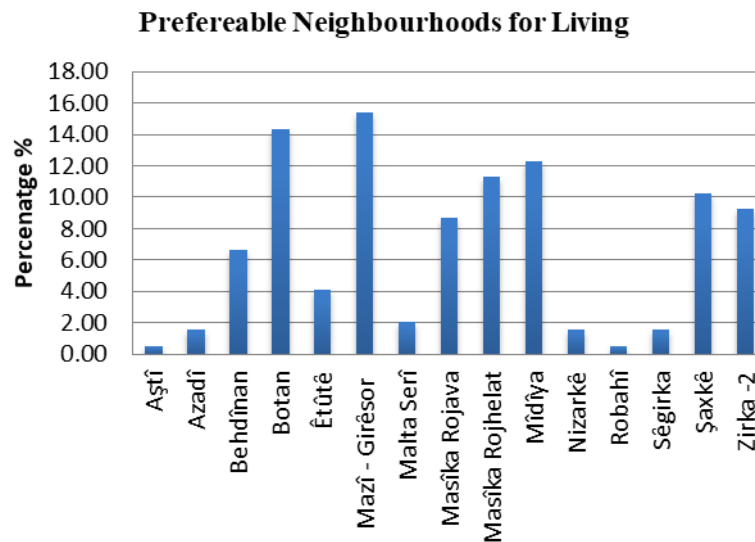


Figure 14-5: Preferable neighbourhoods for dwelling in the city of Duhok
Source: Own construct based on interviews with residents

The southern part of Mazî neighbourhood (Grêsor) ranked as the most preferable neighbourhood for a living (15.38%), Botan neighbourhood (KRO) ranked second (14.36%) as a favourable neighbourhood for living, followed by Mîdîya (12.31%), Masîka Rojhelat (11.28%), Şaxka Nu (10.26%), Zirka Du (9.23%), Masîka Rojava (8.72%) and Behdînan (6.67%). The neighbourhoods that were developed before 1990 (Aşfî and Sêgirka) received the lowest rate. The interviewees do not favour the neighbourhoods in the eastern part of the city, which are dominated by unguided development and informal neighbourhoods around the city centre.

In fact, the main reasons for attracting people's attention to live in the newly developed neighbourhoods are not only affordability of the urban facilities as indicated by their answers rather; property value, relatively wider streets and new design trends of housing and the tranquillity of the new neighbourhoods comparing to the old and crowded ones.

(Question-11): How would you prefer your single-house to be in terms of exposure?

Knowing the favourable type of the houses by the residents is essential to improve the pattern of setbacks, subdivisions and block size. The most favourable type of house exposure is the detached type (39.46%). The type of attached houses on two sides (left and right) is ranked as second favoured (27.69%) and attached on the backyard and one side is (22.31%). The current type of houses that are attached on the back and both sides (left and right) and dominant in the newly developed neighbourhood, is not preferable and accepted by 10.54% of the interviewees- see Figure 14-6.

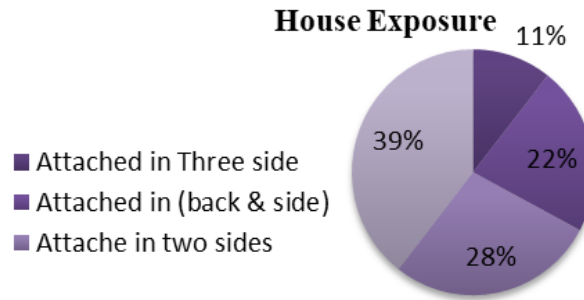


Figure 14-6: The preferable type of house exposure
Source: Own construct based on interviews with residents

(Question-12): Which type of residential buildings do you prefer? Single- House (Low Residential) or apartment (High Residential)

Investigating the degree of preference for the pattern of high-residential housing and low-residential housing shows the extent of which municipality encourages high-rise residential housing in the city. It is evident that the majority of the interviewees prefer low rise housing more than the high residential housing- see Figure 14-7. It is clear that there is a social acceptance toward high-rise housing, especially by small family sizes and newlyweds.

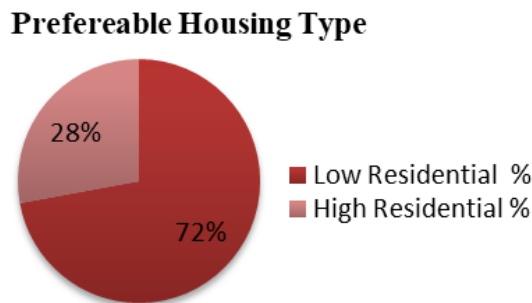


Figure 14-7: The preferable type of housing
Source: Own construct based on interviews with residents

14.4. Interaction with Urban Form and Structure

The posed questions try to gain answers from the interviewees relating the way they interact and use the urban form at the neighbourhood and the city level.

(Question-13): Why do you go to the city centre, is it for shopping, leisure, social contacts or working?

This question shows the purposes for going to the city centre. The interviewees' answers give a clear indication that the majority (59.30%) of the residents go to the city centre for shopping purposes. While 19.63% of the interviewees go to the city centre for leisure and spending time, and 13.64% for social contacts and meeting friends and 7.44% go to the city centre for working which majority are the owners of the small retail and shops or workers- see Figure 14-8.

Purposes of the Trip to the City Centre

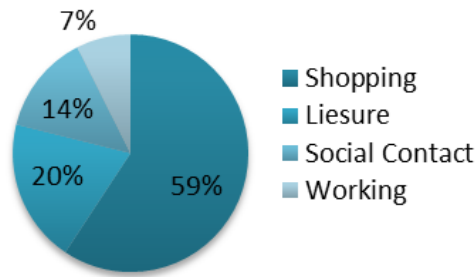


Figure 14-8: Purposes of the trips to the city Centre
 Source: Own construct based on interviews with residents

(Question-14): *When you go to the city centre for shopping, which type of shopping do you perform? Daily, Weekly or Monthly*

Answering this question is related to the previous question-13. The question asks the interviewees the performed type of shopping from the city centre. It is important to know where daily and weekly shopping are performed. All the daily and weekly shopping should be performed inside the neighbourhood or the centre of the district. The results display that most of the trips are for weekly shopping (46.28%), while for monthly shopping is (35.94%) and daily shopping is (17.77%). Daily and Weekly trips to city centre cause extra loading to infrastructure especially streets and other services – see Figure 14-9.

Type of Shopping



Figure 14-9: Types of shopping from city centre
 Source: Own construct based on interviews with residents

(Question-15): *Where do you perform your daily shopping? Within the neighbourhood, in other Neighbourhoods, or in the city centre.*

This question is also related to the other two previous questions. The question asks interviewees where they perform their daily shopping. None of the neighbourhoods provides fully for the daily needs of their inhabitants. The majority of the residents who settle in the neighbourhoods near to the city centre do their shopping in the city centre, or in other neighbourhoods, if they do not find the needed items in their neighbourhood like; Aşti,

Sêgirka and Şehîdan. The neighbourhoods of Sêgirka, Aşti and Masîka Rojava are the best to provide daily needs to their inhabitants, while the neighbourhoods of Kanîmehmedkê, Êtûtê and Geverkê are not providing the necessary daily needs to their residents – see Figure 14-10.

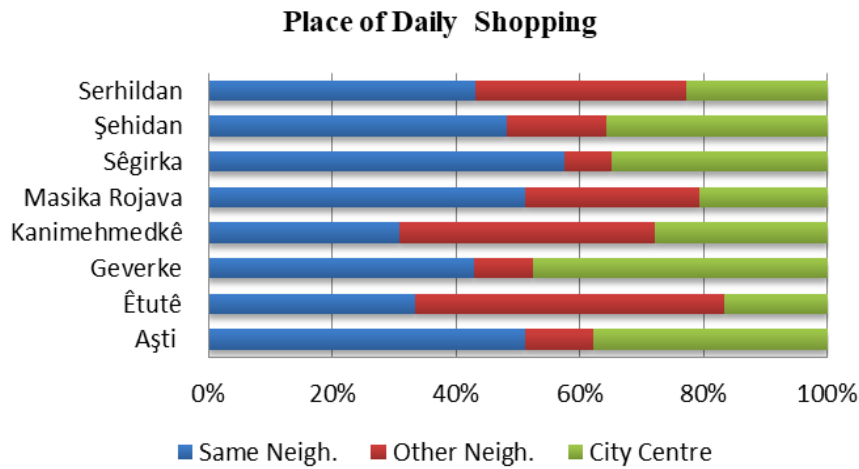


Figure 14-10: Destinations for daily shopping
Source: Own construct based on interviews with residents

It is evident that the neighbourhoods in the city of Duhok are not able to provide all the citizens' daily needs. Only 44.83% of the residents perform shopping in the same neighbourhood, and 26.65% in other neighbourhoods and arterial streets, while 28.72% of the residents are still depending on the city centre for their daily shopping- see Figure 14-11. There are two reasons pushing residents to depend on the city centre; *first*, the available daily needs in the neighbourhood are not of a good quality or cannot be found, and *second*, the cost of the items in the neighbourhoods surpass the costs of the items in the city centre from 12.5% to 20.0%⁷³.

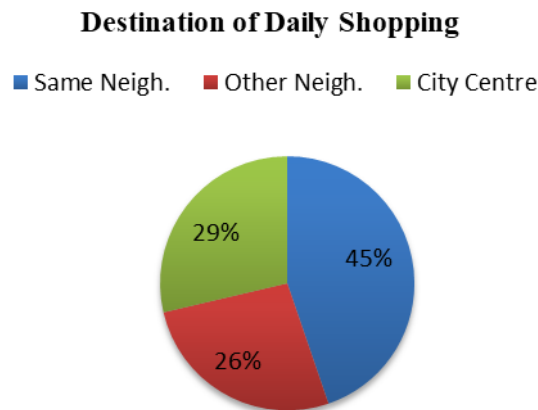


Figure 14-11: Percentages of the residents who perform daily shopping
Source: Own construct based on interviews with residents

(Question- 16): How do you normally go to the city centre? By taxi, bus or private car or walking.

⁷³ - Consumers Association in Duhok, 2014

The question indicates the common mode of transportation used by the residents for travelling to the city centre residents can walk and the high percentages of walking residents are indicated in Şehîdan neighbourhood (16.07%) followed by Aşti (13.33%), Sêgirka (7.58%) and Kanîmehmedkê (7.29%), while in other neighbourhoods due to their remoteness from the city centre, no one walks – see Figure 14-12. The residents in the neighbourhoods which are far from the city centre depend on taxi as the main mode of transportation for their trips such as Geverkê (38.10%), Masîka Rojava (36.59%) and Êtûtê (33.33%). Residents in these neighbourhoods also are highly depending on private cars. The residents in the neighbourhoods of Serhildan and Kanîmehmedkê are highly dependent on available local buses as a means for travel. Knowing that, these two neighbourhoods registered a high percentage of low-income families. Cycling as a mean of transport is not popular.

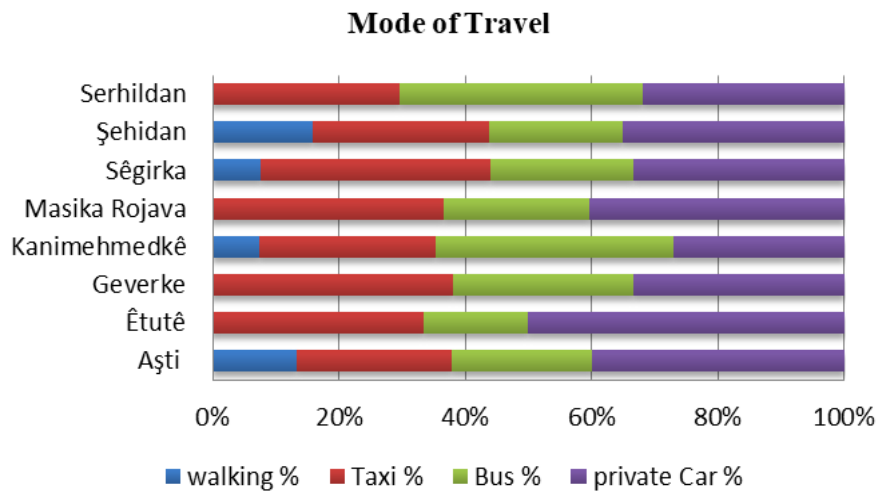


Figure 14-12: Using modes of transportation to the city Centre and other Destinations

Source: Own construct based on interviews with residents

As a general trend, the residents are highly dependent on private cars (34.92%) and taxis (31.40%) and less on available buses as only means of public transportation (28.31%) – see Figure 14-13.

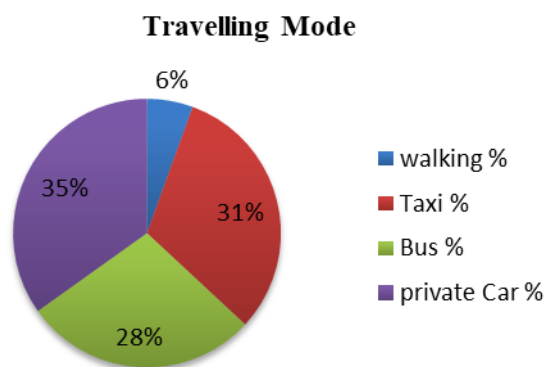


Figure 14-13: Using modes of transportation to city centres' trip

Source: Own construct based on interviews with residents

(Question-17): Do you have a private car? How many? Where do you park?

This question investigates the rate of car ownership between the residents of the neighbourhoods. Aforementioned, Duhok is highly dependent on private cars as the main mean for the internal trip. Knowing that the rate of car ownership is crucial for planners to estimate the number of on-street and off-street car parking inside the city centre and neighbourhoods. Most of the car owners' park in the street due to unavailability of car parks in their houses or on the roads which are not accessible to the houses. The lack of effective laws regulating parking in public places and streets has restrained accessibility in the residential streets because the streets are not designed and planned to accommodate on-street cars. Parking of private cars whether on-street or in garages at home, differ between the neighbourhoods. Masîka Rojava displayed the highest percentage of on-street car parks (74.42%) followed by Sêgirka (65.96%) and Şehidan (63.64%) - see Figure 14-14 and 14-15. The low percentage of the on-street car park and higher percentages of at-home parking registered in Geverkê (69.23%) and Êtûtê (56.52%), perhaps this returns to bigger plots in these two neighbourhoods.

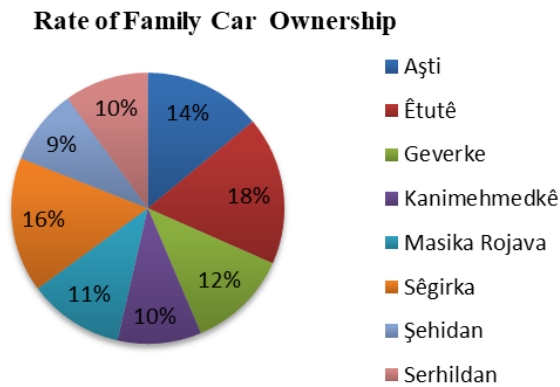


Figure 14-14: Rate of car-ownership in the neighbourhoods
Source: Own construct based on interviews with residents

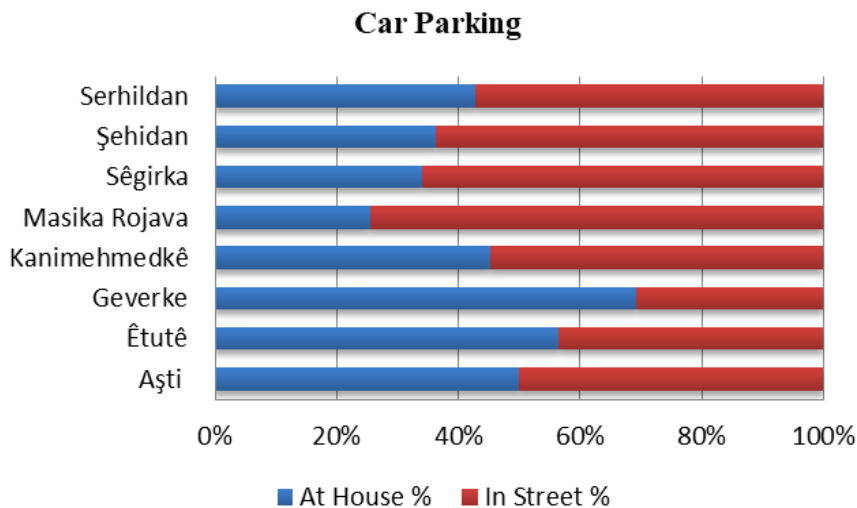


Figure 14-15: Percentages of at-home and on-street car parking in the neighbourhoods
Source: Own construct based on interviews with residents

(Question-18): Do you consider the sidewalk space as a private, semi-private, semi-public, or public?

