

An-Najah National University

Faculty of Graduate Studies

**Analysis and Evaluation of Development in Palestine
using Urban Carrying Capacity Assessment System :
Tulkarem Governorate as a Case Study**

By

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**This Thesis is Submitted in Partial Fulfillment of the Requirements for
the Degree of Master of Urban and Regional Planning Engineering,
Faculty of Graduate Studies, An-Najah National University,
Nablus- Palestine.**

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Dedication

I dedicate this thesis to my loving **parents** for their words of encouragement.

A special feeling of gratitude to my dear **husband** for his incessant support.

My **beloved children**, brothers and sisters who have never left my side and are very special.

I also dedicate this dissertation to the family's friend (**Eng. Saed Saleh**) and who supported me throughout the process.

My **friends** and all who taught me, helped me, and encouraged me on my way to success.

All people in my life who touched my heart.

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Finally , I would like to thank everybody who supported me in any respect during the completion of this thesis.

Alaa Abdalrahman

الإقرار

أنا الموقعة أدناه، مقدمة الرسالة التي تحمل العنوان:

Analysis and Evaluation of Development in Palestine using Urban Carrying Capacity Assessment System : Tulkarem Governorate as a Case Study

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Declaration

The work provided in this thesis, unless otherwise referenced. Is the
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any other degree or qualification.

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Abstract

This study examines the analysis the development in Tulkarm governorate using the urban carrying capacity assessment system during the period (2005-2016), which is defined as the maximum level of human activities, such as population's growth ,land use and physical development without considerable degradation and damage.

The problem lies in this study is that the Tulkarm governorate developed highly and intensely during the period (2005-2016), Consequently, more pressure was put on natural resources. However, this rapid development may does not commensurate with the urban carrying capacity. This, in turn, leads to persistent and permanent problems, especially those related to population and overlapped land use, which jeopardize the natural resources . In addition to the impact of the political factor that limits and prevents the achievement of the potential development, which is compatible with the urban carrying capacity of the governorate, where there is enough area that

can be exploited in the case of absence of the occupation to guide and achieve the best development that preserves the governorate in a sustainable manner.

This study aims first to analyze ,and evaluate the development in Tulkarm governorate using the Urban Carrying Capacity Assessment System (UCCAS) through building up a **Framework** of factors of urban carrying capacity. Therefore and in order to determine the change in the development in the governorate and identify the influential factors of carrying capacity. the researcher divided the study , according the available data, into two periods : (2005 and 2016) , used GIS for built up spatial databases for the study periods, and used aerial photographs (Orthophotos 2005 and 2016) for the sake of review and audit. secondly, planning for potential development scenarios in terms of carrying capacity in both cases with and without the geopolitical situation of the Governorate to develop it in a convenient manner in case of land availability and suitability.

The results showed that the urban carrying capacity of the Governorate was determined mainly by two factors: population density and agriculture land use , and it also showed according to the analyses of both scenarios, that the political factor limits and prevents the achievement of the potential development, which is compatible with the urban carrying capacity of the governorate ,where there is enough area that can be exploited in the case of absence of the occupation to guide and achieve the best development that preserves the governorate in a sustainable manner.

Based on these results, the researcher came up with the following recommendations: establishment of a geospatial database based on Geographic Information System (GIS) for the classification the land uses accurately. The researcher also recommends, to prepare ways to control future developments in any area of Palestine within its urban carrying capacity, and application of this methodology of different levels and characteristics of urban environments in Palestine to achieve to achieve the desired sustainable development.

Chapter One

Introduction

1.1 Preface

Development is a broad concept that entails economic, social, cultural and political, economic, social, cultural and political aspects of the community. One of the shortcomings in development planning is less sensitive to the environmental aspect which is one of the most important challenges facing the community so as to meets the basic human needs in an environmentally friendly manner . However, the urban development is a comprehensive concept, which is defined as moving a community with low standard conditions to more advanced ones to achieve specific goals and raise the standards of living of the society as a whole in all aspects of life (Lesley, 2004).

The environmental capacity, which is also called the (Carrying Capacity), is considered as the key concept in the sustainable development. It is defined as "a property of the environment and its ability to accommodate to a particular activity or a percentage of an activity, without an unacceptable impact, "(UNDP, 2005). The ecologists describe the urban carrying capacity as the maximum number of individuals that can be supported in an environment without the area experiencing decreases in the ability to support future generations within that area (Chung,1988).

The planners defined the urban carrying capacity as the ability of the natural or artificial systems to absorb the population growth, or physical

development without considerable degradation or damage (Schneider,1978), along with the level of human activities that can preserve the environment without causing any decline or permanent degradation. These approaches of urban carrying capacity can be very useful when they determine its far limit with the times (Oh, 2005).

The urban carrying capacity emerged lately as a result of the development of the cities and the speed of intensity use of environmental resources. This development was incompatible with the natural capacity suggested by the various approaches and studies, which accurately specified the excessive use of environmental resources in urban areas. In addition, there is a tendency to study the development density using urban carrying capacity, which is defined as the maximum level of human activities, such as population's growth, land use and physical development. (Kozlowski, 1990).

1.2 Research Problem

Tulkarm governorate developed highly and intensely during the period (2005-2016), Consequently, more pressure was put on natural resources and emergence of a group of environmental problems linked to the development in Tulkarm governorate, this development included a changes in the areas of land uses in the Governorate, and the population density increased in the localities of the Governorate . In addition to the impact of the political factor that limits and prevents the achievement of the potential development, which is compatible with the urban carrying capacity of the

governorate ,where there is enough area that can be exploited in the case of absence of the occupation to guide and achieve the best development that preserves the governorate in a sustainable manner.

1.3 Research Objectives

This study aims to:

- 1- Analyze, evaluate, the development in Tulkarm governorate using the Urban Carrying Capacity Assessment System to build a framework of the selected urban carrying capacity factors that is appropriate to the circumstances of the governorate and the accelerated development during the period of study(2005-2016).
- 2- Planning for potential development scenarios in terms of urban carrying capacity in both cases; with and without the geopolitical situation of the Governorate to develop it in a convenient manner in case of land availability and suitability.

1.4 The significance and importance of the research

There are several factors that led the researcher to choose this study:

1. The emergence of a group of environmental problems linked to the urban development in Tulkarm governorate, and the increase of pressures on land use in areas of the governorate as a result of the development.
2. The lack of the studies and frameworks of urban carrying capacity factors, which may help the decision-makers to determine the development

based on the urban carrying capacity criteria, which take into account generations in the sustainable urban environment.

3. The prospective contribution of this study to analyze the most important factors: The natural and social factors, that determine the nature and development of urban environment in the governorate, by building a framework that combines data of environmental and social factors which are available, and helping in diagnosing the urban carrying capacity in the context of the development.

1.5 Research Question

What are the main determining factors of urban carrying capacity which play a role in the dynamics of development in the Governorate, and to what extent does the geopolitical situation affects the urban carrying capacity of the Governorate?

1.6 Methodology

The methodology of the study was based on:

1. The descriptive approach: Collecting the previous studies, research and information on the subject of the study, the descriptive data from the respective ministries and institutions, and the spatial data (maps) to identify the existing capabilities, problems and constraints.
2. The analytical approach: Selecting some urban carrying capacity factors, which were described and used in previous studies, to determine

the of development that commensurate with the conditions of Tulkarm governorate and is based on the aerial images (Orthophotos2005 -2016) .

3. Building a Framework, depending on the proposed factors of urban carrying capacity, as shown in table (1.1).
4. Preparing (Spatial Database) for all geographic data (spatial and descriptive) for a required map, which contain urban carrying capacity factors.
5. Analyzing and evaluating, the development of the Governorate during the period 2005-2016 by using the factors of the urban carrying capacity.
6. Planning for potential development scenarios in terms of urban carrying capacity in both cases, with and without the geopolitical situation of the Governorate.

1.7 Thesis Organization

This thesis is organized as follows: Chapter one provides a brief introduction about the research, research problem, research objectives, the importance of the research, research questions and the methodology. Chapter two provides a brief literature review about the Urban Carrying Capacity, determining the factors of CC, sustainable urban development, and applying the studies of GIS to CC. Chapter three presents the characteristics of the study area in terms of location, topography, soil, vegetation and agricultural use, demographic characteristics, land use and urban planning in the governorate. Chapter four presents the overall

research methodology, which includes building the framework and evaluation the urban development. Chapter five analyzes the factors of the urban carrying capacity. Chapter six presents the conclusions and recommendations.

Table (1.1) The Proposed Factors of Urban Carrying Capacity to Build a Framework.

Subject	Required Data	Methods of Data Collection
Population Growth and Population Density	Population	The researcher will classify land use by using zoning maps , the data about road networks and Population will be collected using GIS Ministries data, Palestinian Central Bureau of Statistics and Geomolg system
Land and Natural Resources	Changing in land uses: Agricultural areas , Protected areas , industrial areas , Urban areas, Recreational areas, Israeli settlements, Quarries areas and Fallow lands	
Transportation	Road Network,	
Air Quality	Carbon Monoxide (CO), Carbon Sulfur Dioxide (SO ₂), Ozone Gas (O ₃) Nitrogen dioxide (NO ₂), Inhalable Suspended minutes(PM ₁₀ &PM _{2.5}) Hydrogen Sulfide (H ₂ S)	Data from Environmental Quality Authority, depending on some environmental standards affecting air quality as decreed by the United Nations
Soil	Types and Characteristics of Soil	The soil data will be collected using the relevant soil maps in addition to what the researcher can get from her survey of the related studies.

1.8. Summary

This chapter discusses the problem, objectives, and significance of the study. It also explains the research questions and its methodology together with the concept of the urban carrying capacity, which is considered the key concept in the sustainable development; it is defined as the maximum level of human activities, such as population's growth, land use and physical development. This concept together with other concepts like the carrying capacity and its controlling factors, the sustainable development and the studies about GIS in carrying capacity will be discussed in detail in the next chapter.

Chapter Two

Literature Review

2.1 Preface

The urbanization caused by the population growth led to a change in land use and land cover, which, in turn, influenced the environment and natural resources, so it is important to understand the growth of the urban fabric and determine which lands that are suitable for the urban future expansion within a comprehensive regional scheme, that takes into account the economic, humanitarian and environmental factors. Theories and models used in the sustainable land use planning and analysis of the humanitarian, economic, environmental information and distribution of future land uses are based on the sustainable land use model. Therefore, the use of a multivariate evaluation through geographic information systems, to ensure the integration of the humanitarian and economic information with environmental and natural information, and performing various stages in the analysis to produce a sustainable plan for land use show the importance of the environmental considerations in planning for the future urban growth (Egbarieh, 2006).

2.2 The Urban Carrying Capacity

Several studies and applications about the carrying capacity were surveyed to derive a set of relevant factors related to areas of study as: soil, slope, vegetation, wetland, critical resources, natural hazards, air and water quality, and energy availability were the major factors, which affect

ecology and environment and used in urban carrying capacity survey (Godschalk and Axler, 1977).

Onishi (1994), employed other factors, such as water supply, sanitation and waste treatment, rail road, housing, along with other factors, such as recreational, educational, and administrative services, while the public perception includes: the behavior of human , values and the apparent expectation towards adjusting other types of the urban carrying capacity(Axler, 1977).

Parker (1975), suggested the law of land use (Land use Regulation), such as performance standards and controls of density, the economic and cultural criteria in environmental decision-making and government structure and financial stability as the major factors of the institutional urban carrying capacity.

Recently and as a result of the development of the cities and the intensive use of the environmental resources, different approaches and methodologies emerged and studied and analyzed the excessive use of the environmental resources in urban areas. The most famous of these is the research by Oh, (**Determining development density using the Urban Carrying, 2005**) about determining the density of development by using urban carrying capacity in the South Korean capital, Seoul, through choosing multiple criteria in the GIS systems in order to determine the development density and the ability of urban areas to expand. Because of the sophistication and focus excessive load, which exceeds the carrying

capacity, environmental problems have emerged, such as air and water pollution , which have become the central issues for planners and decision-makers in urban areas (Oh, 2005).

Based on the previous studies, the researcher will select some factors of the urban carrying capacity to built a framework that commensurate with the conditions of the Governorate during the period of study(2005-2016) in order to analyze and evaluate the development in the Governorate .

2.3 Determining Factors of Urban Carrying Capacity Assessment System

Oh (2005), aimed to develop a (Framework) to evaluate the (Urban Capacity Carrying System Assessment – UCCAS) ,from which you can identify sustainable development density as shown in figure (2.2.1) .This has resulted in seven factors of urban carrying capacity in urban areas including: energy and green spaces, roads ,subway networks, water supply, sewage treatment and waste water treatment. Then the development of this framework comes through the integration of these factors, and the development of a system based on the geographical information system (GIS) by building geospatial data base, which includes all the selected factors .

To determine the urban capacity, the support system decision "in Seoul / Korea" (Urban Capacity Carrying System Assessment – UCCAS)was developed, which showed that it is possible to help in planning and managing effectively the urban development through the geospatial

database, and updating the data constantly. Then this methodology has been applied in a wide range and used in many studies around the world and constantly developed to suit the circumstances of the study areas.

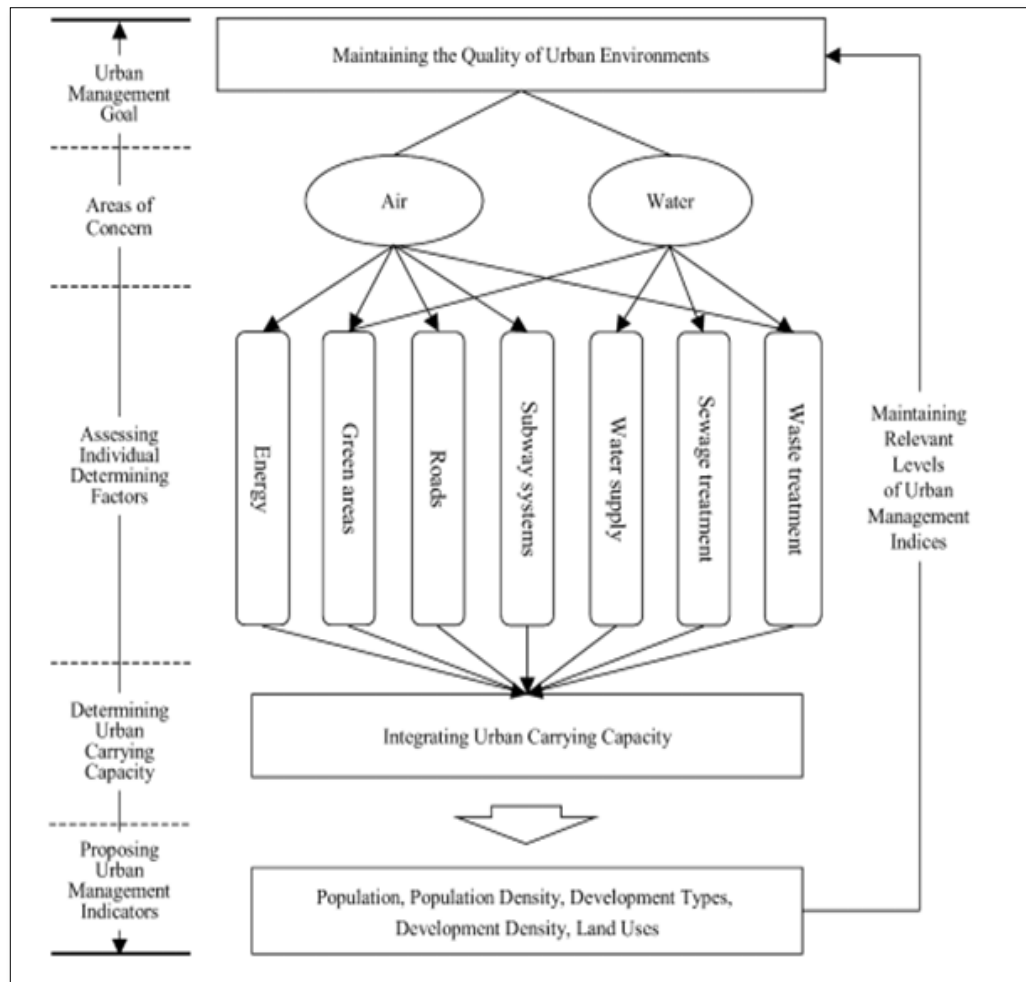


Figure (2.2.1): Urban Carrying Capacity Assessment System Source :(Oh, 2005).

Based on the previous studies, and according to data viability ,the researcher will depend on using of GIS techniques and will use two of determining components of urban carrying capacity: (Ecological and Environmental) and (Urban facilitates),focus on some determining factors

to built an assessment carrying capacity which can play a pivotal role in planning and urban management.

Through these components, the researcher will analyze and evaluate each of the factors of carrying capacity and determine the most influential factor(s) affecting urban carrying capacity based on urban development indicators that measure the level of the progress in this affected factor and the extent to which it achieve the sustainability and quality of urban environment.

2.4 The Sustainable Development and Urban Carrying Capacity using GIS

1-The study carried out by the researcher (Thawaba,2007) entitled" Sustainable development and Landscape Capacity for Absorbing Urban Development: A case study from Tulkarem\Palestine". The study focuses on the problem of how to absorb urban development within the landscape texture without changing the landscape character and the quality of the assigned area, by using a landscape assessment process in which the area was characterized into different character and quality areas. In this study, three grades of landscape quality areas were assigned and zones were created accordingly in order to attach the appropriate activity to the appropriate grade.

The study concluded that the landscape assessment can help much in categorizing areas according to their potentiality and sensitivity, especially outside the urban areas and such assessments are needed both local and

regional levels to protect natural resources as well as to direct urban development in a sustainable way.

2- A study applied in Malaysia (Muhammad, 2004) has confirmed the importance of the urban planning in terms of the urban development indicators. The indicators were classified in a form of a pyramid describing each indicator and depending on the state requirements to measure the performance of the urban areas with its several benefits. The study, a set of indicators of development of urban areas and that serve the objectives of the study are adopted:

1-Social indicators include: population density, length of roads (km)

2-Natural resources and environmental indicators; include: the, change in land use (Km²).

3- A master thesis entitled "**Evaluation and Analysis of Sustainable Development density using urban Capacity in the Kingdom of Bahrain 1998-2009**". The researcher (Al-Marikhi, 2011), aimed at identifying, evaluating, analyzing and comparing the Sustainable Development Density in governorates of Al Bahrain kingdom, using urban carrying capacity (UCC - Carrying Urban Capacity) through building a framework that fits the conditions of the kingdom and the accelerated development during the period 1998-2009. The proposed framework compiled sixteen criteria, the most important of which are the population density and land use of all types, concentration of air quality, soil and noise pollution.

Geographic information systems were used for collection, storage, organization and analysis and evaluation. The results showed an increase in the intensity of the sustainable development in the Kingdom in terms of its area. The study recommended setting specific values for the urban carrying capacity through density and population activities.

2.5 Study consistency with the previous studies

Based on the previous studies, and according to data viability ,the researcher in this study will :

- 1-Depend on using of GIS techniques to analyze and evaluate the changes in the land uses in the governorate during the period (2005-2016).
- 2- Use two of determining components of urban carrying capacity assessment system: (Ecological and Environmental) and (Urban facilitates), focus on some factors to built the urban carrying capacity assessment system which can a pivotal role in planning and development management.
- 3- Built a framework that contains these determining factors of urban carrying capacity which commensurate with the conditions of the Governorate in order to analyze and evaluate the development in the governorate. Through these components, the researcher will analyze and evaluate each of the factors of urban carrying capacity and determine the most influential factor(s) affecting carrying capacity based on development

indicators that measure the level of the progress in that aspect of development in the governorate.

4- The actual addition to this study is the spatial development of the Governorate in terms of putting scenarios for the future development of the Governorate in the concept of urban carrying capacity . These scenarios will include, first, the potential development of the Governorate according to the current geopolitical situation (C areas, settlements, separation wall) , second scenario is the potential development of the Governorate in the absence of the geopolitical situation, then making a comparison between them in terms of the urban carrying capacity and the available area in the governorate.

2.6 Summary

This chapter is divided into two groups; the first group is concerned with the relevant studies on the urban carrying capacity and determining factors of urban carrying capacity Assessment System; the second group includes the studies on the sustainable development and application of the GIS studies in the field of the urban carrying capacity. In the next chapter, the researcher provides an overview of the study area (Tulkarm governorate) in terms of the geographical location, area, population characteristics and the urban characteristics of the Governorate in order to study the spatial dimension and the available resources to come up with realistic and feasible plans.