Investigating how residents look to the sidewalk privacy is an important indicator for improving accessibility. The interviewees' perception regarding the privacy of the sidewalks adjacent to their houses show that 37.81% of them consider the sidewalk as a part of their houses, and 34.92% see it as a semi-private space and consider the sidewalk as the extension of the plot frontages – see Figure 14-16. The sidewalks are occupied by the residents for different uses as private adornment garden or car-parks or other uses. The lack of Municipality's intervention in paving and controlling sidewalks' heights give the rise to a sense of considering sidewalks as private or semi-private space among the residents. Any step towards improving sidewalks in order to increase accessibility in the residential areas needs effective participation of residents.

Perceptions on Privacy of Sidewalk

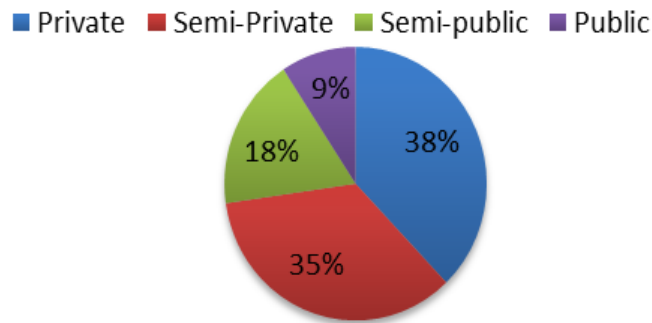


Figure 14-16: Perceptions on the privacy of the sidewalks
Source Own construct based on interviews with residents

(Question-19): Which type of green space facilities do you attend in the city, the public space or private? and why

Residents' preferences about the preferable type of green spaces are needed for enhancing green spaces in the city. All the residents from all the neighbourhoods prefer the privately managed green open space. About 57.23% of the interviewees visit green open spaces which are run by the private sector instead of those run by the Municipality. The reasons mentioned by the residents for choosing privately managed green open spaces are; better facilities, well-managed, more choices, safe and clean, while the interviewees who used to visit publicly managed green open spaces state that the public green spaces are free of charge and near to their neighbourhoods- see Figure 14-17.

Percentage of Visiting Green Open Spaces

■ Public Green Space ■ Private Green Space

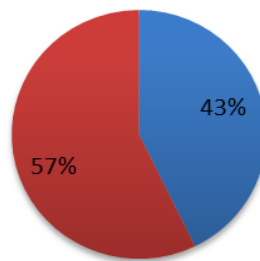


Figure 14-17: Percentage of residents who using public and private green open space

Source: Own construct based on interviews with residents

14.5. Residents' Appreciation for House and Neighbourhood Elements

To obtain a wider range of data regarding the satisfaction with the elements of houses, interviews with the residents were conducted. Many researchers have identified several determinants for residents' satisfaction, such as the characteristics of the neighbourhood and housing. The researchers have confirmed that these characteristics can be measured through objective and subjective attributes of the neighbourhood and housing (Rioux & Werner, 2011). The physical characteristics, facilities and environment of the neighbourhoods and housing can be objectively measured, while the perceptions, attitudes and emotions towards housing attributes can be subjectively measured (Temlova & Dvorčáková, 2012).

For the assessment of the degree of the residents' satisfaction, specific to this assessment, the measuring scale contains three steps for evaluation (dissatisfied, neither/nor, satisfied). To measure the degree of satisfaction quantitatively three numerical values have been given to the weight the responses. The given values are -1=dissatisfied, 0= neither nor, +1=satisfied. This method is used for evaluating residents' satisfaction regarding the house elements and the neighbourhood elements.

The following questions number 20 and 21 investigate the degree of the residents' satisfaction regarding the elements of the houses and neighbourhoods.

(Question-20): *Are you satisfied with these elements of the house, plot size, building setback, building height, built-up area, open area, building orientation and car park?*

Interviews with the residents of the selected neighbourhoods displayed varying opinions regarding the quality of the elements of the houses. The degree of satisfaction with house elements varies among the residents and also differs between the neighbourhoods.

Overall, the higher percentages of the degree of the satisfaction with the elements of houses in the neighbourhoods are displayed as follows: Êtûtê 60.00% satisfied, Ařtî 52.69 % satisfied, Masıka Rojava 51.35% satisfied. The higher percentages of dissatisfaction displayed in řehıdan 59.36% dissatisfied, Serhıdan 58.28% dissatisfied, Geverkê 57.79% dissatisfied, and Kanîmehmedkê 56.18% dissatisfied - see Figure 14-18.

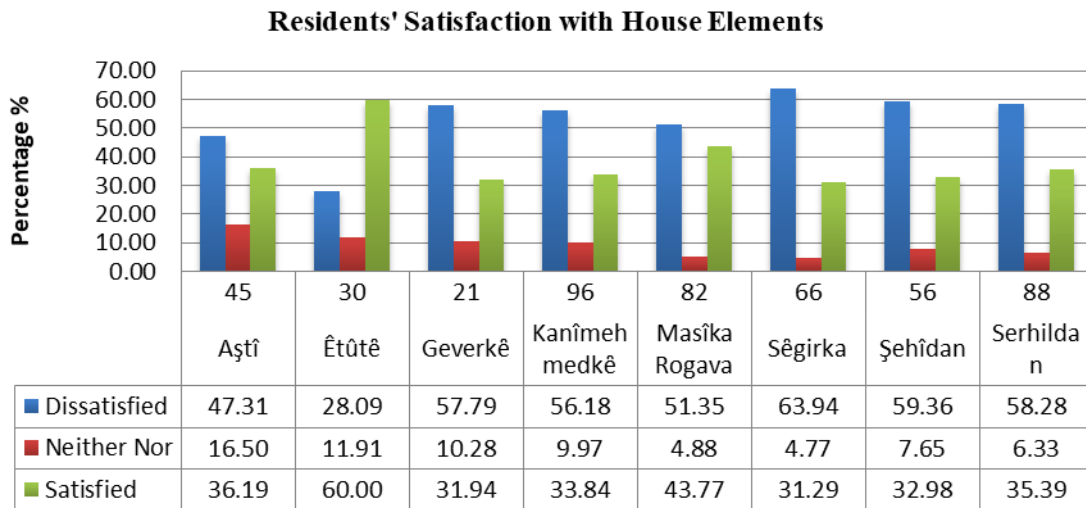


Figure 14-18: General satisfaction of the residents with the elements of the houses in the neighbourhoods

Source: Own construct based on interviews with residents

The houses in the Êtûtê neighbourhood have ranked first as the desirable houses to meet the residents' satisfaction. All the elements of the houses have satisfied most the residents. Masîka Rojava as the recently developed neighbourhood is ranked second, but all the elements of the houses have not met the satisfaction of the residents such as; building setback, building height, open area and car park. Aştî neighbourhood has ranked the third; three elements (plot size, building setback and house orientation) of the houses did not satisfy the residents.

The neighbourhoods of Kanîmehmedkê which was informally developed and Geverkê as an unguided development, most of the houses' elements in both neighbourhoods have not satisfied the neighbourhood ambitions, with exception of the house orientation in Kanîmehmedkê and the built-up area in Geverkê which has satisfied the residents because the built-up ratio (0.58) is the lower among all the neighbourhoods.

The neighbourhood of Sêgirka, Şehîdan and Serhildan despite they formally developed, most of the house elements have not satisfied the residents' ambition with exception to the open area and house orientation in Sêgirka neighbourhood. The wide front and side setbacks in Sêgirka give more open area and less coverage build area, and most of the houses are orientated towards south and east as a favourable direction. The house orientation in Şehîdan and Serhildan neighbourhoods has satisfied the residents.

The calculations confirm that most of the selected elements of the houses are not satisfied with- see Figure 14-19 and Table 14-1. The important point is that the houses' elements of both the formally developed neighbourhoods (Serhildan, Şehîdan and Sêgirka) and informally developed neighbourhoods (Geverkê and Kanîmehmedkê) did not meet residents' satisfaction.

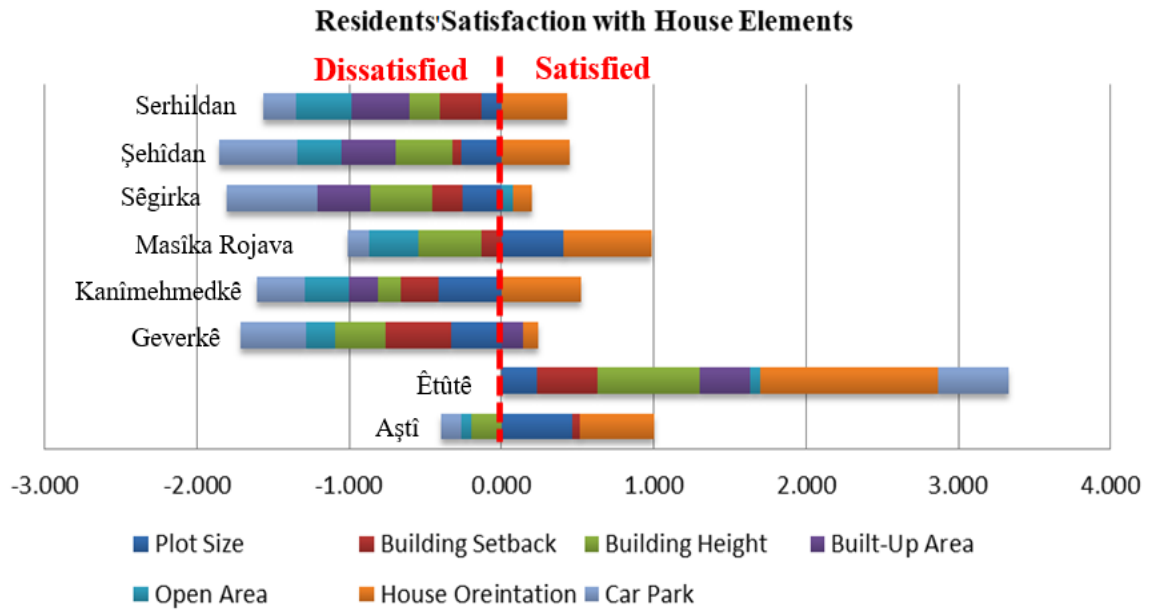


Figure 14-19: Degree of satisfaction with the elements of the houses in the neighbourhoods
Source: Own construct based on interviews with residents

Table 14-1: The weight of the house elements

House Elements	Aştî	Êtûtê	Geverkê	Kanîmehmedkê	Masîka Rogava	Sêgirka	Şehidan	Serhildan
Plot Size	0.467	0.233	-0.333	-0.417	0.402	-0.258	-0.268	-0.136
Building Setback	0.044	0.400	-0.429	-0.250	-0.134	-0.197	-0.054	-0.273
Building Height	-0.200	0.667	-0.333	-0.146	-0.415	-0.409	-0.375	-0.193
Built-Up Area	0.000	0.333	0.143	-0.188	0.000	-0.348	-0.357	-0.386
Open Area	-0.067	0.067	-0.190	-0.292	-0.317	0.076	-0.286	-0.364
House Orientation	0.489	1.167	0.095	0.521	0.585	0.121	0.446	0.432
Car Park	-0.133	0.467	-0.429	-0.313	-0.146	-0.591	-0.518	-0.216

Source: Own construct

Moreover, the question has asked the interviewees to clarify the reasons behind their satisfaction or dissatisfaction towards the houses' elements. These reasons, in general, are related to the physical aspects of the houses' elements. Of course, the reasons differ from one neighbourhood to another but they are very close regarding the same elements. The summary of the commonly repeated reasons among the interviewees is below- see Table 14-2.

Table 14-2: Summary of the most repeated reasons for being satisfied or dissatisfied with house elements

Neighbourhoods	Degree of Satisfaction	Plot Size	Building Setback	Building Height
Aştî	Satisfied	Enough plot size 15x20 m ² & 15x25 m ²	Enough space 5m front and 2m side setback	Enough height of building of 3.20 m for each story
	Not-Satisfied	Big size to manage and maintain	Setback at front and back necessary	Heights are not controlled height
Êtûtê	Satisfied	Different plot size 15x20 m ² & 15x25 m ²	Setback from front and back	Controlled height
	Not-Satisfied	Big size to manage and maintain Not allowed to subdivide	Consuming much space for setbacks	Controlled in expense of the cost
Geverkê	Satisfied	Different plot size and Area	Enough setback	Accepted height no disturbance
	Not-Satisfied	Irregular plot Dimensions	Not enough and not controlled	Not controlled height
Kanîmehmedkê	Satisfied	Different plot size	Enough setback	Accepted height one & two stories
	Not-Satisfied	Irregular plot dimensions	Different & not controlled Setbacks	Not controlled height
Masîka Rojava	Satisfied	The area 240 m ² & 200m ² is enough	Setback 4.00m is enough	Accepted height of one & two stories
	Not-Satisfied	Dimensions are disproportional	No Rear and Side setbacks	Not controlled height disturbing the privacy
Sêgirka	Satisfied	200m ² Plot Area & Size 20x10m is enough	5.00m enough setback of front	Height one & two accepted
	Not-Satisfied	Either big or Small	Rear & side setbacks not controlled	Height of new buildings not controlled
Şehîdan	Satisfied	200m ² & 150m ² plot area is enough	3.0m & 5.0m enough setbacks	One & two stories are accepted
	Not-Satisfied	Irregular plot dimensions & areas	No front or side setbacks Too much setback	Not controlled height disturbing the privacy
Serhildan	Satisfied	200m ² is enough plot area	2.50m setback is enough	Accepted height no disturbance
	Not-Satisfied	150m ² not enough Disproportional plot dimensions	No rear and side setbacks Too much setback (12m)	Not controlled height

(Continue)

Built-up Area	Open Area	House Orientation	Car Park
75-80% Enough covered area rate	Enough area for indoor garden	Desired orientations	Enough space for indoor car park
High rate of building covered area	Lack of indoor space	North & west not desired orientations	Not enough space
Accepted build-up area	Enough open space	Well orientated	Enough space
65%-75% is enough, existing too much build area	30 - 35% of the plot area is much	North orientation	Not well planned
Accepted build-up area	Enough open space	Well orientated	Enough space
Not controlled	Not controlled a village	North & west orientation	Not enough spaces it is a village
Accepted build-up area	Enough open space	Well orientated	Enough space
Not controlled too much	Not controlled informal settlement	North & west orientation	Not enough spaces
Accepted build-up area	Enough open space	Well orientated	Enough space
Not controlled too high	Not enough open space	North & west orientation	Not enough spaces
70% - 80% Accepted build-up area	Enough open space	Well orientated	Enough space
Not controlled too much	Lack of open space	North & west orientation	Not enough spaces
Accepted build-up area	Enough open space	Well orientated	Enough space
Not controlled too much	Lack of open space	North & west orientation	Not enough spaces
Accepted build-up area	Enough open space	Well orientated	Enough space
Not controlled too much in new Jamiya Little in old Jamiya (about 35% is built)	Lack of open space in new Jamiya Too much in Old Jamiya	North & west orientation is not desirable	Not enough spaces

Source: Own construct

(Question-21): Are you satisfied with these features of the Neighbourhood? Block size, number of houses, population density, easy access, availability of local services, proximity to services, street width and length, sidewalk and open green space.