Chapter Three

Study Area

3.1 Preface

Development is closely related to the (Development Planning) ,which coordinates efforts and organizes activities , exploits all natural and human resources to achieve a better life and standard of living for the individuals of the community, and achieving the highest level of the sustainable utilization of resources, social justice and economic growth rates .

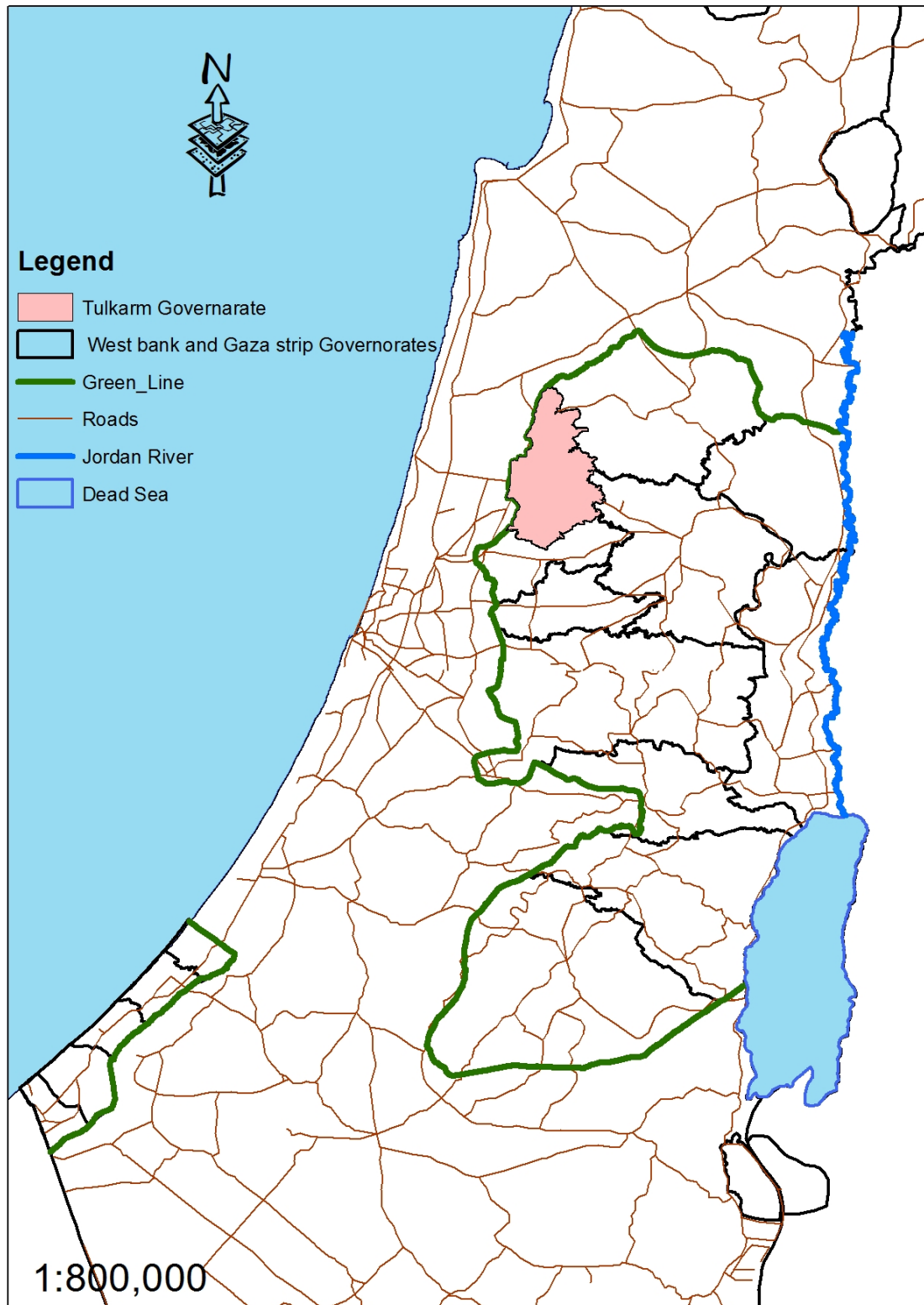
In this chapter, the researcher provides an overview of the study area(Tulkarm governorate) in terms of the geographical location, area, population characteristics, land use and urban characteristics of the Governorate in order to study the spatial dimension and the available resources to come up with realistic and feasible plans.

3.2 Location and boundaries

Tulkarm governorate is located in the western center of Palestine, in the northern West Bank. It is bordered by Jenin governorate in the north, and Qalqiliya governorate in the south, and Nablus governorate in the east. It extends along the green line from the west. The total area of Tulkarm governorate is about 246 km², which constitutes about 4.7% of the total area of the West Bank. The governorate includes 35 localities: Akkaba, Bala'a, Iqtaba, Nur Shams Camp, Tulkarm Camp, Tulkarm, Anabta, Qaffen, Kafr el-Labd, Kafah, Hafasi, Far'oon, Shufa, Khirbet Jubara,

Safarin, Beit Lid, NazlaIssa, Nazalah Al- Sharqyah, Baka Al Sharqiya, Nazlah Al-Wusta, Nazlah Al Gharibah, Zita, Saida, Illar

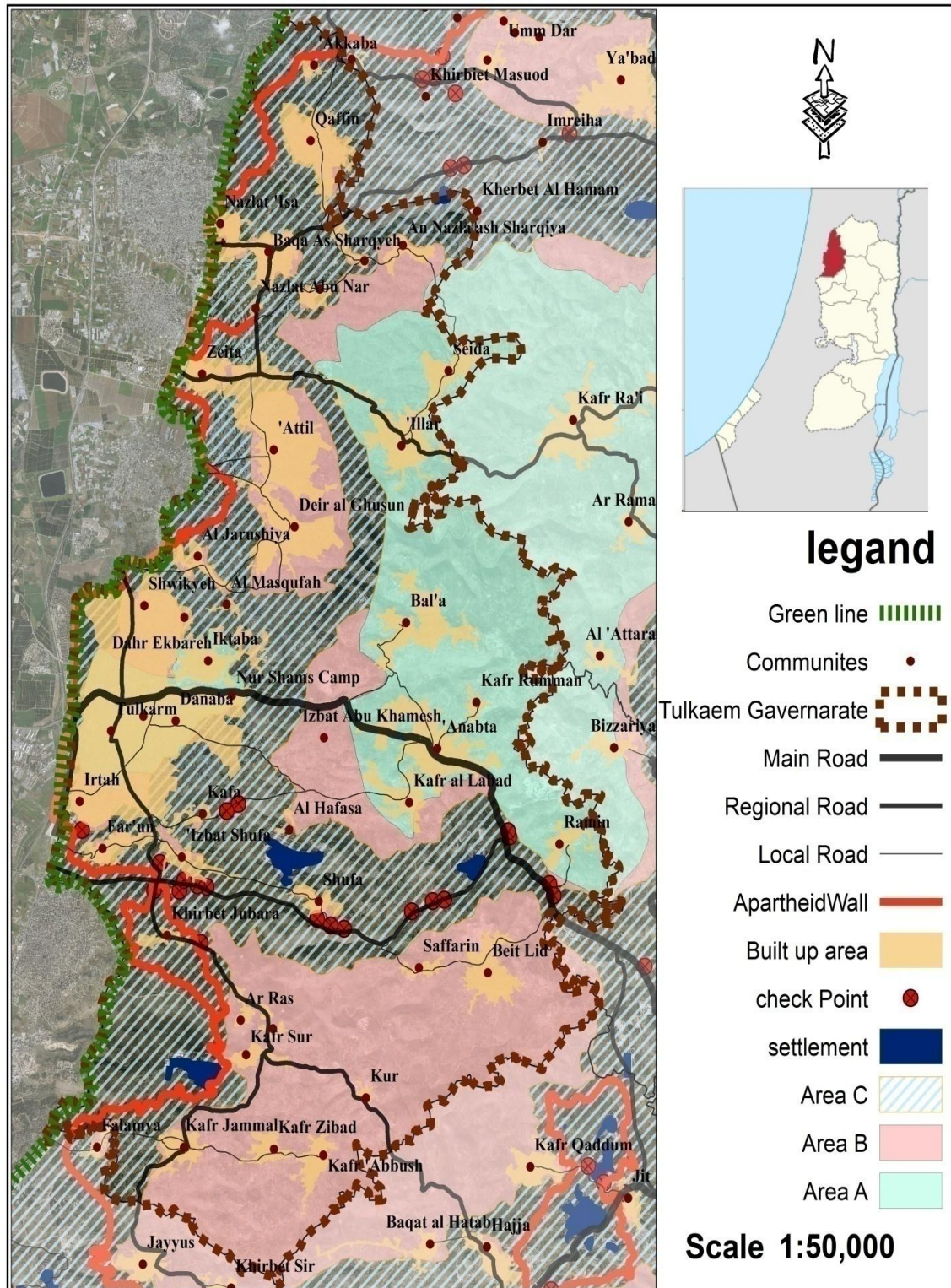
Atil, DeirAl-Ghasur, Al-Jaroushiyah, Al-Masqufah ,Kafr Sur, Kafr Jamal, KafrAbush, KafrZibad, Kor, Ramin and Al Ras (Strategic Development Plan for Tulkarm Governorate,2014). This location in the middle of Palestine and between these cities has a major impact on the city. That is, the trade that is coming from the coastal ports is passing through this area on their way to inner Palestinian cities as Nablus and Jerusalem. This location at the crossroads of trade routes contributed to the growth of the governorate clearly (Budier, 1965,P.18) .



Map (1): Tulkarm Governorate according to West Bank and Gaza Strip

Source: (An-Najah National University, Urban and Regional Planning Unit, 2017)

In terms of Israeli settlements activity in the governorate, the number of settlements in the governorate reached three settlements, occupying 3.6 kilometers of the total area of the governorate, where the Israeli settlements besiege Tulkarm. The most dangerous issue of the settlements in Tulkarm is the Israeli factories in the western areas of Tulkarm and their negative effects on the human and Palestinian environment. As for the separation Wall, the total length, according to the Israeli maps, is 40.4 km, which was completed by Israel in 2004 ,and led to the isolation of 19.9 km² of the total area of the Governorate.(Strategic Development Plan For Tulkarem Governorate, 2014) .



Map (2) Geopolitical Situation of Tulkarm Governorate

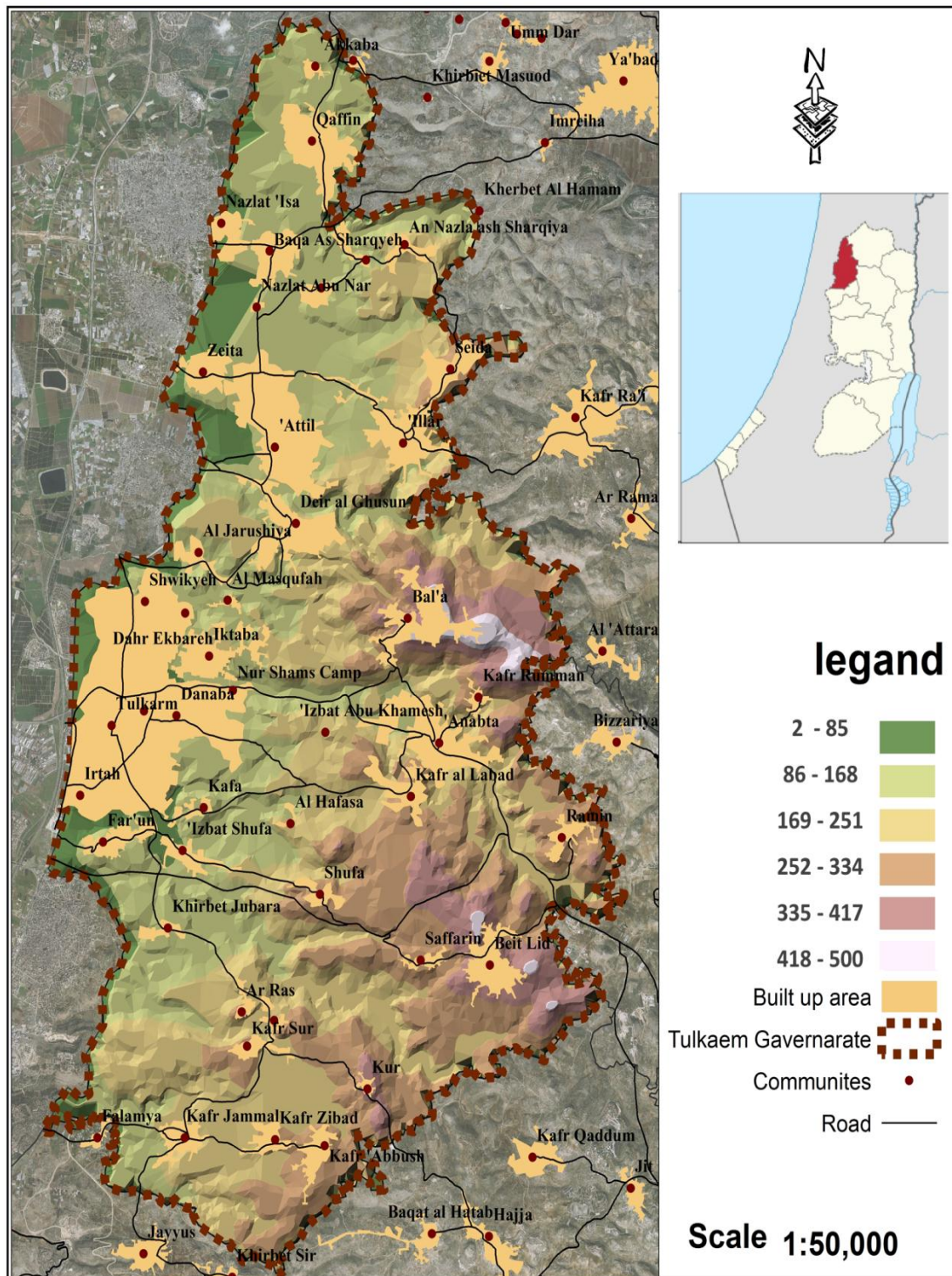
Source: (An-Najah National University, Urban and Regional Planning Unit, 2017)

3.3 Topography

Topography in the governorate played a major role in determining the extent of its land ranges, urbanization, agriculture, pastures and the network of roads, water sources, and thus determine the economic structures and social area residents. The topography of the governorate is estimated to be between 512 m in the highest point in the eastern part, which expands to the north-eastern part of Kafr Rumman (Mount Rasheen), and 49 m in the lowest point there, which expands to the north -western part of Zeita Village in the western part of the governorate (Melhem, 1999,P.16).

In general, the governorate consists of hills with a series of valleys stretching from the highlands to the east, toward the coastal plain to the west, and descend into these hills from all sides. (Budier, 1965,P.18). The valleys which are running across the governorate are: Valley of Al zumr, Wadi Abu Nar and Wadi Ateen (Melhem, 1999,P.18).

The topography of the governorate and its location are the main two factors in the development of the commercial activity, not to mention the moderate climate, convenient movement of wind and soil fertility, and other factors that contribute to a large extent to attracting the people's attention (Melhem, 1999,P.18), as show in (map 3) below.



Map (3): Topography of Tulkarm Governorate

Source:(An-Najah National University,Urban and Regional Planning Unit, 2017)

3.4 Soil

Soil plays an important role in the lives of the region's population; it is the soil surface which covers the ground, which may be thin or thick and, fertile or rich .(Budier, 1965,P.20).

In Tulkarm, the soil is composed of calcareous material from the sediments generated from drifts brought by the floods from the mountains in the east and deposited in the valleys and lowlands. The plains' soil extends from Tulkarm in the west and the north and the south-east.

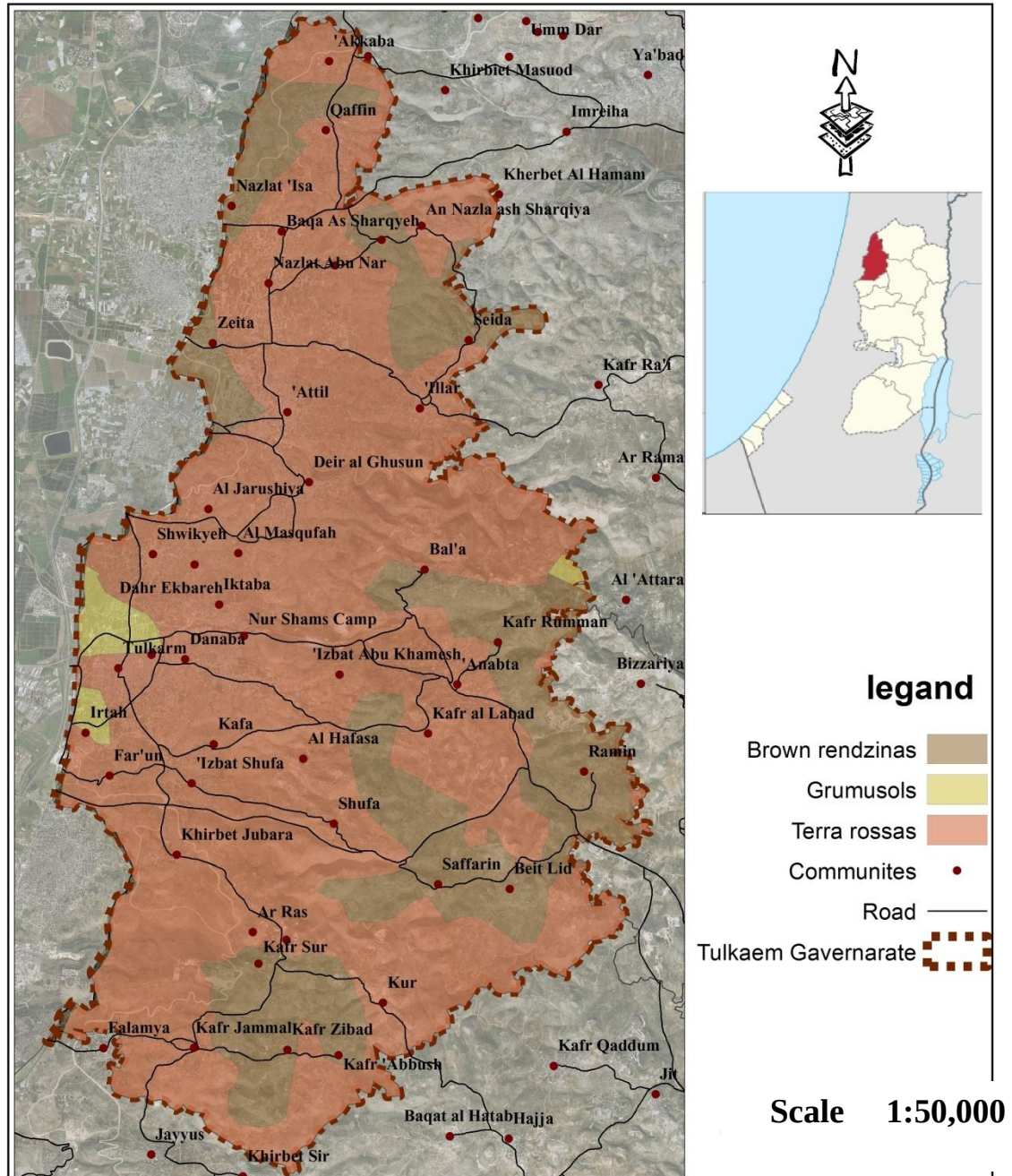
The soil in Tulkarm has been one of the most fertile in the world since ancient time and is still characterized by its great fertility which made the area the most fertile agricultural areas , and the soil factor still plays an important role in determining and controlling urban land uses.(Budier, 1965,P.20). .

The following major soil components are found in the governorate as shown in (figure 4):

- **Grumusols:** This type of soil covers about 1,201hectars of the Tulkarm. It is found in an area with smooth to gentle sloping topography of Tulkarm, Zetaand Attara . The soil is originally formed from fine-textured alluvial or aeolian sediments. The usage of this soil type for production purposes is currently limited to grow wheat.

- **Terra Rosa , Brown Rendzians and Pale Rendzians :** This type of soil occupies a total area of about 25,252 hectares, which covers about 75% of the governorate. Around 30-50 % of this soil is outcropped with rocks. The major native vegetation covers are *Quercus calliprions*, *Pistacia palestina*, *Pistacia lentiscus*. Wheat, barley, vineyards, olive and fruit trees are the dominant land use pattern.