The interviewees' have been asked to declare their satisfaction regarding the neighbourhood elements such as; neighbourhood boundary, block size (number of houses in block), population density, easy access, availability of the local services (retail, educational services, health services, recreational services, religious facilities, bus stops, playgrounds), proximity to the services, residential street width and length, transition spaces, sidewalk designs and availability of the green open spaces.

Overall, the higher average percentages for the degree of the residents' dissatisfaction with the elements of the neighbourhoods show that; Kanîmehmedkê 62.70% dissatisfied, Şehîdan 60.60% dissatisfied, Serhildan 60.44% dissatisfied, Sêgirka 60.32% dissatisfied, Masîka Rojava 59.45% dissatisfied, Aşti 55.00% dissatisfied, Geverkê 51.19% dissatisfied and Êtûtê 46.25% dissatisfied - see Figure 14-20.

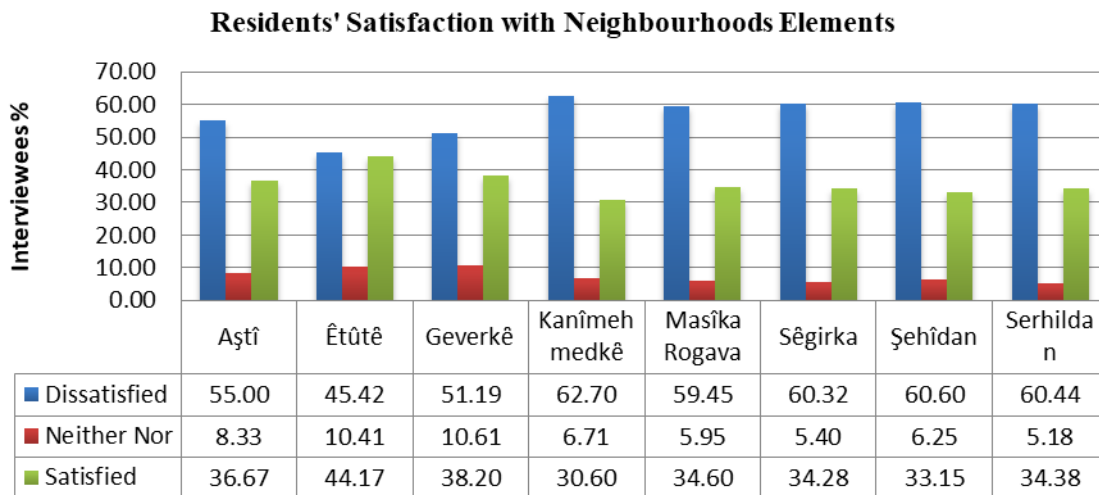


Figure 14-20: The on-average percentages of residents' satisfaction of overall elements of the neighbourhoods

Source: Own construct based on interviews with residents

The calculations reveal that most of the elements of the neighbourhoods did not satisfy residents' ambition. Êtûtê neighbourhood has ranked first as the most satisfying neighbourhood. Many of the neighbourhood elements have satisfied residents' ambitions such as; neighbourhood boundary, block size, population density, easy access, sidewalk and availability of open green spaces⁷⁴. Aşti has ranked second in terms of satisfying members of the neighbourhood, while the elements differ. Neighbourhood boundary, population density, availability of religious facilities and proximity of many services within a 500m walk, has satisfied the residents in Aşti neighbourhood. Geverkê and Masîka Rojava neighbourhoods have ranked third. The elements that satisfied the residents in Geverkê are population density, easy access and availability of religious facilities, whereas in Masîka Rojava the elements that

⁷⁴ - This neighbourhood is under development. The infrastructure has not been implemented and many plots are still vacant.

have satisfied the residents are neighbourhood boundary, block size and easy access to the neighbourhood – see Figure 14-21 and Table 14-3.

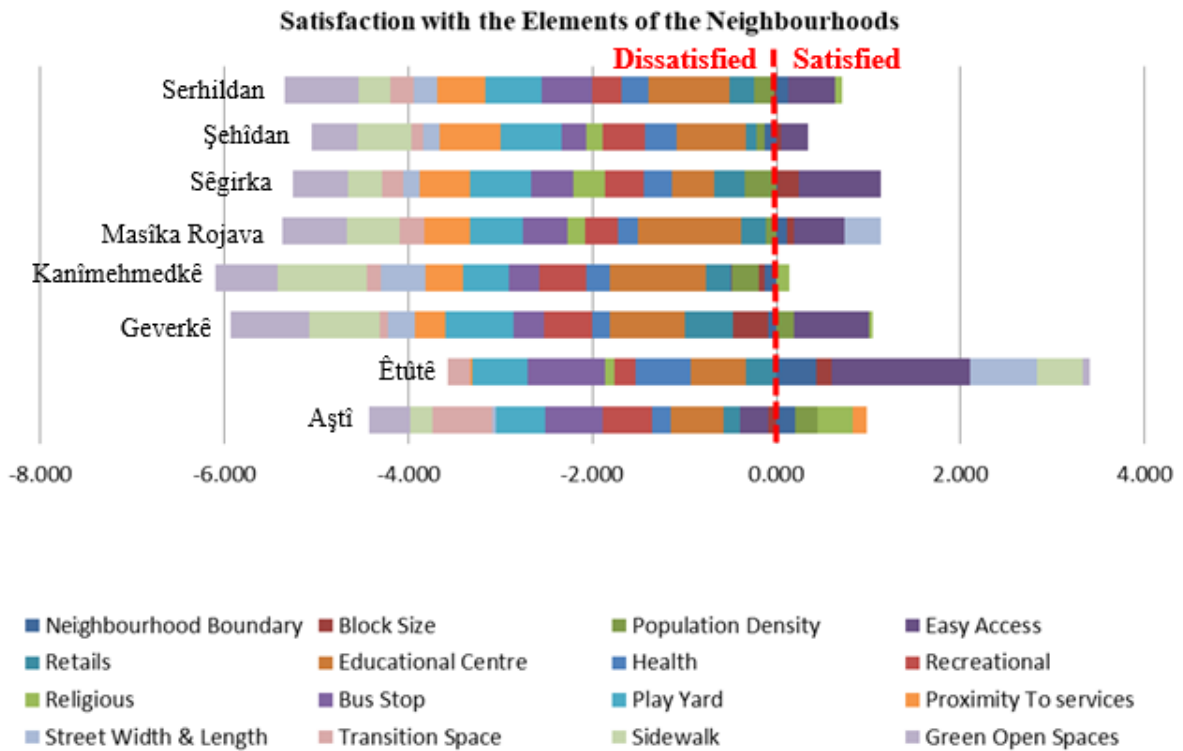


Figure 14-21: Satisfaction with the elements of the neighbourhoods

Source: Own construct based on interviews with residents

Table 14-3: The weights of the neighbourhood elements

Neighbourhood Elements	Aşti	Êtûtê	Geverkê	Kanîmehmedkê	Masîka Rojava	Sêgirka	Şehidan
Neighbourhood Boundary	0.200	0.433	-0.095	-0.125	0.110	0.015	-0.125
Block Size	-0.089	0.167	-0.381	-0.063	0.085	0.227	0.054
Population Density	0.244	0.267	0.190	-0.302	-0.110	-0.348	-0.089
Easy Access	-0.311	1.500	0.810	-0.010	0.549	0.894	0.286
Retails	-0.178	-0.333	-0.524	-0.260	-0.268	-0.333	-0.125
Educational Centre	-0.578	-0.600	-0.810	-1.052	-1.122	-0.455	-0.750
Health	-0.200	-0.600	-0.190	-0.260	-0.220	-0.303	-0.339
Recreational	-0.533	-0.233	-0.524	-0.510	-0.366	-0.424	-0.464
Religious	0.378	-0.100	0.048	0.135	-0.183	-0.348	-0.179
Bus Stop	-0.622	-0.833	-0.333	-0.323	-0.488	-0.455	-0.268
Playground	-0.533	-0.600	-0.741	-0.500	-0.573	-0.667	-0.661
Proximity To services	0.156	-0.033	-0.333	-0.406	-0.500	-0.545	-0.661
Street Width & Length	-0.044	0.733	-0.286	-0.490	0.390	-0.182	-0.179
Transition Space	-0.644	-0.233	-0.095	-0.156	-0.268	-0.227	-0.125
Sidewalk	-0.244	0.500	-0.762	-0.958	-0.573	-0.364	-0.589
Green Open Spaces	-0.444	0.067	-0.857	-0.927	-0.695	-0.606	-0.500

Source: Own construct

Moreover, it is requested from the interviewees to clarify the reasons behind their decision regarding satisfaction or dissatisfaction towards the neighbourhoods' elements. These reasons, in general, are very similar and directly related to the physical aspects of the neighbourhoods. Of course, the reasons differ slightly from one neighbourhood to another but they are very close regarding the same elements. The summary of the most repeated reasons among the interviewees - see Table 14-4.

In general, most of the elements of the neighbourhood do not receive the approval of the inhabitants, showing that, the planning and design of the elements of the neighbourhoods have problems which restrain sustainability and response to the need of its inhabitants and satisfy them.

Table 14-4: Summary of the most repeated reasons for being satisfied or dissatisfied with neighbourhood elements

Neighb.	Degree of Satisfaction	Neighbourhood Boundary	Block Size	Population Density	Easy Access
Aşî	Satisfied	It is defined & enough size	The average number of houses is from 20 to 30 in each block, Big blocks (the average is 40 x 200m)	Not crowded	Easy to IN & Out
	Not-Satisfied	Bisected by an arterial road	Too many houses in one block	Low density	Many junctions and segments
Êtûtê	Satisfied	Well defined	Enough number average is 10 Enough block size average is 120 m	Accepted	No many junctions
	Not-Satisfied	Too big about 400 hectares, it should be divided	Many houses in blocks (25 houses) Too long block 264 m & Curvilinear blocks	Low density	Many junctions & Short blocks
Geverkê	Satisfied	Not Defined precisely	Enough number & Enough block size	Enough density	Many entries and exists
	Not-Satisfied	Not clearly defined becomes part of Şindoxa	Not controlled number & Irregular urban blocks	Low density	No direct entrance
Kanîmehm e-dkê	Satisfied	Defined but not clear	Enough number & Enough block size	Accepted	Direct entry and exist
	Not-Satisfied	No clear boundary/ mixed with Gelî & Beruşkê	Not controlled number & Irregular urban blocks	High density very crowded	Many crocked alleys & no direct entrance
Masîka Rojava	Satisfied	Known & defined	Enough number & Enough block size	Enough density	Wide street & fewer junctions
	Not-Satisfied	Not well defined & big	Not controlled number (average 36houses/block) Long urban blocks average length180-220 m	High density	Long segments and many junctions
Sêgirka	Satisfied	Defined & clear	Enough number & Enough block size	Enough density	Fewer junctions
	Not-Satisfied	Not well defined & no clear boundary	Not controlled number (average 40-60 houses/block) Long urban blocks average length200-300 m	Low Density	Sharp corners & many junctions
Şehîdan	Satisfied	Known boundary	Enough number & Enough block size	Enough density	Easy to In & Out
	Not-Satisfied	No Clear boundary/ mixed with Grêbasê neighbourhood	Not controlled number (40-60 houses/block) Long urban blocks average length160-200 m	High density	Many junctions
Serhildan	Satisfied	Defined	Enough number & Enough block size	Enough density	Direct entry & Exist
	Not-Satisfied	No clear boundary & very big	Not controlled number (30-50 houses/block) Long urban blocks average length180-250 m	High density	Many intersections, sharp turns & short segments

Local Services					
Retails	Educational	Health	Recreational	Religious	Bus Stops
Enough retails	Sufficient	Sufficient	Sufficient	Sufficient	Sufficient
Insufficient & not diversified	Insufficient	Lack of health centres	Not available	Insufficient	Insufficient
Sufficient	Sufficient	Sufficient	Sufficient	Sufficient	Sufficient
Insufficient	Lack of schools	Not available	Not available & shortage of open green spaces	Insufficient	Shortage of means
Sufficient	Available	Sufficient	Enough	Sufficient	Sufficient
Do not meet residents' need	High schools not available	Not available	Not available at all	Insufficient	Lacks & far
Sufficient & available	Sufficient	Enough facilities	Available & Sufficient	Sufficient	Sufficient
Insufficient & not available	Insufficient & don't meet needs	Lack of health centres	Insufficient	Insufficient	Insufficient
Sufficient	Sufficient	Enough facilities	Sufficient	Sufficient	Sufficient
Insufficient & not available	Lack of High schools	Shortage of advanced centres	lack of facilities	Insufficient	Shortages
Sufficient	Enough schools	Available & Sufficient	Sufficient	Sufficient	Sufficient
Insufficient	Insufficient	Shortage of advanced centres	Not available	Insufficient	Insufficient
Sufficient	Sufficient	Sufficient	Sufficient	Sufficient	Sufficient
Insufficient	Shortage of high schools	Shortage of facilities	Not available	Insufficient	Insufficient
Sufficient	Available	Sufficient	Sufficient	Sufficient	Sufficient
Insufficient	Not enough	Insufficient facilities	Not available	Insufficient	Insufficient & far

Playground	Proximity to services	Street width and length	Transition spaces	Sidewalk	Open green space
Sufficient	Reachable	Enough width 10 m	Well planned no problem	Enough width 2.00m	Enough area
Not available	Not reachable	Narrow streets and alleys & too long	Not well designed between public & private	Sidewalks not free & some street have no sidewalks	Not enough area & not well managed
Sufficient	Reachable	Enough width 12 m	Well planned	Enough width	Enough area
Not available	Not reachable	Short streets & some too long	Not clear change	1.00m is not enough	Too much land consumed
Sufficient	Reachable	10 m is enough	Well planned	Not Existed	Not available
Not available	Not reachable	Irregular width & some too long	Don't exist & not distinguished		
Sufficient	Reachable	Accepted different widths	No problem	Not Existed	Not available
Not available	Not reachable	Irregular width & long	Not recognised		
Sufficient	Reachable	Enough 10 m width	Well planned	1.50m width Accepted	Enough area
Insufficient	Not reachable	Some street is too long	Not well designed	Not levelled to house entrance	Public green space not enough
Sufficient	Reachable	10m width is enough	Clear	2.00 m is Accepted	Enough area
Insufficient & far	Not reachable	Paved street is narrow 6.5m	Not well designed & ambiguous	Not levelled to house entrance & not free	Public green space not enough
Sufficient	Reachable	Accepted but different width	Well planned	Accepted	Enough area
Not available	Not reachable	Narrow streets and alleys	Not clear & not recognised	Not levelled to house entrance & some have no sidewalks	Public green space not enough
Sufficient	Reachable	enough 10m width	Clear & accepted	2.00m width is Accepted	Enough area
Not available	Not reachable	Too short & too long segments	Not recognised & not well designed	Some streets have no sidewalks & Not levelled to house entrance	Public green space not enough

Source: Own construct

14.6. Municipality's Performance and the Effectiveness of the Regulations

Five questions have been posed to evaluate residents' satisfaction with the Municipality's performance and the effectiveness of the regulations and policies. The questions asked are about the mobility in the city, transforming of residential to commercial uses, the ability of the Municipality of Duhok to enforce regulations, the effectiveness of the regulations and the success in creating good urban form and structure. It is not significant to evaluate the degree of satisfaction independently for each neighbourhood; rather, the matter is related to all the neighbourhoods and the city.