- **Brown Rendzians and Pale Rendzians:** This type of soil is dominant in the area of Qaffin, Nazlet Isa, Al Nazla El –Sharqya, AlNazle El Wusta ,Saida, Nazlat Abu Nar, Ramin, Seffarin, BeitLeed, KafrAbosh,KafrZibad and Faroun. This soil covers about 7,000 hectares. Similar to the previous soil types, 30-50 % of this soil is outcropped with rocks. The major native vegetation covers are *Quercus calliprions*, *Pistacia palestina*, *Pistacia lentiscus*. The major plants in this soil type are *Pinus halepensis*, *Pistachio lentiscus*, *Pistachio palestina*. In these areas grapes, olives, wheat and barley are the main land uses especially in the shallow and steep sloping areas (Environmental Profile for The West Bank Volume 8,Tulkarm District, Applied Research Costitute-Jerusalem,1996) .



Map (4) Soil Classification in Tulkarm Governorate

Source:(An-Najah National University, Urban and Regional Planning Unit, 2017)

3.5 Vegetation and Agricultural Land

Plants are distributed homogenously with climatic regions, because they are associated with natural factors such as climate and terrain. These factors are considered to be the most important determinants of the diversity of the natural vegetation and their diversity from one region to another (Shuli, 2008,p.39).This diversity in the natural vegetation is due to the following reasons :

- The diversity of terrain within the study area :Tulkarm governorate is characterized by its varied terrain, which ranges from the coastal plain to the Palestinian highlands. This diversity in the terrain results in temperature variations that have led to diversity in plantations and natural vegetation.

- The impact of climate on the distribution of natural plants: in the western slopes of the governorate, the evergreen forests prevail because of the high amount of rain falling on them, and moderate temperature, specifically in winter, as the western winds come from the Mediterranean that causes rain and provides the water needed for plant growth(Shuli, 2008).

- Agricultural Land in the Governorate

Tulkarm Governorate is a first-class agricultural governorate with all kinds of plants and animals, despite the loss of many of its lands and extensive plains in the Nakba of 1948, which were cultivated with crops of grains, vegetables and citrus orchards (Strategic Development Plan for Tulkarm Governorate, 2014) .

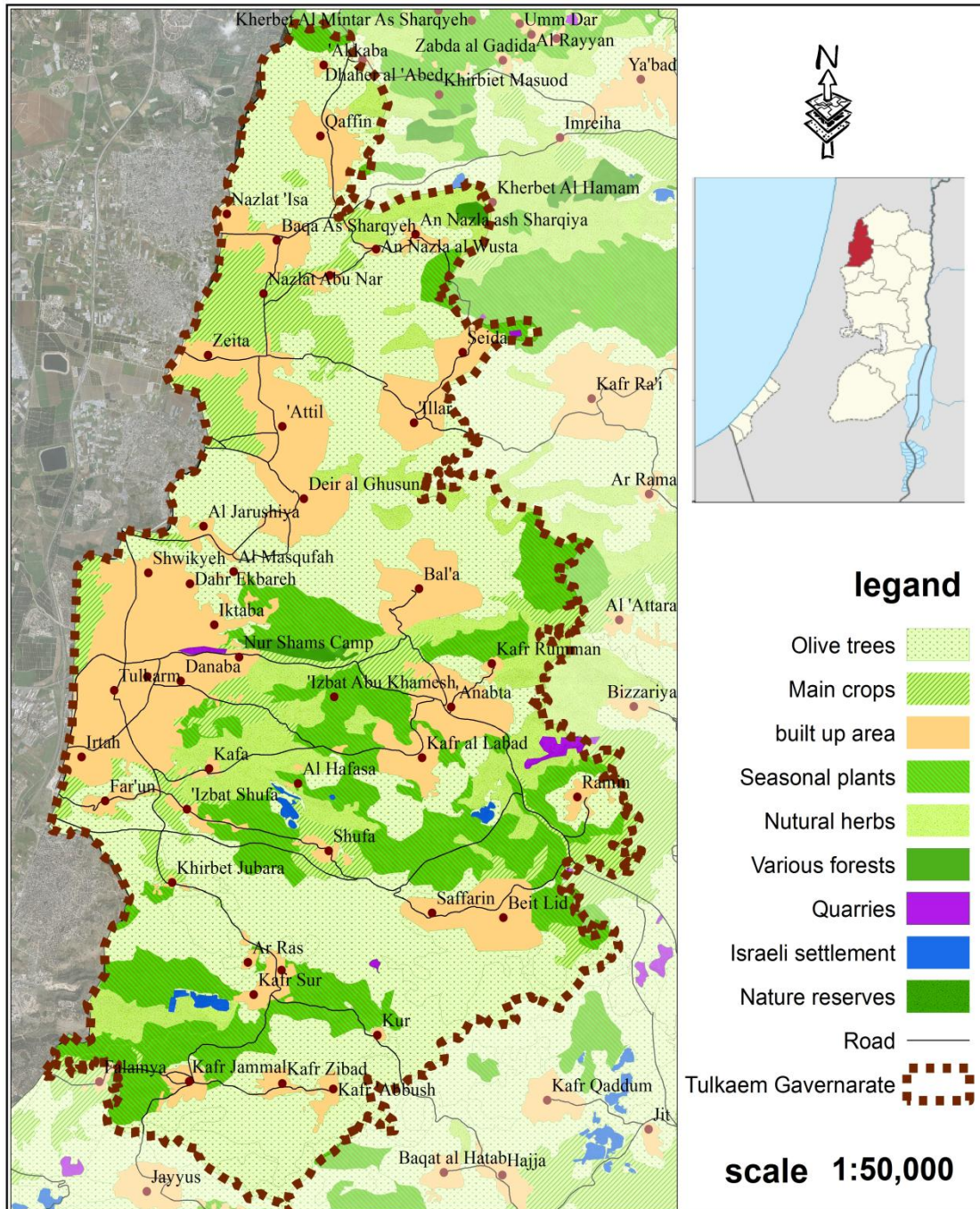
The total area of the agricultural land in the Governorate is 121000 dunums, and the cultivated area is 118000, which is temporarily cultivated with 3000 dunums. The area of the irrigated land is 15200 dunums, of which 4,200 dunum are protected vegetables (plastic houses): (cucumber, tomatoes, colored peppers, beans and Jew's mallow), 4000 dunums, such as: avocado, irrigated almonds, guava, etc. The rest of the irrigated area is planted with open vegetables (cauliflower, cabbage, eggplant, squash, beans, shumer, tomato, cucumber (Strategic Development Plan for Tulkarm Governorate, 2014).

The number of agricultural holdings in Tulkarm Governorate reached 8035. In terms of tenure, the number of plant holdings reached 6595, which is the most common possession of 82.1% of the total holdings. The number of animal holdings reached 544 and the ownership of 6.8% . The number of mixed agricultural holdings 896 ,which constitutes 1.1% of the total agricultural holdings in Tulkarm Governorate.

-Natural Reserves, Forests and Grasslands: Tulkarm Governorate contains 1638 dunums of nature reserves. The most important of these are Nur Shams 1188dunums, and Qaffin 450 dunums, which consist of dense natural forests, most of which are planted with pine trees and large cypress trees.

The presence of grasslands in the province is considered as a single outlet for the people of the province and is part of the natural biodiversity of the vegetation cover, which contributes to improving the quality of the

environment in addition to the aesthetic appearance of the region and the map below shows the type of natural vegetation and reserves in the governorate.



Map (5)Vegetation and Agricultural lands in Tulkarm Governorate

Source:(An-Najah National University,Urban and Regional Planning Unit, 2017)

3.6 Demographics Characteristics

3.6.1 Development of Population and Growth Rate

According to the census of 1961, the population of the Tulkarm area reached 83,600. The city of Tulkarm was accounted for 24.7% (about 20,688 people) of the total. In 1967, the population of the area dropped to 72,200 due to the population migration as a result of the 1967 war. In 1987, the population increased to 121,000, with a growth rate of 2.6%. The percentage of the city of Tulkarm was 24.9% (about 30,151 inhabitants) (Strategic Development Plan for Tulkarm Governorate, 2014).

In 1997, according to the Palestinian Central Bureau of Statistics (PCBS), the population of Tulkarm was 128,960 with a growth rate of about 1.0% in the period 1987-1997. The percentage of Tulkarm city was 26.2% (33,799 inhabitants) (Palestinian Central Bureau of Statistics , 1997).

According to the results of the 2007 census, the population of the governorate grew to 156,792 with a growth rate of about 2.0%, while the population of the city reached about 50,912 with a larger contribution of (32.5%) (Palestinian Central Bureau of Statistics, General Population and Housing Census 2007, Tulkarem Governorate, 2009).

The population of Tulkarm in the mid 2016 was estimated 178,774 people, constituting 6.4% of the total population of the West Bank. The population of Tulkarm city was estimated at 58,050 inhabitants, i.e 34.5% (Palestinian

Central Bureau of Statistics, Book of the Northern Governorates of the West Bank, Statistical 2013, 2014).The Tables (3.6.1.1)and(3.6.1.2)and Figures 1 and2 illustrate the evolution of the population and population growth rate of Tulkarm governorate and city during the period 1961-2016.

Table (3.6.1.1): Development of the Population of Tulkarm Governorate and the City (1961-2016).

year	Number of Population	
	Tulkarm Governorate	Tulkarm City
1961	83,600	20,688
1967	72,200	15,177
1987	121,000	30,151
1997	128,960	33,799
2005	156,792	50,912
2016	185,314	58,050

Sources :

- (Palestinian Central Bureau of Statistics, General Population and Housing Census, 1997, Tulkarm Governorate, 1998)
- (Palestinian Central Bureau of Statistics, General Population and Housing Census 2007, Tulkarem Governorate, 2009)
- (Palestinian Central Bureau of Statistics, Book of the Northern Governorates of the West Bank, Statistical , 2016)
- (Palestinian Central Bureau of Statistics, Population Estimation of Tulkarm Governorate, 2016)

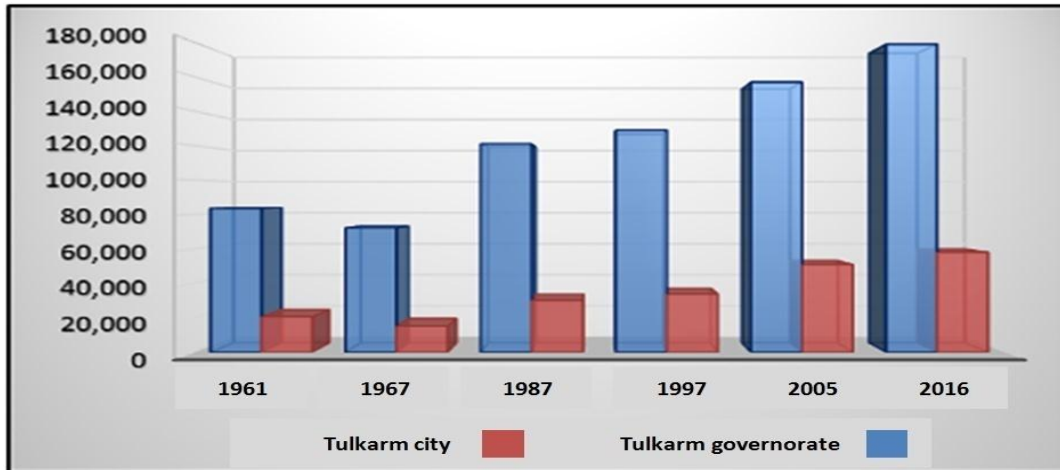


Figure (3.6.1.2): Development of the Population of Tulkarm Governorate and the City (1961-2016). Source :Depend on data from table (3.1)

Table (3.6.1.2): Population Growth Rate of Tulkarm Governorate (1961-2016).

Time Period	Population Growth Rate %	
	TulkarmGovernorate	TulkarmCity
1961-1967	-2.4	-5.2
1976-1987	2.6	3.4
1987-1997	1.0	1.2
1997-2005	2.0	4.1
2005-2016	1.9	1.9

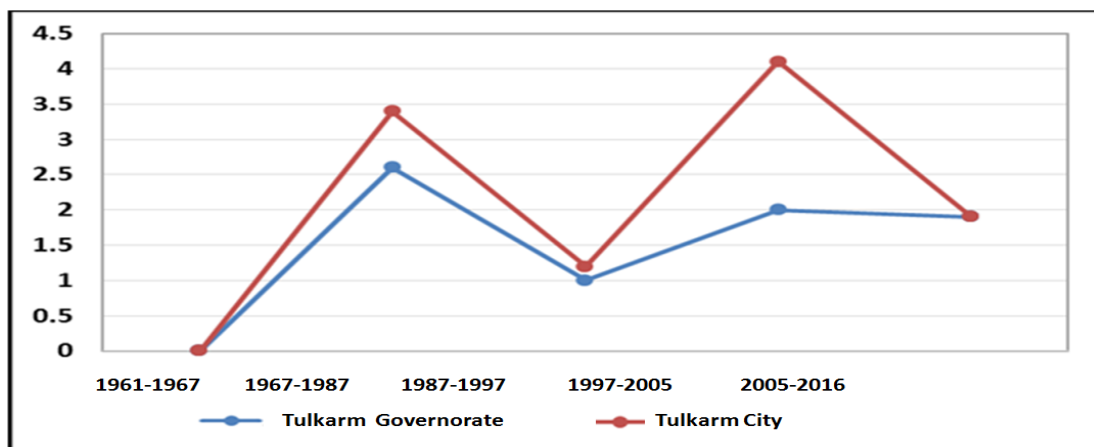


Figure (3.6.1.4): Population Growth Rate of Tulkarm Governorate and City during the Period (1961-2016). Source :Depend on data from table (3.6.1.2).

3.6.2 Population Characteristics

According to the results of the 2007 census, 61.5% of the total population of Tulkarm was urban; the rural residents were 27.7% ,and camp residents were 10.8%. When comparing these percentages with 1997, we note that the proportion of the urban population has increased significantly at the expense of the proportion of the rural population (due to the increase in the population localities in the governorate, which was classified within the urban areas), and the percentage of camp residents to about 10.8%. According to the population estimates of 2016, the urban population was 67.2%; the rural population was about 22% of the population of governorate, while the population of the camps remained 10.8%. Table (3.6.2.1) and figure (3.6.2.2) show the distribution of the population in the governorate in the years 1997, 2005 and 2016 according to the type of population.

Table (3.6.2.1): Distribution of the Population in Tulkarm Governorate by Type of locality (1997, 2005, 2016).

Type of community	1997		2005		2016	
	Number of population	%	Number of population	%	Number of population	%
Urban	52.183	40.5	96.354	61.5	124.1531	67.2
Rural	60.815	47.2	43.448	27.7	39.769	22.0
Camps	15.963	12.3	16.990	10.8	20.014	10.8
Total	128.960	100	156.792	100	185.314	100

Sources :

- (Palestinian Central Bureau of Statistics, General Population and Housing Census,1997, Tulkarm Governorate, 1998)
- (Palestinian Central Bureau of Statistics,General Population and Housing Census 2007,Tulkarm Governorate,2009)
- (Palestinian Central Bureau of Statistics (PCBS), Localities in Tulkarm Governorate by Type of Locality , and Population Estimates (2007-2016).
- (Palestinian Central Bureau of Statistics Population Estimation of Tulkarm Governorate , 2016).

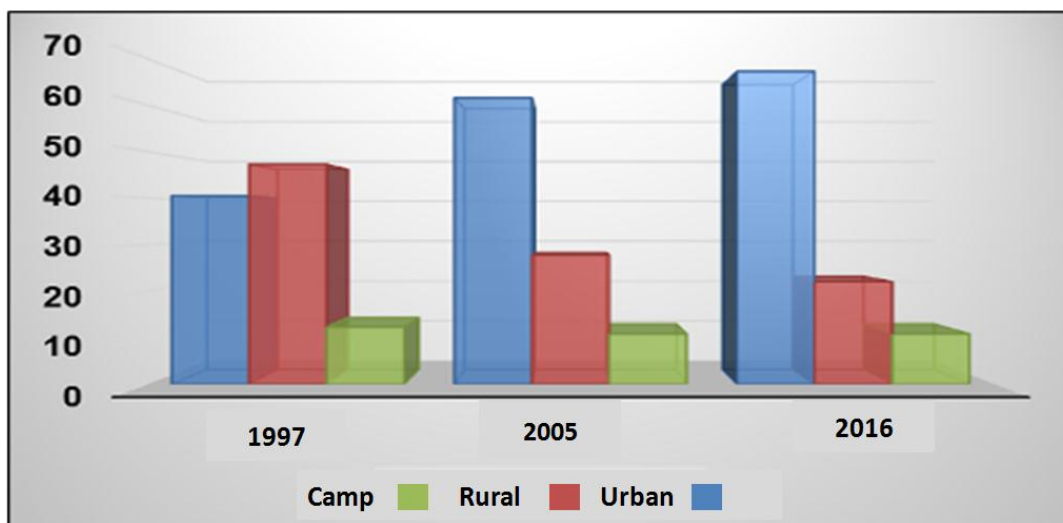


Figure (3.6.2.2): Population Distribution in Tulkarm Governorate by Type of Community (1997, 2007, 2016). Source: (Table 3.3).

3.7 Land Use and Urban Planning

3.7.1 Preface

Land is the basis of every development process and a key input to any agricultural or industrial process. Today, the world is confronting a number of economic, social and environmental problems, which have resulted from the indiscriminate use and exploitation of land resources. In the first half of the 20th century, most European countries tended to focus on surveys and land use planning as a practical way to overcome these problems and find appropriate solutions (Braun, 1985).

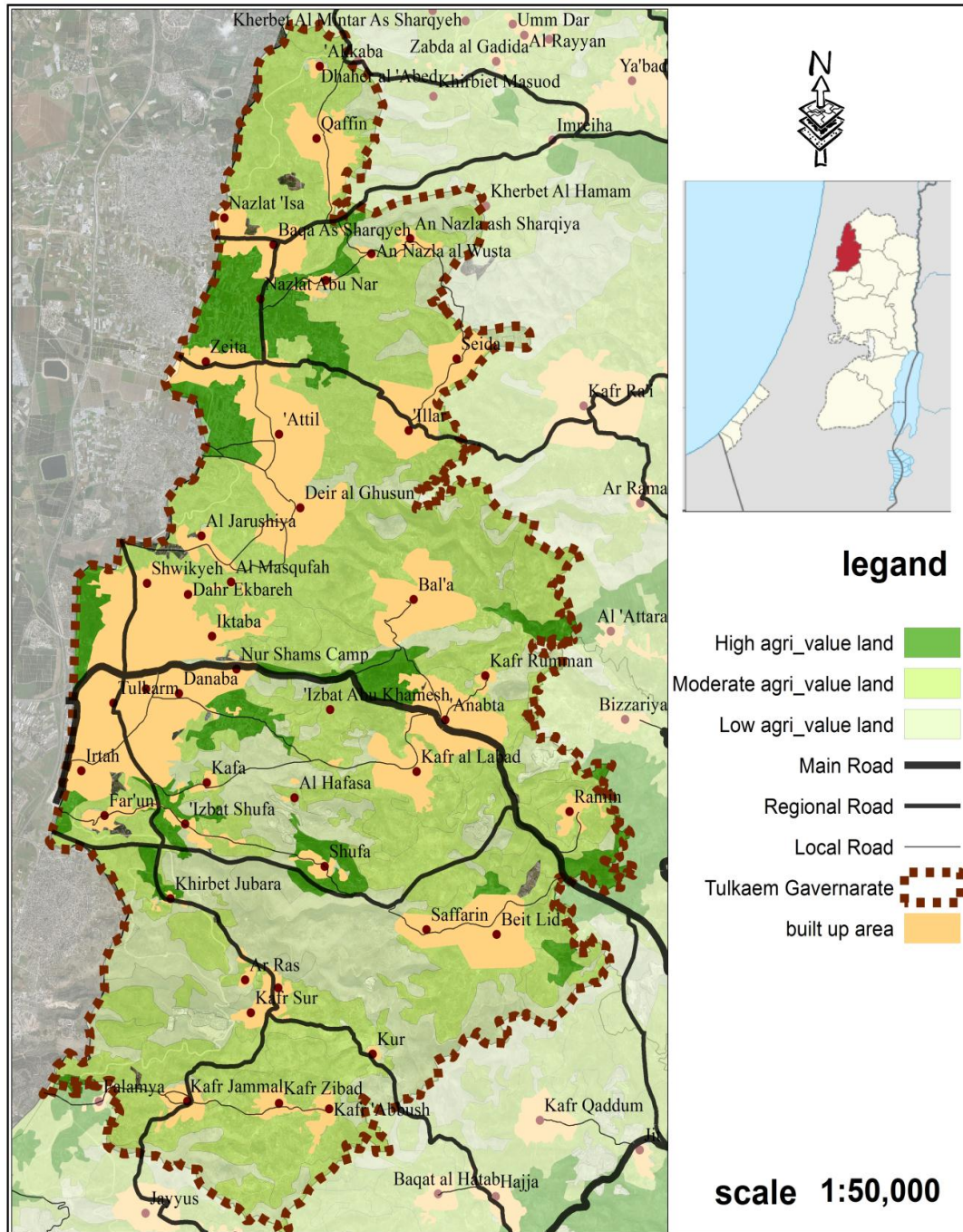
A range of factors have been put in place to control survey and Land use planning as topography, soil, population density and geographical distribution, transportation and transport lines and land-use intensity (Shami, 1999).