(Question-22): How would you evaluate mobility as a whole in the city of Duhok?

This question shows the extent that the residents are satisfied with mobility in the city of Duhok. Most of the interviewees (65%) are not satisfied with mobility in the city. The high degree of the dissatisfaction and the residents' complaining about the movement in the city is a clear indication of the deficiencies of the internal street networks and supports the results, obtain in section 12.5 of Chapter Twelve through calculating the degree of the connectivity of the street networks and the efficiency of the available form of the public transport lines – see Figure 14-22.

Satisfaction with the Mobility in the city of Duhok

■ Dissatisfied % ■ Neither Nor % ■ Satisfied %

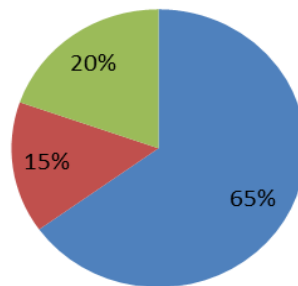


Figure 14-22: Satisfaction with mobility in the city of Duhok

Source: Own construct based on interviews with residents

(Question-23): How would you evaluate the impact of the commercial strip on residences and streets? The impact on value, height & congestion.

Excessive dependence on commercial strips by the Municipality of Duhok as the only way of promoting commercial initiatives has created many planning problems in the urban form of the city. Asking the residents their opinions about the current commercial strips is crucial to assess the impact of such development initiatives. Therefore, five issues have been raised to evaluate the impact of transforming residential uses on commercial. These issues are:

- A-Decreasing the value of the residential property behind the strip
- B-Increasing the congestion on the streets
- C-Disturbing the privacy and blocking sun and wind from the residential buildings
- D-Bringing life and crowds to the area
- E- An initiative for promoting mixed use

The opinions have differed about the positive and negative impacts of these issues, most of the interviewees (72.73%) see that it decreases the value of the residential properties behind the strips. Also, 68.18% of the interviewees think that it brings liveability to the streets, whereas 61.98% see that it is the main causes of the traffic congestion in the main arterial roads in the city, and 54.75% think that it disturbs the privacy of the residential houses behind the commercial strips. Only 46.28% see that it is a good way of bringing mixed uses to the streets- see Figure 14-23. The issue of transforming residential uses to commercial uses has been investigated in Section 12.8 of Chapter Twelve.

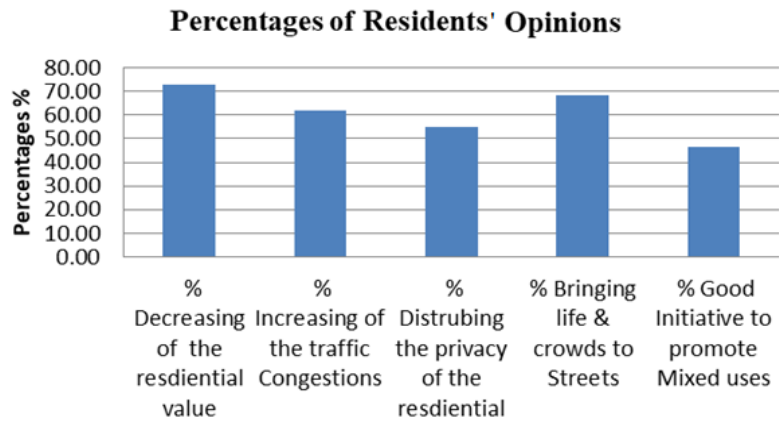


Figure 14-23: Opinions of the residents regarding the impacts of commercial strips
 Source: Own construct based on interviews with residents

(Question-24): In your opinion, to what extent is the Municipality of Duhok able to enforce and apply the regulations in a proper way?

Residents' satisfaction regarding the ability of the Municipality in enforcing and applying the regulations in a proper way to encourage planning authorities to proceed with periodic updating and reviewing policies and regulations. The interviewed residents (59.88%) are not satisfied that the Municipality and Planning authorities in the city of Duhok are able to enforce the regulations in a proper way – see Figure 14-24.

Satisfaction with the Ability of the Municipality

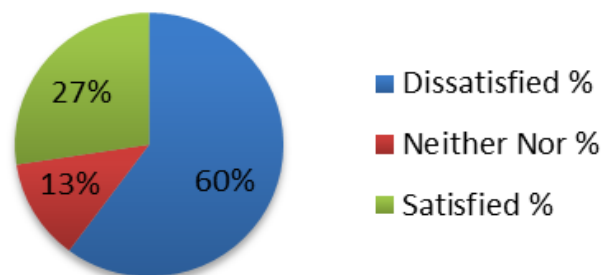


Figure 13-24: Satisfaction with the ability of the Municipality and planning authorities to enforce regulations in the city of Duhok
 Source: Own construct based on interviews with residents

These results return to the fact that the planning authorities do not have the full authorisation to enforce regulations due to many interventions from other sides, as well as the lack of awareness, absence of accountability and deficiencies and outdated regulations. There are many cases of abuse of regulation enforcement by the elites and politicians⁷⁵, which encourage other people to oppose the enforcement process.

(Question-25): *In your opinion, to what extent are policies, legislations and regulations effective in arranging and controlling urban form in regards to height, setback and building area ratio, accessibility and availability of urban services and infrastructure?*

This question asks the interviewees to indicate their opinions regarding the effectiveness of the current policies, legislations and regulations in arranging and controlling urban form in order to promote urban sustainability in the city of Duhok. Most of the interviewees (54.00%) see the current policies, legislations and regulations are not effective in promoting and bringing sustainability to the city of Duhok. The rest of the interviewees (31.40%) think that the regulations are effective in improving urban form and 14.88% stated that they do not know whether they are effective or not- see Figure 14-25.

Percentages of Residents' Opinions

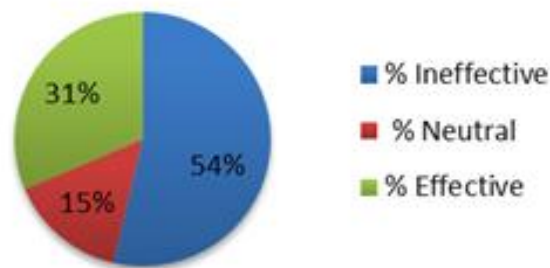


Figure 14-25: Opinions of the residents regarding the effectiveness of policies, legislations and regulations

Source: Own construct based on interviews with residents

(Question-26): *Do you think that the municipality and planning institutions have succeeded to create a good urban form in the city of Duhok?*

The last question in this section is regarding the overall performance of the municipality and planning institutions and their success in creating a good urban form which brings better quality and improvements to the built environment of the city of Duhok. The majority of the interviewees (62.60%) think that the Municipality and other Planning Institutions of Duhok have not been successful in creating a good urban form with less urban problems. Compared to the previous years, the problems have increased. Whereas 25.41% believe that the planning institutions were able to create a better urban form in recent years, and 11.98% of the interviewees do not have clear opinions –see Figure 14-26.

⁷⁵ - Interview with Mayor of Duhok in 2013

Residents Opinions

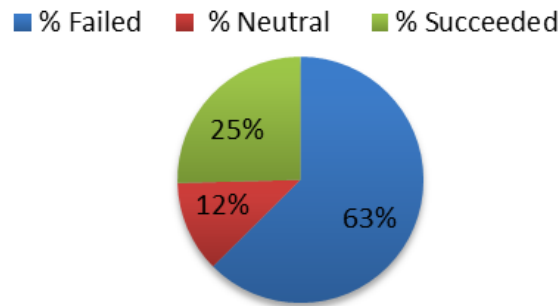


Figure 14-26: Residents' opinions regarding the success of the creation good urban form in the city of Duhok

Source: Own construct based on interviews with residents

14.7. Residents' Recognitions and Suggestions

The last three questions of the interviews are open-ended to enrich the research with the residents' suggestions and opinions regarding the existing problems in their neighbourhood and the city as a whole.

(Question-27): What problems do you see in your neighbourhood in terms of spatial urban planning, please be specific as possible?

The question seeks from the interviewees to disclose the spatial problems relating to the physical development in their neighbourhoods. In general, the answers are very similar in all formally developed neighbourhoods with slight differences, while they differ from the informally developed neighbourhood because the informal neighbourhoods have more urban problems than the formally developed neighbourhoods.

The answers of the interviewees from different neighbourhoods have been summarised here to give hints about the spatial urban problems from which that the neighbourhoods suffer:

- High density and very overcrowded neighbourhoods and low density in others,
- No enough and accessible daily urban facilities and services (e.g. retails, schools, health services...etc.),
- Lack of trunk infrastructures (e.g. water, streets, sewage, electricity),
- Lack of open green spaces
- Absence of recreational areas & children playgrounds,
- Narrow streets and sidewalks,
- Uncontrolled building heights and levels from the streets,
- Improperly directed urban blocks, too long urban blocks,
- Uncontrolled front setbacks and absence of side setbacks,
- High built-up ratio,
- Absence of the neighbourhood centres,
- undefined neighbourhood boundaries and proper sizes,
- Informal neighbourhoods need urgent upgrading and improving the urban quality,

- Dependency on low-residential houses, no diversity of affordable houses in the neighbourhoods
- Occupying sidewalks in the residential areas,
- Public vacant plots within the neighbourhoods,
- Existence of the undeveloped private plots for extended periods in the neighbourhood for land speculations, and
- No effective community participation during decisions making.

(Question-28): If you were asked to design a plan for improving your neighbourhood in terms of spatial development, what would you prefer to suggest?

The question seeks the interviewees' suggestions should they be asked to design a plan for improving the neighbourhoods. The majority of the interviewees have made suggestions based on the type of problems recognised. The most repeated suggestions are summarised here:

- Increasing green space,
- Developing street network, paving of sidewalks and unifying of sidewalk levels and materials,
- Decreasing population density in some neighbourhood and increasing in others,
- Offering housing choices,
- Offering children playgrounds,
- Increasing commercial facilities,
- Controlling building heights,
- Controlling the accesses to the neighbourhood, pedestrian safety, increase walkability and increasing of accessibility
- Providing more neighbourhood facilities (kindergarten, preparatory school, advanced health centres),
- Encouraging building of more than one storey,
- Street plantation, arranging of on-street and off-street parking,
- Increasing permeability of urban blocks,
- Adding more amenities for the benefit of the neighbourhood,
- Enhancing the appearance of the overall neighbourhood by upgrading the buildings, appropriate landscaping,
- Increasing mixed uses,
- Using low, open fencing and gates around common areas,
- Using standard fencing height for houses,
- Develop leftover land and residuals, and
- Providing a sewage system and other infrastructures.

(Question-29): In your opinion, what are the most urgent problems to be addressed in Duhok city in terms of spatial development?

The last question seeks the interviewees' opinions on the most urgent spatial problems. Some of the spatial urban problems have been identified by the interviewees. These problems are crucial to be solved to improve urban quality in the city, which are:

- Lack of modern public transportation system,

- Lack of mobility and connectivity between the city parts,
- High congestion in the city centre and other main arterial roads,
- Laxity in enforcing regulations,
- Highly dependency on private cars for mobility,
- On-street and Off-street parking in the city centre,
- Absence of open green spaces in the city centre,
- Overcrowded city centre, and dependency on one centre,
- Uncontrolled building heights in the main streets,
- Lack of sewage system and other infrastructures,
- Concentration of daily, weekly and monthly goods in the city centre,
- Promoting street hierarchy and controlling car speeds in different zones in the city, and
- Absence of districts and clear neighbourhood boundaries.

These are some of the problems seen by the residents in the city of Duhok.

14.8. Conclusion

The residents' attachments to the current neighbourhood or interest in moving to another neighbourhood with declaring the reasons behind such desire are crucial in understanding population movements and demographic changes of the neighbourhoods. Also, it is useful for future plans to improve the residential neighbourhood. The main reasons for changing current neighbourhoods in the city of Duhok are related to the spatial deficiencies and affordability of urban services. The percentages of the residents who wish to leave are more in the old neighbourhoods than the newly developed neighbourhoods, and at the same time, the percentages differ between the formally and informally developed neighbourhoods.

The most desirable neighbourhoods for a living are those which were developed after 2004 because they provide some basic services and the houses have high property values, whereas, the neighbourhoods formally developed before 1990, have received low percentages as being a favourable place for living. The informal and unguided development have not received any percentages as being attractive places for living.

The majority of the residents prefer low residential housing more than the high residential housing, although there is a clear trend toward accepting high residential especially among new marrieds and small families. The first development initiative of high residential housing in the city of Duhok was very low quality with poor management which give a bad impression on high-residential housings. Also, the absence of clear regulations defining the private property and assigning the responsibilities in the high-residential housing.

A high percentage of residents make trips to the city centre for purchasing daily and weekly home needs, using private cars and taxis as the main mode of transportation. Due to the shortage of the services in the neighbourhoods and the absence of a public transportation system.

In general, all the neighbourhoods are not able to provide their inhabitants with full daily needs. About 45% of the residents perform their shopping in the same neighbourhoods while 29% depend on other neighbourhoods and the rest 26%, are still depending on the city centre.

According to the regulations, all the sidewalks whether in the residential area or other areas considered as public properties should be only used for the public interest. The residents have different opinions about investing the space of the sidewalks and their privacy. A high percentage of the residents use the sidewalks as private spaces for certain purposes, therefore most of the sidewalks have been occupied and impedes accessibility.

High percentages of the residents in the neighbourhoods, prefer visiting open green spaces that are managed or owned by the private sector in the city due to the availability of better services, while fewer residents visit publicly managed open green spaces in the city.

The sustainability of the elements of the houses and neighbourhoods influences the degree of the residents' satisfaction. Therefore, the degree of resident's satisfaction with the house and neighbourhood elements is an important indicator for improving and promoting sustainability at the neighbourhood level.

In general, satisfaction with the elements of the houses in formally developed neighbourhoods has higher percentages of satisfaction than the neighbourhoods which are informally developed. Regardless of this, there is a remarkable percentage of the interviewees from the formally developed neighbourhoods who are dissatisfied with house elements (e.g. Masika Rojava, Sêgirka and Serhildan neighbourhoods). Most of the house elements such as plot size, building setbacks, building heights, built-up area, house orientations and availability of open spaces and car parks, do not satisfy residents' expectations. There are slight differences between the neighbourhoods in terms of houses' satisfaction, only the houses in Êtûtê neighbourhoods have gained more percentages as the best and the satisfactory houses. Different reasons are affecting the residents' satisfaction.

The elements of the neighbourhoods such as neighbourhood boundary, block size, population density, easy access, availability of essential services, proximity to the services within 5 minutes' walk, residential street width and length, transitions spaces, sidewalks and availability of open green spaces have not meet the residents' satisfaction with exceptions to few elements in different neighbourhoods. Also, the residents declared their justifications regarding making such decisions as have been indicated.

Residents' perception towards the Municipality's performances in the city of Duhok and the effectiveness of the regulations differ among the residents. Generally, about two-thirds of the interviewees are dissatisfied with the way the planning institutions and Municipality enforce the regulations and control it, and the ability to create good urban form.

Chapter Fifteen: Findings and Recommendations

15.1. Introduction

The chapter on hand is the summary of the main results obtained and conclusions of the preceded chapters. The findings and recommendation are divided into sections and subsections, so that, the reader can follow up easier. Followed by the conclusion, the area of further research and theoretical and methodological reflections.

15.2. Summary of the Findings

In this section, the summary of the findings is organised depending on the related themes and subjects:

15.2.1. Regulatory and Institutional Structure

- The policy, regulatory and institutional arrangements are key failures including lack of authorisation to the local governments⁷⁶. Eroded and outdated system of the planning institutions, as well as an ambiguous and non-inclusive regulatory system, and perception of regulations as ‘controlling tools’ rather than as ‘development tools’ have deepened the deficiencies in the planning system in the Region.
- The absence of centralised urban management to coordinate and cooperate between the different bodies to engage in the development process. Although, there are many ministries and bodies responsible for the development planning in the Kurdistan Region. The responsibilities of urban development are scattered between these bodies.
- The shortage of a comprehensive strategy to lead the development process in the cities, rather than depending on providing of the sectorial needs which are excessively technolised, and disjointed among the various development programmes.
- Hasty decision making, the planning system lacks in-depth studies to identify the pros and cons.
- Incapability of the planning body at various levels in planning, designing and managing the development planning and process.
- Non-compliance with the local standards, regulations and laws by the planning bodies, despite the existence of many effective laws and regulations. Adapting these laws and regulations would have created a better-built environment. The effective regulations are mostly concerned with the physical aspects more than other environmental and social aspects. In general, the regulations lack mechanisms and procedures for applying these regulations. The regulation needs more interpretations and clarifications and should be collected in a handout to be available to the planners and the citizens. The shortage of such work has created many confusions; *firstly*; the officials and managers because they were not aware of the huge amount continuously issued regulations, the interpretation and applying of these regulations dependent on the personal subjective attitudes, rather than the legal or engineering interpretation, *secondly*; most of the

⁷⁶ - In recent years after 2003, according to the new constitution the local governments in Iraq and Kurdistan Region enjoy more powers, by experiencing the first decentralisation process in the country, but in practical it needs more elaboration and coordination between different sectors in the provinces.

citizens who engage in developing issues (i.e. constructing a house) are not aware about the effective construction regulations, or maybe they face new regulations during implementations.

- The existence of the huge legacy of conflicting regulations, laws and legalisations needs revision, updating and modification.
- The urban political bargaining atmosphere influences the implementation of policies and regulations, the degree to which urban-dwellers are interested to comply with, as well as affects the extent to which the urban planning regulations are implemented. The local government is not able to enforce the regulations and incapable to control over the urban physical development.
- Lack of public and official awareness regarding urban built environmental issues.
- Responsibilities and tasks are not clear, especially between the different parts of the planning institutions at the local, regional and federal levels.
- The City Council⁷⁷ has given many responsibilities that are above their capability to make decisions regarding them, these responsibilities can hardly be achieved even by the specialised planning committee. Therefore, the City Council instead of advocating for the citizens' rights has become a weak link through in which the interests of many elite groups can be achieved.
- The land policy is mainly forced by market forces intervention due to the weakness of the development management processes. The planning institutions have failed to manage and allocate over land control and infrastructures delivery, and to cope with the rapid urban growth. Government authorities in the Kurdistan Region are unable to avoid widespread illegal, thoughtless and urbanised patterns of developments that are deleterious to improve the sound economic, social and environmental aspects. Also, failure to improve the living conditions of citizens in cities and falling as a victim to new urban planning trends and not being able to build the capacity and prerequisites for promoting sustainable urban development in the city of Duhok.
- The Municipalities have used the previous development approaches in the following development initiatives, without considerable changes in the approach of the new developments towards more sustainability. Therefore, the development of the city has not contributed to the improvement of the built environment at macro and micro-levels through adapting new and sound planning schemes for block size and shape, land use pattern, accessibility, open spaces and allocating urban services.
- Absence of detailed regulations concerning the size of urban blocks, building heights and rear setbacks which created disorganised urban form.
- Lack of control over the land outside the municipality jurisdictions has encouraged land-owners to subdivide the land and sell it for residential purposes at a lower price than in the city (e.g. Êtûtê, Qasara and Bêsirê villages). This has increased the size of the informal settlements around these villages which have annexed to the city.
- Inability in applying and utilising citizens' power and under-estimating of community participation.

⁷⁷ - There are no certain qualifications or conditions regarding members electing city council, the current city council members are directly elected by the authorities.

- The majority of officials at different levels, have a strong desire to treat and correct the weaknesses and the flaws in the planning system and urban design.

15.2.2. Urban Form and Structure

- Inattention to the cultural characteristics and identity of the towns and cities have led to the destruction of all historical urban fabrics in the city centre.
- Transformation of the residential uses to commercial after the process of implementation zoning and land divisions has generated many planning problems.
- Often the new development initiatives that take place use pre-existing sets of patterns of streets, urban blocks, plot divisions, neighbourhoods, and local centres and so on, as a guide for onward development, thereby generated many urban problems and deteriorating of the urban built environment.
- The planning institutions in the city of Duhok have ignored balancing between spatial planning and distribution of green open layout.
- Uncontrolled front setbacks have generated very compacted and dispersed forms of development, as well as constrained accessibility in streets.
- Dominating of single plot size in many areas created non-diverse neighbourhoods in the city.
- The city is threatened by low-density neighbourhoods and high-density neighbourhoods, declining of the gross density and transforming from more walkable compact pattern to car-dependended sprawl pattern.
- Urban growth and population growth were both disproportionate and poorly directed. The related policies, laws and regulations were not able to create a liveable city, which has led the city into a chaotic urban growth and development. Based on the calculations, the extra-developed land which makes about 38.06% of the total area of the city, can accommodate an extra population of 509257 inhabitants to obtain a gross population density of 150 persons per hectare.
- The major driving forces behind rapid urban growth and sprawling of the city are population growth, migration from rural to urban and the process of granting residential plots for single-family citizens.
- Lack of strict zoning laws has led to the haphazard urban development through allocating the uses in inconvenient areas that fall short in integrating the physical development of the city with the provision of infrastructure. The unilateral application of land use in the city of Duhok creates many single-function neighbourhoods such as; Mazî, Zanko and Peşangeha. Land use in the city is not carefully managed in line with the strategic vision for the city.
- Absence of a clear concept of the neighbourhood in terms of boundary and an identified centre.
- In general, residential areas are lacking proximity to the daily services, accessibility, open space, playgrounds, unbalancing in distributing density. Despite the availability of some essential daily facilities such as grocery, bakery, school and clinic, they are not spatially distributed to serve the residents properly, and *secondly*; some of the areas are developed without a plan like the annexed villages to the city and the

informal settlement pockets. These areas lack daily facilities. The shortage of land for future development within these areas restricts any step to provide essential facilities.

- Planning, Managing and designing a green area in the neighbourhoods need more efforts to elaborate and improve the local landscaping and the quality of the environment.
- The calculations regarding the residential areas, coverage areas, density and street areas of the recently planned neighbourhoods like Masika Rojava in 2006, are close to the calculations of the informal and unguided developments such as Kanimehmedkê reflecting the fact that planning institutions have paid no attention to the sustainable criteria during the planning and designing of new developments.
- There are many deficiencies and inappropriateness in the design of urban blocks in terms of the order, width and length, the number of plots and heights of buildings.
- The plot size has a significant impact on the character of the neighbourhood. It establishes a neighbourhood's appearance in terms of building type, setback and building's orientation to the street. Most of the planned neighbourhoods in Duhok are dominated by a single type of plot size, which has given a certain characteristic to the neighbourhood, while the unguided development and informal neighbourhoods have a range of diversity of the plots and size of buildings.

15.2.3. Residents' Satisfaction

- There is a public recognition regarding the existence of urban problems in the city.
- Residents' recognition regarding the weak performance of the planning institutions and their role and the effectiveness of the regulations.
- Dissatisfaction with the current urban form and its failure to produce a better quality of life.
- More than half of the population of the neighbourhoods changes their place of residence between fifteenth to twenty years to dwell in new neighbourhoods.
- There are some neighbourhoods that the residents prefer to settle there because these neighbourhoods have high property value and better facilities.
- The elements of the houses such as plot size, controlling building height, setbacks, built-up area, open area and car parks do not satisfy the majority of the residents. The plot size affects residents' preference more than other elements.
- Most of the elements of the neighbourhood such as neighbourhood boundary, a distinct centre of the neighbourhood, urban block size, and proximity to the services, green open spaces, sidewalks and transition spaces do not satisfy the residents' ambitions. Location of the neighbourhoods and the proximity to the services affect the residents' preference more than any other elements.
- About 65% of the residents are not satisfied with mobility and the efficiency of the street network in the city.
- Majority of the residents are satisfied with transforming residential plots to commercial in the arterial streets, and they think that this process is bringing congestion and decreasing the value of the resident units behind the commercial strip.

15.3. Recommendations and Guidelines

To reorient urban form and structure towards more sustainability, important changes are required to the way that the planning institutions and society, managing the three tiers of sustainability namely; economic, social and environmental in their context. The degree of the success of these changes or modifications greatly depends on the specific issues of institutional factors, citizens' behaviours and attitudes, and urban morphology, urban form and structure. Therefore, any step towards achieving this goal requires a fundamental change by adopting new tools and thinking, to direct spatial urban planning system to acquire more sustainability into the spatial practices.

To embrace sustainability, the planning institutions need to reinforce the legal and regulatory structure and improve the building regulations and enforcement, as a way to achieve physical sustainable development.

Engaging with key stakeholders is critical towards creating a common planning and sustainable development approach. The integration of the land use planning and transportation planning towards a more sustainable city form is needed to increase accessibility and more compactness following the sustainable approaches of urban forms. The importance of the density, open spaces and land use, integrating of the green and brown agenda, and evolving city structure is critical.

The following practical steps have been recommended to reorient the physical urban development towards more sustainability.

15.3.1. Reforming Planning Institutions

The installation of the viable institutional system is needed to devise strategies, programmes and policies essential for questioning sustainability. The planning system in the Kurdistan Region suffers from many deficiencies, that should be adjusted to direct the planning process towards more sustainable development. The distribution of the roles, responsibilities and tasks between the different planning institutions at different levels should be designated and clarified.

State institutions need to be reinforced by the design and implementation of staff development through training programmes striving to improve the capacity and competence of different government spheres and agencies. The training and advocacy activities should include the appointed staff, other senior and main managerial staff and elected officials.

Bridging the capacity gap by reinforcing urban planning academic systems and developing specialised planning cadre to develop urban development plans which keeps pace with current challenges and emerging issues.

Planning institutions should be converted into participatory institutions by adopting integrated mechanisms that can engage the private sector, the civil society and the government in promoting shared visions. All the planning levels namely; local, regional and national have to play a great role in promoting, planning and operating the process of pursuing sustainability. The roles of these levels should be complementary, consistent, non-overlapping or competitive in order to avoid inconsistency, time and resource consumption.

The non-inclusive planning approach influenced by the master plan approach as a rigid model fails to take the leading power from the political powers and other non-state actors. It is important to search for planning solutions to the master plan approach to have the flexibility

of preparing short-term plans within the long-term visions for the structural plan approach of the city.

To promote sustainable urban development in the Kurdistan cities, the following tasks and reforms must be undertaken throughout the general role of national level in supervising, enabling and facilitating such as:

- Updating and reviewing of the national policies and the institutional frameworks and structures to minimise and eliminate unintended conflicts,
- Empowering of the local authorities through decentralisation to engage in participatory planning, administrative and fiscal reforms and flexibility in responding to the local needs and priorities,
- Elaboration on a national strategy for sustainable development, which works like an umbrella to guide institutions, and planning at different levels,
- Capacity building by supporting training and educational efforts that mainstream concepts, methods and approaches of sustainable urban development into the planning system,
- To mobilise the resources of the public and private sector for investing in trunk infrastructures.

The responsibility of the local level is also important to address the agenda of sustainable urban development. The local level can best understand the needs of people and is closest to them. In order to successfully fulfil their role as main authorities in managing, implementing, controlling and directing of development initiatives - represented by the General Directorate of Municipalities, Directorate of Constructive planning and Presidencies of Municipalities of major cities in Kurdistan -they have to:

- Guide the development and not to control.
- Involve all sectors to ensure accountability, integrity and creation of an enabling environment.
- Increase transparency and liability through following decision-making and participatory planning approach.
- Increase the administrative, technical and financial capacities by organising programs as well as for capacity building to increase awareness among the citizens for challenges of urbanisation and the way that quality of urban life improves.

The regional level has a direct responsibility in areas that fall outside the local spheres. This should include building inter-municipal collaboration, coordination, harmonisation of conflicting policies and exchanging of expertise vertically and horizontally between and among the various local and national authorities.

15.3.2. Amendment of Planning polices and Development Regulations

There should be a great concern of the planning policies and regulations to operationalise and legitimise sustainability within the legal framework of the context. Kurdistan has many inherited planning policies, laws and regulations which are no longer influential and needs to be modified, as well as effective and sound regulations⁷⁸ and laws that need to be activated and updated to address the sustainability of the cities. The new updated policies and

⁷⁸ - Referring to the Iraqi Housing Standards which prepared in 1983 by the ministry of Planning and Housing in Iraq.

regulations should cover economic, social, ecological aspects, and deal with the challenges facing the context such as high population growth rates and the rapid mode of the urbanisation.

The spatial planning system in Kurdistan should recognise and encourage investment and livelihood opportunities which can overcome the governance fragmentation. There is a need to empower the regulatory system that promotes the principles of equity and betterment of urban quality and performance, and consider the proactive and elaborative roles of the planning regulations and laws in redesigning urban planning system and planning outcome.

Moreover, policy-makers should search for balancing in proposed policies and regulations. Correspondingly, the updated policies and regulations should contain statements concerning government commitments to strive towards ensuring the sustainability of urban development and urban growth in the cities. For instance, failure to elaborate effective urban development policy concerning public transportation, will encourage private-cars and worsen the city's mobility and increase congestion. A revised policy may attract more investments contributing to enhancing the quality of life through offering job opportunities in the city.

The planning policies and regulations need to be periodically revised and adjusted to include new priorities. As a part of broad evaluations and assessment processes, all the building standards, environmental regulations and infrastructure provisions should be continuously revised and amended.

Elaborated urban form⁷⁹ can effectively contribute to promoting sustainability and reducing the need for movement through land use mixture and shortening commuting, curbing sprawl through increasing the density and the compactness and encouraging high-rise housing. In this light, the following are some examples that should be included the planning policies and regulations:

- Encouraging high-rise housing and discouraging low-density residential areas, and stop granting residential plot to the citizens in the major cities,
- Concentrating on the essential daily facilities in the neighbourhoods,
- Increasing public green open space within the neighbourhoods and districts,
- Integration of the development and public transportation facilities, and
- Maintaining relatively high density along to the transportation access.

15.3.3. Developing Strategies and Techniques for Implementation and Monitoring

Cities in Kurdistan are facing very weak execution and implementation of plans such as; master plan and detailed plans, applying the laws and regulations. Developing mechanisms for monitoring is an essential task to be undertaken for operationalising the concept of sustainable urban development at different levels. Therefore, the planning tools and instruments required to uphold other actions, such as; full cost price of service, fines and charges on environmental polluters, incentives for best-practices and examples in the cities and towns. Listing and clarifying the responsibilities to determine the tasks and duties and allocation of required funds are important, also increasing the knowledge about sustainable development for better implementation through educating various partners of the governmental, social, business groups and technical institutions.