Urban planning plays an important role in helping to change land use patterns and sustain land use and urban development. Land use planning is part of a comprehensive planning

process that develops future perspectives for urban and administrative, social, cultural, economic, service, environmental and future land use patterns (Strategic Development Plan for Tulkarm Governorate, 2014).

3.7.2 The Land use and Urban Planning Sector in Tulkarm Governorate

The total area of land in Tulkarm governorate is 246 km². The built-up area constitutes about 13% of the governorate, while the population density in the governorate is 727 inhabitant / km². The Agricultural use in Tulkarm governorate is the predominant use; the agricultural land in the governorate accounts for about 68% of the total land area, while the agricultural land with high value is about 14% of the governorate. The areas were classified: forests and nature reserves were about 0.5% of the total area of the governorate, that is concentrated in the northern and central areas of the governorate, the built up areas (Palestinian localities) constitute 13% of the area, and the industrial, commercial and quarrying areas occupy about 0.5% of the governorate, as shown in the map (6) below (National Spatial plan, 2014).



Map (6) Classification of Agricultural Land Use in the Governorate according to the National Spatial Plan.

Source :(An-Najah National University,Urban and Regional Planning Unit, 2017)

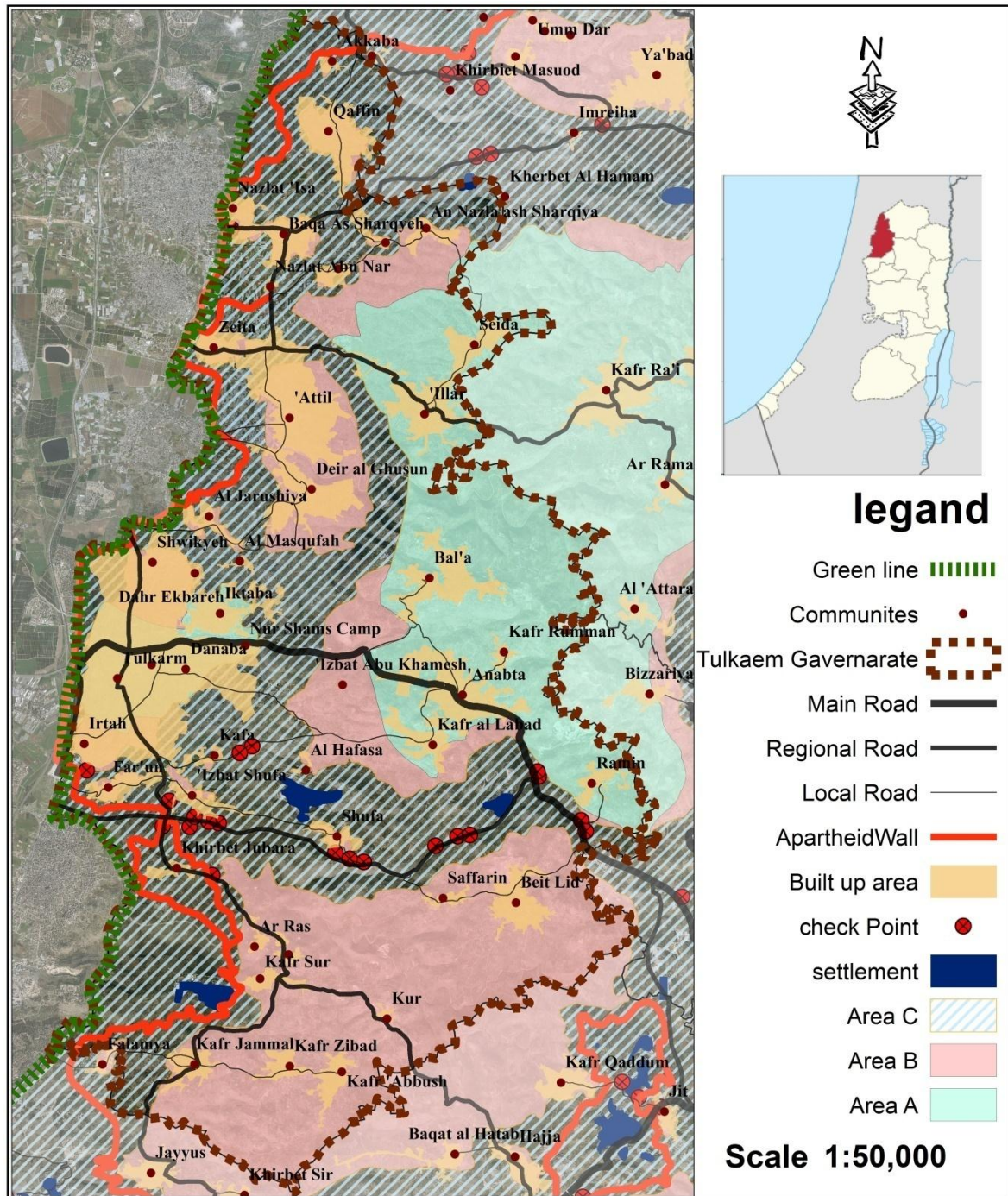
The areas of land which are classified as Area (A) under Palestinian authority in Tulkarm governorate is about 21.9% of the total area of the governorate, which is concentrated in most residential areas, and the land classified as Area (B) is about 34.7%. In contrast, the land classified as (C) holds the largest proportion (about 43.4%) of the governorate's area and contains most of the agricultural lands and open areas in the governorate, The governorate includes 3 settlements occupying about 0.004% of the area of the governorate as shown in map (7) below (National Spatial Plan , 2014).

According to the study of the hierarchy of service centers in the West Bank and Gaza Strip prepared by the Ministry of Planning in 2006, there are seven service centers in Tulkarm governorate divided into: two local centers: (Anabta and Attil) and (illar, KafrZibad, Qaffin, Baka al-Sharqiyah). These centers were based on the spatial distribution and communication between these centers and their surroundings.

The urban planning in the governorate faces many obstacles at all levels due to the Israeli measures on the land, which create a reality that limits the development opportunities, urban composition of the population in the governorate and the effectiveness of the structural plans of these communities and their extent to meet population needs.

Tulkarm governorate was also severely damaged by the Separation Wall, which extends about 40.4 km in the governorate, resulting in the

confiscation and isolation of 19.9 km² of the land, where the majority of the confiscated land is agricultural land as shown in



Map (7): Israeli Obstacles in Tulkarm Governorate

Source :(An-Najah National University,Urban and Regional Planning Unit, 2017).

3.8 Summary

In this chapter, the researcher provides an overview of the study area (Tulkarm governorate) in terms of the geographical location, area, population characteristics and land use and urban characteristics of the Governorate in order to study the spatial dimension and the available resources to set key criteria, which are applicable to Tulkarm governorate. Then these criteria will be used to build the framework of this study to address the changes in the land use of the governorate between 2005 and 2016 and assess the density of the sustainable development of the population, land and natural resources. The next chapter will discuss the overall research methodology.

Chapter Four

Methodology Building the Framework and Evaluating the Development Using the Urban Carrying Capacity System

4.1 Preface

For a sustainable land use planning, nowadays, land use planning (LUP) approach requires more data integration, multi-disciplinary and complex analysis, and faster or more precise information for the participants in the LUP approaches. Certainly, Geographic Information System (GIS) which has a strong capacity in data integration, analysis and visualization became the main tool to support LUP approaches (Trung, 2006).

The environmental capacity, which is also called the (Carrying Capacity), is considered as the key concept in the sustainable development, thus urban development should be controlled properly within the capacity that the environment can be sustained.

To determine the factors of urban carrying capacity which are influencing carrying capacity can be classified based upon the purpose of application and spatial setting, previous studies identified different types of carrying capacity, which are classified to four specific categories, is the (Ecological and Environmental), (Urban facilitates), (Perception public) and (Institutional dimensions) as shown in the table (4.1).

The analysis approach in this study was based on previous studies, which used a specific methodology to determine the development using urban carrying capacity, the most important of which were the researches by (Oh,2005) and (Al-Marikhi,2011).

According to data viability ,the researcher depend on using of GIS techniques and using two of determining components of urban carrying capacity: (Ecological and Environmental) and (Urban facilitates), focus on the five primary factors were selected to built an assessment urban carrying capacity which can play a pivotal role in planning and urban management , these type of factors are : population density because we are talking about the degree of human activity as am main factor affecting the components of urban carrying capacity .

Land and natural resources and roads are type of factors of urban carrying capacity were chosen , soil and air quality factors were chosen from the ecological and environmental urban carrying capacity components ,which is explained in figure (4.1) and the table (4.2) below.

Through these components, the researcher will analyze and evaluate each of the factors of urban carrying capacity and determine the most influential factor(s) affecting the urban carrying capacity based on urban development indicators that measure the level of the progress in this affected factor and the extent to which it achieve the sustainability and quality of urban environment.

Table 4.1 Determining Components of Urban Carrying Capacity.

component	Definitions	Type of factors
Environmental and Ecological	The degree of human activity that the environments and ecosystem within an area can support without causing serious deterioration or damage the quality of life .	Soil, Slope, Agriculture, lands , Natural disasters, Air and Water quality, Energy, Water bridge
Urban Facilities	The degree of human activity that the facilities and services within an area can support without causing serious deterioration or damage to the quality of life.	Water systems, Sewage network Health, Wastewater treatment Roads, Railways, Housing , Recreational places
Public Perception	The amount of activity or degree of change that can appear before recognizing the visual or psychological quality of environment differently than previously perceived.	Human attitudes, values, behavior and ethics.
Institutional	The administrative/financial condition of a city for maintaining the optimal scale of urban development towards public goals.	Regulations and standards, financial issues and economic, governmental structure, environmental decision.