⁷⁹ - See Chapters Four and Six for the contribution of urban form to sustainability.

Sustainable development planning calls for transparency and accountability as measures for successful implementations and efficient human and resource management and allocation. A comparison between the main objectives of sustainability and the actual outcome of planning indicates whether these objectives are being achieved or not.

The development should enhance integration between trunk infrastructure (e.g. roads, water) and spatial planning which shapes the spatial outline of the city. Integrated spatial utility plans should be recognised and complemented by strong regional governance to overcome administrative constraints. The following complementary actions are needed:

- Collaboration of urban spatial planning and the investment exercises

The role of the local government is central to city planning activities is critical. The master plan is the most dependent document for the development which is normally disjointing the investment plan in the city. The master plan and the investment plan have to agree with each other. The investment exercises should reflect the urban growth pattern and vice-versa to control and avoid further deterioration of the physical development due to the negative roles that the investors played during the last years in the city of Duhok.
- Creating of Transparent land use management and acquisition model

Spatial planning practises need to ensure the land market forces are taken into account. The market forces in the cities of Kurdistan determine land pricing and therefore play importance in considering effective city development plan execution. Effective regulatory tools in land management support managing city spatial growth and conservation of green covers and preservation of natural resources.
- Strengthening the enforcement

Effective enforcement is needed to ensure the success of planning practices which can be promoted through supporting effective policies and a set of incentives and deterrent. Correspondingly, bylaws can be amended to mainstream the proposed incentives into development planning.
- City and Regional Planning Aspects (Macro-level)
 1. Reinforcing the link between the city planning and cross-cutting and sectoral development activities through adopting an integrated planning approach is crucial and encompasses the following issues;
 - i. Setting of the regional/city strategic vision plan

A Ten-year strategic vision plan is critical to be developed to provide broad tenets for the future city spatial planning and investment plan of the city. This plan should adopt an approach entailing elaboration of a non-statutory flexible plan and focusing on land allocation and infrastructure as well as indicating with certainty notions about the land use policies and future directions of the city growth.
 - ii. City Spatial Plan

Elaborating of land use plan for a maximum five-year cycle aimed at interpreting strategies set in the strategic vision plan into specific land use rules and guidelines. The spatial city plan through five-year updating will ensure analysing in-ground realities and the market forces changing in a short-term period, rather than depending on fifteen to a twenty-years vision that leads to outdating of the adopted spatial plans in the city. The success of such an approach will grant planning institutions the use of modern planning tools such as GIS, and its ability

to integrate environment and socio-economic considerations into the formulation of spatial policies. City spatial plan should also include other urban resilience planning and management such as disaster management planning, slum-free planning and integrated transportation planning to ensure sustainable urban development in the city.

iii. City Infrastructure Plan

Preparing the key infrastructure plans for the city is critical for promoting sustainable urban form. These plans are on transportation, water and sewage, energy, communications. These plans may need thorough updating and should precede the city development plan.

2. Integrated land use planning and public transportation system towards adopting a transit-oriented development and smart growth. Public transportation systems should be the crux for managing and directing urban growth in the city in areas of greenfield development in addition to regulating growth and consolidating brownfield development. Land value is proportional to easy access to public transport routes. Determining spatial planning guidelines for land use ensures integrating land use with transport development and is essential to promoting sustainable urban growth in the city.
 3. Integrating green and the grown agenda, the focus of Duhok should be on developing sustainable transport to increase accessibility, increasing green structures and upgrading the informal areas and unguided development in the city.
 4. Encouraging the concept of decentralisation for utility distribution at neighbourhood, city and regional level with connecting of all CBD through effective public transport system,
 5. Integration of informal settlements into development planning initiatives in the city through parallel efforts of regularisation and upgrading of unguided and informally developed areas of utmost importance in urban planning procedures.
 6. Encouraging of densification that minimises transport and service delivery costs, optimize the use of land, and protect and support urban open spaces. The densification initiatives include area redevelopment, the layout of new areas with higher densities, brownfield development.
- Neighbourhood-level interventions (Micro-Level)
 1. Applying of gross medium-to-high density (200-250 persons per hectare)⁸⁰, the cost for providing and maintaining utilities should be taken into account.
 2. Accessibility and transport: encouraging walkability through pedestrian-oriented development within the neighbourhoods by connected urban open and green spaces and providing effective public transport access on neighbourhood edges within 500-600 m walk.
 3. Promoting conical massing by high density and high rise buildings in the centre of neighbourhoods, districts and city tapering out towards the edges. Providing play areas and public spaces within the neighbourhood and city centre.

⁸⁰ - The proposed gross population density is compatible with the recordings of first and second morphological stages (302.20 and 187.32 persons per hectare), the current gross density in the city is very low (61.63 persons per hectare)

4. Mechanisms for ensuring orderly balanced densification of formally planned neighbourhoods and unguided development are needed to provide the city with a spatial form and structure that can support socioeconomic and environmental sustainability. To achieve this, expansions and densification plans are required to enable cities to accommodate the expected growth in the next decades in a sustainable way.

15.3.4. Community Participation and Private Sector Involvement

The step towards embracing sustainable urban development needs the involvement of a wide spectrum of the people from the national, regional and local governments, local community, civil society and NGOs, private sectors and international agencies (e.g. UN-habitat). The participation of the local communities and other stakeholders can assist to define the bottlenecks and identify methods and mechanisms for paving the way for city development. The citizens of the city are the focus of sustainable development.

The role of the city council should be defined more precisely by selecting effective and knowledgeable members as the delegate link between the municipality and citizens. So the municipalities and local authorities have to engage with civil society from the local community in planning, designing, supervising, budgeting, organising and monitoring the process of the development. The journey towards sustainable urban development should be according to the deliberate programme and incrementally carried out. To achieve effective participation, the following two steps are essential to be applied:

- Clarifying the role of the stakeholders

It is important to identify the stakeholders and clarify the role of each stakeholder. In general, four primary stakeholders are identified in the city; city citizens, civil society organisations engaged in development activities, the private sector and the government bodies. To promote sustainable urban form requires sharing responsibilities between these four stakeholders. To set up a 'local area planning' process will enhance the coordination and harmonisation between the mentioned stakeholders. The previous efforts have led to the multiplication of institutions, complex relationships, and institutional fragmentation, among others.

- Ensuring political buy-in and leadership

It is critical to elect representatives of the City Council and other non-state actors to participate, in order to give more power and meaning to the participation process and to address challenges of a scope and identify the opportunities and capacity.

15.3.5. Developing an Integrated Planning Approach

To embrace sustainable urban development a kind of integrated mechanism and strategy is required to bring various dimensions and sectors to adopt the concept of sustainable development. This implies that an integrated planning approach applies the same principles to each aspect of urban development at different levels. To pursue an integrated planning approach is an important step on the way to promote physical sustainable urban development in the cities of Kurdistan, since - as mentioned earlier- there is a lack of integration and coordination between different planning institutions at different levels that considered as one of the main deficiencies in the planning system in Iraq and the Kurdistan Region.

There is a crucial and urgent need to update the current planning approach in the Kurdistan Region and adopt new approaches that rely on a holistic way of acting and strategic vision.

The following set of coordinated tasks is essential to bring an integrated planning approach as summarised below;

- Institutional integration coordinating inter-agency as well as cross-ministerial cooperation at different levels of national, regional and local,
- Policy integration coordinating different policies of environmental, social and economic aspects,
- Political integration establishing partnership and encouraging participation of different stakeholders and community segments and groups,
- Sectoral integration coordinating land use and urban development issues with sectoral issues (e.g. transport, housing or infrastructure), and
- Resource integration coordinating programs, projects and funding resources to achieve planning objectives,

The separate task does not work on its own and produce advantages unless, all the functions coordinate and link into a specific time frame that considers trends, goals, targets and pressures of the short and long-term.

15.3.6. Elaborating Sustainable Development Planning and Strategy at Different Levels

The prepared national development plan for Iraq and the regional development plan of the Kurdistan⁸¹ Region should cover the economic, social and environmental objectives of the society. The development plans should aim to meet threats and challenges in the short, medium and long terms, and how to deal with rapid population growth and affording essential infrastructures. Managing urban spatial expansion is the main and central task of the urban institutions in city government in terms of population growth and physical growth of the city.

In order for the development plan to be successful and guide the process of sustainability, it should reflect effectively in the planning policies, regulations, planning instruments and tools in cross-cutting and sectoral planning issue. The evaluation and assessment procedures should be operated on various levels of national, regional and local.

Link the brown agenda (i.e. protecting population growth) and green agenda (i.e. protecting the natural environment) by urban planning means; this linkage has been overlooked in the urban planning in the context of the Kurdistan Region. The spatial urban planning system needs to concentrate on human and economic opportunities which stimulate urban growth of the cities sustainably by considering issues of land degradation and resources and energy. This can be achieved parallel to amending and modifying bylaws, zoning regulations, development controls, building regulations...etc. to ensure a holistic sustainable outcome.

Developing the national sustainable urban development strategy is the responsibility of the authorities at the national level. The national sustainable development strategy should integrate the different requirements and filter them down into the strategies of sustainable development to cover sectors such as transport and physical development. To achieve sustainability in the cities of Kurdistan the following steps are required:

⁸¹ - Despite that Iraq has prepared a national development plan for 2014- 2017 and a regional development plan by the Kurdistan Regional Government for 2014-2017. These plans have not been implemented due to the political situation and waging wars.

- To shift from developing and implementing fixed plans towards operating an adaptive system that responds to the different challenges and continuously improve governance and coherence,
- To adopt integrating planning instead of incremental and sectoral planning approach,
- To depend on the local-driven economy instead of a centralised designative budget,
- To change the citizen's view towards the responsibility of development as a responsibility of government and society as a whole,
- To focus on outcomes (e.g. impacts) rather on outputs (e.g. projects),
- To shift towards performing of joint actions and sharing of results, opportunities and transparency instead of centralised decision-making,
- To adopt a process that encourages learning, improvement and monitoring instead of the old rigid routine.

The national strategy should be based on a vision that promotes programs and activities, and coordinated mechanisms and processes that improve complementarily and splint inconsistency and reconcile trade-offs. Moreover, the national strategy should be flexible, adjustable and adaptable to any unexpected circumstances.

15.3.7. Current Opportunities for Early Changes

There are many strategic opportunities for the city of Duhok which the municipality if it takes, will put the first step on pursuing sustainability with particularly focusing on the potentials to strengthen urban form and structure of the city. The actions are:

Improving Accessibility

- Increasing mobility through establishing central station and sub-centres to control and arrange taxis' movement in the different parts in the city, and striving to implement an effective public transportation system.⁸²
- Connecting and joining streets between Xebat and Serbestî neighbourhoods, Diyarî with Serbestî, Kanîxişmana with Reza neighbourhoods and Korek Roundabout with Kanîxişmana⁸³,
- Limiting the number of entrances to the neighbourhoods by closing some intersections and junctions with the main arterial streets to avoid traffic accidents, increase the sense of community and restrict vehicular transit-movement within the neighbourhoods.
- Removing all the physical obstacles from the sidewalks and reduce the levels with streets to smooth walkability.
- Widening the width of streets in allowable places to elevate the efficiency and capacity of the existing network via two available options; first to build a modern and efficient street network, through widening the current streets such as Zaxo Street and Mîdîya wherever possible. Constructing overpasses in main nodes and adding more lanes to maximise the efficiency of the street network, and also provide choices to

⁸² - There is proposal plan for implementing Duhok Tram Project. The proposed tram line will not serve all the parts of the city; therefore, it needs another revision before implementation to include the none-served areas.

⁸³ - The proposal for connecting these two neighbourhoods was existed since 1990, which replaced by Şoreş Bridge due to the existence of political headquarters on both sides of the Hişkerû River.

- people by designating sidewalks to walking and encouraging riding a bicycle, and second; to upgrade the current public transportation system of minibuses,
- Implementing fixed bus-stops in different positions in the city by applying urban design and traffic engineering standards and regulations,
 - Constructing of overpasses in Barzan Street in the six main intersections and limiting the number of the connected residential street, and other intersections in the city,
 - Cancelling the current traffic plan for the city centre which caused many accidents and is not user-directed,
 - Offering on-street parking in the city centre and other arterial streets, by imposing identified fees based on parking periods, for decreasing car congestions,
 - Strengthening the coordination between the Municipality and the companies of trading cars to control the number of imported cars (private and taxis), and
 - Breaking the long linear urban blocks, which have the length of more than 120 meters to increase accessibility in the neighbourhoods, and joining the very short blocks to decrease the number of junctions and intersections.

Improving open green spaces

- Enhancing and improving the existing public green space through sound green open space management. Green open spaces are the main components of urban form and are the main element of micro-climate change in the cities and essential element of city beautification,
- Repairing the damaged green-fingers descending from the mountains will help to avoid urban floods and increase green areas, and create green corridors,
- To issue restrict regulations to end abuses to the green structure in the city by encouraging more plantation in Duhok Valley,
- Remove the constructed concrete structures in the Geli of Duhok and adopting an effective programme of replantation and greening, and
- Adopting programmes of greening street medians and sidewalks with suitable types of trees and plantations that adapt to the local climate.

Consolidating densification and compactness

- Supporting families who settle in single-family houses with only one floor to add an extra floor and creating separate entrances to encourage renting. This will promote densification and generate an income for families,
- To allow subdivisions of the plots with an area of 200.00m² and more to promote compactness and densification through exploiting the available land inside the city,
- Encouraging high residential housings through redevelopment programs by removing parts of the low residential houses after consultation and agreement with the house-owners about the appropriate mechanism for redevelopment programs, especially in the eastern part of the city. This can increase the density, promote more compacted form and diversify house choice options within the neighbourhoods,

- Decreasing the area of granted plots for new initiatives to the minimum area⁸⁴ of 120 m², due to increasing the number of the early splitting of families and diminishing of large traditional family size⁸⁵
- Imposing fines on empty residential plots, and restrict the sale of plots to ones once during a certain period to avoid land speculation, and
- Using of compact models in new development to avoid more urban sprawl growth.

Promoting mixed use

- Extending and concentrating on the current CBD as the main economic hub in the city, with supported zonal economic hubs in districts,
- Encourage mixed uses inside the neighbourhood centre by occupying the undeveloped areas for essential services,
- Restricting some types of mixed uses (e.g. workshops and depots) in the commercial strips, those bring much traffic to the main arterial streets to avoid extra congestions.

Through applying sound policies, strategies for urban development planning, and taking advantage of the international experiences of the developed and developing countries in the field of sustainable urban development, Duhok will be able to steer the course of actions for future urban developments.

15.4. Theoretical and Methodological Reflection

It is important to mention that this research is not intended to use a certain sustainable framework for assessing urban development rather, uses the key design concepts as main references and characteristics for evaluating current urban form and structure. Therefore, the evaluation based on many standards and criteria mentioned by the Iraqi Housing Standards and other criteria recommended by UN-Habitat as a main international organisation engaged in promoting urban sustainability in different parts of the world or suggested by researchers and scholars. As learned from this research, the key design concepts of sustainable urban development are effective in evaluating the elements of urban form and structure, despite that the concepts such as compactness and density, the amount of green open spaces, degree of mixed uses and diversity and social sustainability, are disputable and context-related. This practice will encourage planning authorities to think about local devised-indicators and measures under the umbrella of sustainable key concepts, rather than relying on alien indicators for their context to create an urban form that acceptable by the local people.

Choosing the city of Duhok as a generic case study for macro-level investigation and then choosing eight sub-cases within the permit of the case study for micro-level, have provided the study with more in-depth investigations and information. By using this strategy, the urban form and structure of the city are examined in more detail at the block and plot levels, and much spatial differentiation found in respect to the sustainability of urban form and structure.

An in-depth interview with experts has provided the research with inside and more detailed information about the difficulties in achieving sustainable urban development. The good point was the majority of the experts who engaged in managing urban development and planning

⁸⁴- According to the invalid Resolution no.850 on 1979 of the Revolutionary Command Council in Iraq minimum sub-divisions area of the plots for the purpose of residential uses in the capital cities is 120 m².

⁸⁵- The approximate current family size is 7.0 persons/family, while in eighteenth and nineteenth was 7.5 persons/family (Iraqi Living Conditions Survey, 2004)

are aware and recognise the current deficiencies of the current urban form and structure at the city level. Resident interviews also provided the research with much important information and the way that the residents use and interact with the urban form and structure at the neighbourhood level. Interviews pointed out the existing problems, also the degree of the residents' attachment to the neighbourhood and their movement between the neighbourhoods.

15.5. Final Conclusion

To cope with the challenges of rapid urban growth and degradation of the pattern of urban development in the cities of the Kurdistan Region, requires serious attempts to rethink policies, approaches and professional responsibilities currently in use. In this research, the analysis focused on the physical development and how to foster urban sustainability in the city of Duhok which should be based on the fulfilment of social, economic, environmental and political needs of the residents.

Land use, street pattern, green open spaces, spatial layout and diversity are the main elements in bringing environmental and social sustainability to the cities. This can be achieved by adopting key design concepts of sustainable urban development approaches which encourage a degree of acceptable compactness and density, mixed use and diversity, accessibility and proximity to services, offering enough green open spaces and procuring residents' satisfaction.

To reorient physical urban development in the cities of Kurdistan towards more sustainability, this research recommended; *firstly*, to achieve more compact form and densely built-up areas in order to rationalise land consumption and even redistribution and balancing of population density in the neighbourhoods. *secondly*, to warrant more thoughtful mixed use and diversity development initiatives in different neighbourhoods to grant provision and proximity to the basic urban services. *thirdly*, to improve the street networks and provide a public transportation system for increasing mobility in the city and decreasing car-dependency to solve the problem of congested streets. *fourthly*, to increase green open structure and conserve the available natural assets to enhance the image of the city and calm the environment in the city of Duhok. *fifthly*, at the city level, the concept of decentralised-concentration should be adopted to reduce the load on the city centre and reduce trip length.

To achieve more sustainable urban development in Kurdistan cities, the rural areas and other small towns should be considered to reduce and mitigate migration due to an even distribution of resources and facilities, as well as, restrictions on giving residential lands in major cities and reducing residential land speculation.

The recommended and proposed principles and approaches of sustainable urban development can be applied to different cities in the Kurdistan context, although, each city is unique and carry different complicated problems and play different roles at the regional and local context.

Reorienting cities towards more sustainability is a hard task and cannot be achieved overnight; especially as the research deals with the already built city. To adopt these recommendations recognising of a very complicated web of social, economic, technical and governance factors and the attitudes of the city's residents is needed. Sustainability should be

an over-arching subject with deliberate step-by-step planning supported by the political will to act, coordinated policies, strategies and approaches and effective planning institutions.

The result of this research is a mix between very detailed policy guidelines and general conceptual proposals and should be considered as benchmarks towards a positive approach in addressing the city's problems. This research has been motivated by the firm belief that urban problems of the cities in Kurdistan Region should be by through embracing the path of urban sustainability.

15.6. Area for Further Research

To operationalise the recommendations of this research further studies are suggested:

- i. Citizens' satisfaction with respect to future developments and house types is crucial as determinants of the envisaged development.
- ii. Inventory on the applicability and workability of the current building standards and development regulations and policies.
- iii. Classification and identification of the unguided developments and informal settlement areas as potentials for investment development through redevelopment and upgrading programmes. This demands a legislative framework to provide an enabling environment for house-owners to have shares in the new investments.
- iv. The institutionalisation of sustainable urban design principles as an important factor in reorienting cities towards embracing more sustainability.

- End -

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Directorate of Statistics of Duhok

Kurdistan Regional Government-Ministry of Planning

Duhok Province

Kurdistan Board of Investment- Duhok Office

General Directorate of Agriculture in Duhok

Municipality of Duhok

Ministry of Planning in Kurdistan Regional Government (KRG-MoP)

Directorate of Estate Registration in Duhok

Directorate of Traffic in Duhok

Official Documents from:

Documents from the Municipality and Directorate of Constructive Planning, 2014

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Appendixes

Appendix (1)

Area (in hectare) of Community Services in Neighbourhood in relation to population

Services	2400 Inhabitants	4800 Inhabitants	7200 Inhabitants	9600 Inhabitants	12000 Inhabitants
Nursery	0.12	0.24	0.36	0.48	0.60
Kindergarten	0.24	0.48	0.72	0.96	1.2
Primary School	0.77	1.54	2.31	3.08	3.85
Intermediate School	0.48	0.96	1.16	1.54	1.92
Secondary School	-	1.08	1.12	1.68	2.04
Health Centre	-	0.25	0.25	0.34	0.42
Religious Centre	-	0.06	0.09	0.12	0.15
Cultural Centre	-	0.325	0.49	0.65	0.975
Youth Centre	-	-	-	-	1.2
Corner Shop	0.042	-	-	-	-
Local Market	0.2	0.4	0.6	0.8	1.0
Shopping Centre	-	-	-	-	1.2
Tea House	0.072	0.145	0.216	0.290	0.36
Restaurants & Casino	-	0.145	0.216	0.290	0.36
Local Administration	-	-	-	-	0.072
Post Office	-	0.035	0.05	0.07	0.085
Police Station	-	-	-	-	0.12
Fire Brigade	-	-	-	-	0.05
Filling Station	-	-	-	-	0.084
Car Service Station	-	-	-	-	0.24

Source: Ministry of construction and Housing in Iraq, 2010, p.17

Appendix (2)**A Typology of Open Spaces**

Principle Open Space Types	Character & Function
Greenway	A network of spaces encompassing cycle and footpath routes, but also acting as 'wildlife corridors' – enabling wildlife to travel through urban areas. Typically these follow streams or disused railways, for example, with green fingers penetrating from the countryside, through the town/city edge and into the urban core.
Water way	Includes lakes, ponds, rivers, canals and streams, which provide rich wildlife habitats, offer recreational value and can be used as movement corridors.
Meadow	A public space for informal recreation, located on the edge of a neighbourhood. Often part of a flood plain comprising natural grasses and wildflowers.
Woodland/Nature Reserves	A wood or coppice of trees left in the natural state, interlaced with internal footpaths, sometimes designated as a nature reserve, with restricted access to areas rich in wildlife.
Playing field	Open spaces formally laid out for active recreation, such as football or rugby-including golf courses. Management / ownership can be shared between schools, clubs and the wider community to ensure facilities are well used.
Churchyard/Cemetery	Located adjacent to a church and often providing a green oasis at the heart of a community.
Allotments	A semi-public agglomeration of gardening plots rented to individuals by the local authority.
Park	See Appendix (3) for park types
Green	An informal grassed public space associated with the focal point of village life, that sometimes incorporates a football or cricket pitch.
Square	A formal public space, no larger than a block and located at focal points of civic importance fronted by key buildings, usually hard paved and providing passive recreation
Plaza	A public space associated with the extended forecourt of commercial (office / retail) buildings, with formal landscaping.
Communal garden	A semi-private space not accessible to the general public, usually located within the interior of a perimeter block, providing a centrally managed green space for residents.
Private garden	A private space located within the plot of an adjacent building.
Playground	A small area dedicated for child's play, that is fenced and located within close walking distance to nearby houses, overlooked by residents.
Courtyard	A private open space often for vehicular servicing/parking
Atrium	A glass covered semi-public or private space serving as a thoroughfare, seating area and sun trap for building occupants or visitors.

Source: Adapted from (Llewelyn-Davies, 2007, p.55)

Appendix (3)

Functions of the urban open space to the city

Functions	Impacts
Environmental	Carbon sink, atmospheric scrubber, protectors of flora and fauna, control on water pollution, energy saving, water storage & supply, erosion control, soil formation, pollination, habitat nature conservation, wind & noise filtering, Providing shade & Cooling.
Social	Social interaction, Promotion of social encounters, Sense of place, equality and social integration, Reduction of aggression, Recreation & playing, Promoting active & healthy lifestyles, Place to celebrate cultural diversity and assists in assimilation of values & moral attitudes.
Economic	Raising the quality of business, Creating employment opportunities, Attract the potential investors, Working, Investment & tourism, Saving the common property resources, Reduction in costs of pollution control & prevention measures & increasing the estates values.
Health & Psychological	Being outside, Sense of relaxation and reduction of stress, giving a feeling of refuge and freedom, Enhancing the meditation, providing a sense of peacefulness & tranquillity, Decreasing the blood pressure, increase overall fitness levels, Cycling, Running and walking & Decreasing the stress levels.
Aesthetic	Giving a sense of historical and aesthetic continuity for the city, Sense of a comfortable view & Increasing the attractiveness of city.
Educational & Scientific	Environmental education activities, Studying & exploration, Important to children, Social and cognitive development for the students, Researching, Place for genetic resources & also contain the unique biological materials (medicinal plants, genetic materials).

Source: Adapted from (Urban Task Force, 2005; Anderson & West, 2006; NYS, 2007; Maruani & Amit-Cohen, 2007; Baycan-Levent, Vreeker & Nijkamp, 2009; Haq, 2011)

Appendix (4)

A typology of various approaches to the valuation of urban green spaces

Values of urban green spaces	Values of urban green spaces from an economic perspective	Valuation methods
1-Ecological values		
Intrinsic natural value Genetic diversity value Life-support value	Existence value Bequest value Indirect use value	Monetary valuation: cost-benefit analysis, travel cost method, replacement costs, tourism, revenues, production function, contingent, valuation Non-monetary valuation: species and ecosystem richness indices, genetic difference, genetic distance, phenotypic trait analysis, biodiversity index, keystone processes, health index, ecosystem resilience and stability analysis, hierarchical structure, population viability analysis, eco-regions or eco-zones.
2-Economic values		
Market value	Direct/ Indirect use value	Monetary valuation: market analysis, production, functions, financial analysis, economic cost benefit analysis, travel cost methods, hedonic, price method
3-Social Values		
Recreational value Aesthetic value Cultural symbolization value Historical value Character-building value Therapeutic value	Direct use value Existence value Existence value Bequest value Indirect use value Indirect use value	Monetary valuation: travel cost method, tourism revenues, contingent valuation
4-Planning values		
Instrumental/ Structural value Synergetic and competitive value	Indirect use value Existence value	Monetary valuation: cost-benefit analysis, contingent valuation, hedonic price method. Non-monetary valuation: geographical information systems (GIS) method, multi-criteria decision method.
5-Multidimensional values		
Scientific value Policy value	Indirect use value Indirect use value/ Existence value	Monetary valuation: financial analysis, cost benefit analysis, cost-effectiveness analysis, tourism revenues, taxes revenues Non-monetary valuation: performance analysis, multi-criteria decision methods, meta-analysis, value transfer, rough set analysis, fuzzy set analysis, content analysis

Source: Adapted from (Baycan-Levent, Vreker & Nijkamp, 2009)

Appendix (9)

Open Space Characteristics Form

Neighbourhood Name: Number of Open Space:

Name of Observer:.....Date:.....

No. of O. S.	Area of O.S. (m ²)	Pattern of Open Space												Type of Activity		Function of Open Space						Privacy				Area per capita (m ² /person)	Total Served Area (m ²)	Level of Spatial Distribution								
		Playing Field	Cemetery	Allotment	Park	Square	Plaza	Communal garden	Private Garden	Playground	Courtyard	Side-Road Plant.	Car Park	Middle Island	Indoor	Outdoor	Social	Economic	Environment	Health	Aesthetic	Scientific & Education	Public	Semi-Public	Semi-Private			Private	Neigh.	City						

Note: O.S: Open Space, Situat.: Situation, Num.: Number, Plant.: Plantation, Education.: Education, Distrib,: Distribution, Neigh.: Neighbourhood

Source: Own construct

Appendix (11)

A list of the Names of Experts and Academics who have been interviewed between 01st April to 22th October 2014

No.	Names	Job Title	Institutions	Date of Interview
1	Ihasan Kemeky	President of Municipality	Municipality of Duhok	01-04-2014
2	Waheeds Mustafa	Transportation Engineer	Directorate of Constructive Planning in Duhok	04-04-2014
3	Saman Fakhrudin	MSc. Historic Conservation	University of Duhok	10-04-2014
4	Behjat Shawket	Director of East Municipality	Directorate of Municipalities in Duhok	17-03-2014
5	Dilshad Haider	Project Manager	Directorate of Tourism in Duhok	24-03-2014
6	Dilwar Abudulah	Urban Manager	Directorate of Constructive Planning in Duhok	14-10-2014
7	Ilyas Shigari	Master-plan Officer	Municipality of Duhok	22-10-2014
8	Ali Bamerny	Architect & Urban Designer	General Directorate of Municipalities in Duhok	21-10-2014
9	Piroz AbdulALLAH	Planner	Directorate of Municipalities in Duhok	06-05-2014
10	Shivan Abdulghani	Architect & urban designer	Directorate of Constructive Planning in Duhok	15-10-2014

Appendix (12)



Faculty of Spatial Planning

This interview is part of on-going academic studies on topic (Promoting urban Spatial Planning Guidance for achieving Sustainable Physical Urban Development in Duhok city, Kurdistan Region-Iraq). The researcher would like to assure you that your response will not be used for other purpose.

EXPERT INTERVIEW

Date Organization
Name of Interviewee Qualification
Position in the office
Start Time End Time

Theme 1: Spatial Planning and Practices

- 1- Distinct sustainable planning approaches (e.g. Transit-orientated Development, Urban Containment, Compact City and Eco-City) have been adopted to upgrade built urban environment. What planning approaches dominated the planning of new neighbourhoods in the city of Duhok?
.....
- 2- Which neighbourhoods in the city of Duhok would you associate with the above mentioned planning approaches?
.....
- 3- Which of the sustainable approaches of development do you think are considered more appropriate to deliver sustainability in growing cities such as in context of Duhok? And why?
.....
- 4- To what extend sustainable approaches and theories have been contributed to enhance the quality of life in new neighbourhoods in the city of Duhok?
.....
- 5- What planning strategies should be adopted to eliminate the extra loading on infrastructure in the city centre of Duhok?
.....
- 6- To what extend do the local authorities promote the concept of de-centralised concentration for the distribution of local services at neighbourhood and city level?
.....
- 7- What you have learnt from existing urban form when designing new developments initiatives? *(Only for experts from urban planning institutions)*
.....
- 8- What are the specific considerations on urban form in designing and planning new development area in the city of Duhok?

Building Form.....

Urban Block size.....

Spatial Pattern of Street Network.....

Open Space Availability.....

9- Do you think that the current characteristics of urban block and street patterns comply with sustainability (in term of the number of house in block, the size of block, size of streets, number of intersections, sidewalk)? And why?
.....

10- To what extend do the urban block and street pattern accord to natural relief of the city? Has the topographic nature of the city been utilised for purpose of efficient urban design?
.....

11- How do you asses the functioning of the overall current urban form at the neighbourhood and city level? And why?
.....

12- To what extend do the planning institutions succeeded in conserving natural and artificial assets in Duhok (e.g. Duhok Dam Project Channel, natural green fringes, rivers)?
.....

13- To what extend do commercial strip development policies contributed to generate congestion in the context of Duhok?
.....

14- To what extend transforming of residential plots to commercial use on main streets are successful? And what are the criteria for transforming? what are the impacts of the commercial strip on residences and streets? In term of house value, height, noise and privacy.
.....
.....

15- To what extend does urban design departments in the Directorate of Constructive planning and Municipality in Duhok have created sustainable built environment in the context of Duhok?
.....

What are the criteria and determinations of plot selection for different uses (e.g. residential, commercial and industrial)? (The question is to be directed to members of municipality and urban planning directorate)
.....

16- Are there any specific considerations on compactness and density in case of developing new neighbourhoods in the city of Duhok? In some residential areas of the city of Duhok the residential density is five times more than others (e.g. Berushke and Ashti).
.....

17- What are the planning guidelines and criteria to diverse different land parcels and different types of residential buildings and densities in the neighbourhoods?
.....

18- To what extend does the mixed use (in vertically and horizontally) are promoted in neighbourhoods?
.....

- 19- What are the strategies or planning guidelines that encourage and regulate mixed land uses within the neighbourhood and the city in Duhok? *Zoning with certain land use process has many negative impacts on city built environment in term of travel distance, noise, pollution, congestion, land value... etc.*
.....
- 20- What criteria do determine the services and their proximity at neighbourhood level in the city of Duhok?
.....
- 21- In your opinion, to what extend does the chronic traffic congestion in the city of Duhok has affected the mobility in the city?
.....In your opinion, to what extend does the hierarchy of street network is promoted to carry out the required traffic?
.....
- 22- In your opinion, to what extend do urban blocks constrain pedestrian walkability at neighbourhood and city level?
.....
- 23- What indicators are used for measuring proximity to the services in the city of Duhok? (*The question is to be directed to members of municipality and urban planning directorate*)
.....
- 24- The numbers of car taxies in the city of Duhok have increased to an incredible number more than (2500 cars) which is considered one of the factors that causes traffic jam. Is there any kind of cooperation between the planning agencies in Duhok city and the companies that import these taxi cars to limit the number in the future?
.....
- 25- In your opinion, what are the future solutions for the main arterial road (100m wide) which pass through the city of Duhok and carrying high rate of traffic flow and has big share of car accidents and casualties?
.....
- 26- How do you assess the new adopted plan for solving traffic congestion in the Duhok city centre? (*This new plan has generated many problems such as, confusion, cutting long distance to reach certain destinations, pollution and its ineffectiveness in decreasing traffic jam*).
.....
- 27- In spite that the private car has become the main means of transportation in the city of Duhok. But there is no attention paid to devote a land to car parks (*not by the municipality and not by private sector in old area and even in new developed area, especially for public places*). What do you suggest?
.....
- 28- According to the regulations and roles all sidewalks should be used only for walking purpose, but in real life most of the sidewalks are partially or totally have been occupied. What strategies do suggest addressing this problem?
.....

- 29- In general, what are the strategies that promoted by municipality for increasing mobility and accessibility in the city of Duhok? *(The question is to be directed to members of municipality and urban planning directorate)*
.....
- 30- To what extend does the flow of pedestrians and vehicles considered at neighbourhood level in the city of Duhok?
.....
- 31- Why some of the public open spaces have transformed to other use (e.g. to residential and commercial)? *Many of public spaces (especially green areas) within neighbourhoods which were planned for public uses have been changed to other uses like housing and commercial.*
.....
- 32- What conflicts do you experience with regard to change of the use of public spaces? *(The question is to be directed to members of municipality and urban planning directorate)*
.....
- 33- The municipality of Duhok grants free land parcels to certain groups (e.g. teachers, Doctors, lawyers...etc.) within a certain area. To what extend do you think this strategy encourage social segregation in the city of Duhok?
.....

Theme 2: Planning Process and Management

- 34- How the urban planning control guidelines and standards have been enforced? And what are the obstacles that facing? *(The question is to be directed to members of municipality and urban planning directorate).*
.....
- 35- To what extend there is substantial correspondence between local planning polices and development patterns?
.....
- 36- The differentiation between the documents & real life how will be solved? *(The question is to be directed to members of municipality and urban planning directorate)*
.....How do your agency coordinate, cooperate and communicate with other urban planning institutions?
.....
- 37- In your opinion, what are the challenges that hinder urban development planning and process in the context of the city of Duhok in order to achieve sustainability?
.....
- 38- What kinds of strategies are used by the municipality of Duhok to control illegal urban development within and behind the statutory city border? *(The question is to be directed to members of municipality and urban planning directorate)*
.....
- 39- In your opinion, to what extend does current development plan -Master plan- has succeeded to direct and control urban growth and create a liveable city in the context of Duhok?
.....

40- In your opinion, to what extend do the official members of planning institutions are able to undertake the responsibility of designing and managing the physical development in the city of Duhok?
.....

41- Do you think that the new development initiatives responding to their surroundings?
.....

42- Who are the actors and who are the main and leading partners? And they participate?
.....

43- How the actors participate in taking decisions regarding approving new development initiatives?
.....

44- In your option, to what extend does the city council is able to manage and performs tasks which have supported to them in the city of Duhok? Are they have enough qualifications, and how they have elected?
.....

48. To what extend does land owners have affected the physical urban growth direction in the city of Duhok?
.....

Theme3: City Growth, Urbanization and Sprawl

49. In your opinion, what are the driving forces and constrains of the urban growth in the context of Duhok?

1. *What are the socio- economic and demographic forces that affecting urban growth in Duhok Context?*
.....

2. *What are the spatial forces that affecting urban growth in the context of Duhok?*
.....

3. *What are the legal-institutional forces that affecting urban growth in the context of Duhok?*
.....

50. What are the policies and strategies that promoted by planning institutions to control and mitigate urban growth in the city of Duhok? And how they were effective? *The border of municipality of Duhok is always behind new development expectations area without having clear strategic vision for future urban growth. How do you evaluate this process?*
.....

51. In your opinion, what are the appropriate strategies to control and constrain rapid urban growth in city of Duhok?
.....

52. Does the municipality succeed in exploiting non-agriculture land (rocky lands) for the purpose of new development in the city of Duhok? *City of Duhok has encroached hundreds of hectares of fertile agricultural land during last few years and captured more than 13villages.*
.....

53. In your opinion, to what extend does the process of granting free land parcel to public servants by the Kurdistan Regional Government (KRG) encourage the growing of the city of Duhok and successful to offer housing affordability?
.....

54. What strategies should the government adopt to deal with increasing of informal houses in some area of Duhok (e.g. Berushkê, Reza)?
.....

Thanks for your contribution

Ismail Hajani

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Appendix (13)



Faculty of Spatial Planning

This interview is part of on-going academic studies on topic (Promoting urban Spatial Planning Guidance for achieving Sustainable Physical Urban Development in Duhok city, Kurdistan Region-Iraq). The researcher would like to assure you that your response will not be used for other purpose.

INDIVIDUAL INTERVIEW

Instructions:

- *These questions should be directed to the members of the selected (sampled) houses within the neighbourhood.*
- *From each house only one member should be interviewed.*

I. General Background

Neighbourhood Name.....Name of Interviewee

Qualification.....Number of the Interviewee

Occupation.....Age..... Sex.....

Date.....Start Time..... End Time.....

II. Socio-Economic Aspects

- 1- Where do you live? In House Apartment Others
- 2- Is the house your property? Ownership Tenancy Others
- 3- How many families are you sharing the house? (.....) Family/ies
- 4- How many persons do live in the house? (.....) person/s
- a- Adult’s number (M...../ F.....) b- Children less than 16 years old (M..... /F.....)
- 5- Monthly household income (.....ID/\$ USD)
- 6- How long have you been living in the city of Duhok? (.....) years
- 7- When did you moved to this neighbourhood? In year (.....) years
- 8- Where did you come from? Within Duhok Municipality Outside Duhok municipality

III. Residents’ Preferences

- 9- Do you have a plan to move from your present neighbourhood to another? Yes No Why?
.....
.....
- 10- If you have the chance to move from this neighbourhood, which neighbourhood in Duhok city would you choose? Why?
.....
.....
- 11- How would you prefer your own single-house to be in terms of exposure? Attached on two Side - back+ side or side+ side Attached on three Side Detached

- 12- Which type of residential buildings do you prefer? Private single- House (Low Residential)
 Apartment (High Residential)

IV. Interaction with Urban Form

- 13- Why do you go to the city centre? Is it for Shopping Leisure Social contacts Working
- 14- When you go for shopping to the city centre, which type of shopping do you perform?
 Daily Weekly Monthly
- 15- Where do you perform your daily shopping? within the neighbourhood In other Neighbourhoods In city centre
- 16- How do you normally go? By To/From city centre
 Walk
 Taxi
 Bus
 Private car
- 17- Do you have a private car? Yes No If yes Number of Cars
 Where do you park? Home park Street
- 18- Do you consider the sidewalk Space? As Private Semi-Private Semi-Public Public
- 19- Which type of green space facilities do you attend in the city? Public space Private
 Why?

V. Residents' perceptions on urban form elements

20- Are you satisfied with these elements of the Houses?

No.	Element	Dissatisfied	Neutral	Satisfied	Reasons
1	Plot Size				
2	Building Setback				
3	Building Height				
4	Built-up Area				
5	Open Area				
6	Building Orientation				
7	Car Park				

21- Are you satisfied with these features of the Neighbourhood?

No.	Element	Dissatisfied	Neutral	Satisfied	Reasons
1	Block Size				
2	Number of Housing in Block				
3	Population Density				
4	Easy Access				
5	Availability of Local Service (Retail, Educational,				
6	Proximity to services (500m walk)				
7	Street Width & Length				
8	Sidewalks				
9	Greenness (Availability of Open Spaces)				

VI. Municipality’s Performance and the Effectiveness of the Regulations

22- How would you evaluate the mobility as a whole in the city of Duhok?

Dissatisfied Neutral Satisfied

23- How would you evaluate the impacts of the commercial strip on residences and streets? The impact on value, height & congestion.

A-Decreasing the value of the residential property behind strip

B-Increasing of the congestion on the street

C-Closing sun and wind from the residential buildings

D-Bringing crowds to the area

24- In your opinion, to what extent does the municipality of Duhok able to enforce and apply the regulations in proper way?

Not-able Neutral able

25- In your opinion, to what extent policies, legislations and regulations are effective in arranging and controlling urban form in regards to height, setback and building area ratio, accessibility and availability of urban services and infrastructure?

Ineffective Neutral Effective

26- Do you think that the municipality and planning institutions have been succeeded to create a good urban form in the city of Duhok?

Failed Neutral Succeeded

VII. Perceptions on Urban Form

- 27- What problems do you see in your neighbourhood in terms of spatial urban planning, please be specific as possible?
 - 1-
 - 2-
 - 3-
 - 4-
- 28- If you were asked to design a plan for improving your neighbourhood in terms of spatial development, what do you prefer to suggest?
 - 1-
 - 2-
 - 3-
 - 4-
- 29- In your opinion, what are the most urgent problems to be addressed in Duhok city in terms of spatial development?
 - 1-
 - 2-
 - 3-
 - 4-

Thanks for your contribution

Ismail Hajani

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Appendix (14)

A list of the Names of experts and academics, who have been participated in the workshop in 22th November, 2015

No.	Names	Job Title	Institutions	Remarks
1	Cheeman Abdulmajeed	Civil Engineer	Municipality of Duhok	
2	Bewar Hashim	Architect & Urban Planner	Development Centre in Duhok	
3	Waheeds Mustafa	Transportation Engineer	Directorate of Urban Planning	
4	Saman Fakhrudin	MSc. Historic Conservation	University of Duhok	
5	Muhamad JaruALLAH.	Planner	Directorate of Urban Planning	
6	Shireen Younis	PhD, Planner	Academic	
7	Sahim Yousif	Civil Engineer	Directorate of Municipalities in Duhok	
8	Mazin Mohamad	Project Manager	Directorate of Investment in Duhok	
9	Alan Izat	Architect.	Municipality of Duhok	
10	Basim Haider	Planner	Directorate of Municipalities in Duhok	
11	Baravan Faisel	City Planner	Directorate of Urban Planning in Duhok	
12	Dilshad Haider	Project Manager	Directorate of Tourism in Duhok	
13	Dilwar Abudulah	Urban Manager	Directorate of Urban Planning in Duhok	
14	Jambally Abudlah	MSc. Community Development	Academic	
15	Ali Bamerny	Architect & Urban Designer	Directorate of Municipalities in Duhok	
16	Ismail Ibrahim Hajani	Architect and Planner	Researcher	

Appendix (15)

Dear All Participants

This workshop is a part of field work of doctorate research under title (*Promoting Urban planning guidance for achieving sustainable physical urban development: case study city of Duhok*) in the faculty of spatial Planning-Technical University of Dortmund/ Germany.

The workshop revolves around one of the hottest subjects in the area of spatial planning which is urban form. The subject of urban form has been investigated by many researchers from different disciplines like Architectural, Urban planning, Economy, Geography, Sociology... etc. Each of these disciplines has their own conceptual framework and approaches.

Searching for sustainable urban form has motivated many scholars to suggest many forms and approaches, preparing urban planning standards and establishing academic centres in order to enhance the quality of built environment in their own contexts.

The workshop deals with the subject of urban form from the physical point of view, that it means the way it manifests on the ground, and its creation and transformation and the way it should be, and how the people interact with it, the arrangements of cities, buildings, streets...etc. and the interaction between the residents and forms. Any new physical urban development initiatives affect urban form by creating new forms and transforming old urban forms through redevelopment projects, for example constructing new bridges, opening new streets, building new trade centre, development or redevelopment of neighbourhood, new schools...etc. all these will affect other parts of the city by solving some problems in some area and creating new problems at the same time in others.

Urban form touches our daily life, Might or May everybody has asked or asks questions which related directly to the subject of urban form, questions such as:

- Why buildings are arranged in certain way?
- Why this high building is beside the low buildings?
- Why this walk way is too narrow?
- Why some of neighbourhoods lack of amenities?
- Why the shop is too far and not reachable?
- Why the school of my children is so far?
- What is the most appropriate population of the neighbourhood and city?
- Why there is a high density in some areas while low density?
- Why there are social segregations in the city?
- Why there is a congested traffic in the centre and neighbourhoods?
- Why there is a lack of mobility and accessibility in the city?

And more

All these questions and other of thousands may you ask or had been asked is related directly to the physical urban form and touches our daily life.

Our beloved city of Duhok has experienced during the last few years an expected urban development and growth in term of spatial expansion which affected the traditional urban form and changed many urban and social norms. This phenomenon is resulted many spatial, environmental, social and economic problems, which were the consequences of the interaction of several factors such as inefficient planning system and incapable of institutions of urban planning.

The workshop will hold on Sunday 22 of November in cultural and social center in the campus of university of Duhok. The workshop's schedule will be as follow:

Events	Time	Remark
Workshop launch and well coming	9:00 – 9:10 am	
Presentation and questions	9:10 – 10:30 am	Presentation covers an over view of urban form, its definitions, elements, scales, approaches...etc.
Coffee break	10:30 – 10:45 am	
Grouping Work	10:45 – 12:30 pm	Creating groups from participants to investigate city urban form problems at neighbourhood and city level.
Lunch	12:30 – 1:30 pm	
Presenting group's work	1:30 – 2:30 pm	
Final discussions and conclusions	2:30 – 3:30 pm	

Best regards
 Ismail Ibrahim Suliman Hajani
 PhD student in TU-Dortmund- Germany

22-11-2015

Appendix (16)
Administrative Composition of Duhok Province