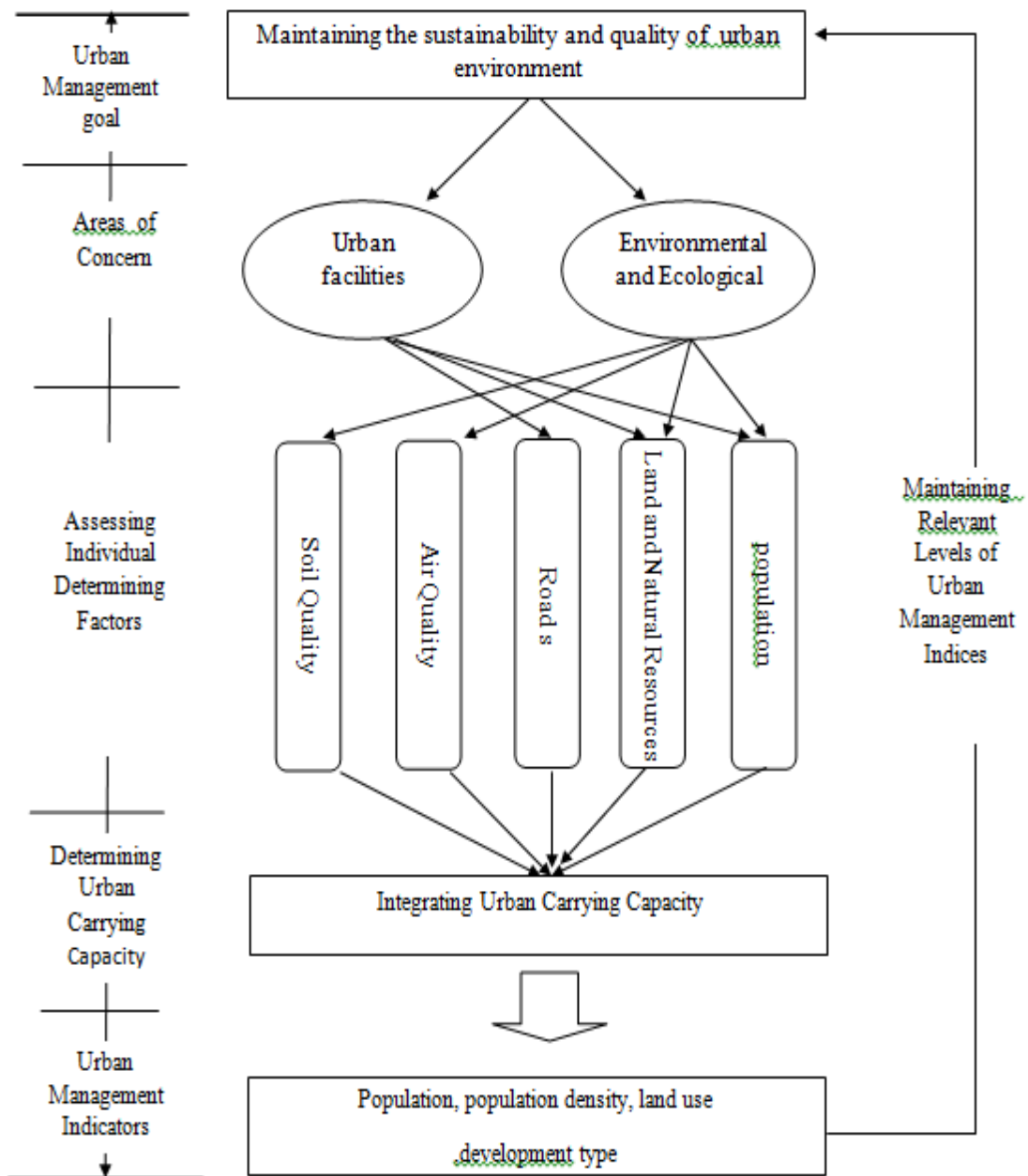


Figure 4.1: Urban Carrying Capacity Assessment System. Source:(Oh.2005).

In this chapter, a set of key factors has been compiled and adapted for the conditions of Tulkarm governorate as shown in table (4.2); it is used to build the framework of this study to address the changes in the land use of the governorate between 2005 and 2016 and assess the development of the population, land, natural resources, which are represented in a set of land use distributed in the governorate, Road length, air quality and soil quality. GIS is used in building spatial database through the available data and maps collected from related sources and producing a number of maps showing land uses during the period of the study and their capacity for human activities. The researcher studied, analyzed, evaluated, presented and discussed the changes in the governorate's land and showed the maps corresponding to the reality accompanied by the tables. These changes were studied based on the aerial photos, field study, Geomolg system and data from GIS system and from the Palestinian Central Bureau of Statistics. Figure (4.2) below explains the overall methodology of the study.

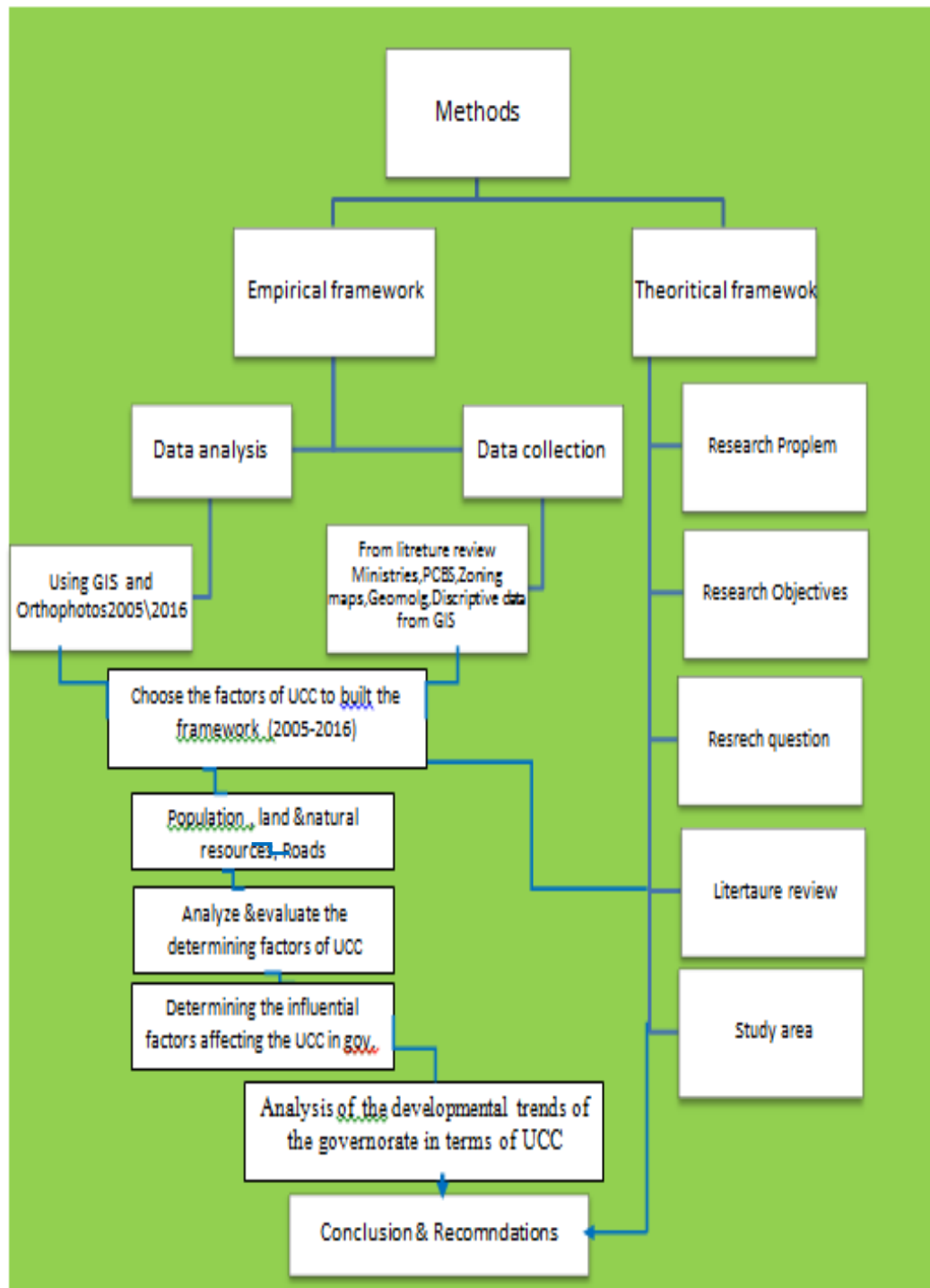


Figure (4.2): The Overall Research Methodology.

Table (4.2) Proposed Framework of Urban Carrying Capacity Factors.

Subject	Required Data	Brief Description	Measuring unit	Measuring Methods and data collection
1-Population	Population Growth and Population Density	Average rate of annual change in population size in a certain Period of time	%	Population Growth Rate, (r) between the times (t_1) and (t_2), and the population during (P_1) and (P_2) which calculated as an exponential growth rate $r = 100 \text{ Ln } (P_2 / P_1) / (t_2 - t_1)$
2-Land and Natural Resources	Changing in land uses, Agricultural areas, Protected areas, industrial areas, Urban areas, Entertainment areas, Quarries, Settlements and Fallow land	Changing in distribution of Land use in Tulkarm Governorate During the period of study (2005-2016)	%Change of each Category of land use according to land use per unit of time in (km^2)	Based on Zoning Maps which were approved by Tulkarm municipality. These maps determined the Land use and distribution, as well as through corrected aerial images (Orthophoto 2005\2016) which cover areas that are not identified by zoning maps, during the digitizing process on GIS system.

Table (4.2) Proposed Framework of Urban Carrying Capacity Factors.

Subject	Required Data	Brief Description	Measuring unit	Measuring methods and data collection
2-Land and Natural Resources	1-Urban Areas	The area that includes (Reconstruction areas ,Housing, Commercial complexes, and Buildings)	% Change in land's area to the total area per unit of time	It depends on depend on Zoning Maps, which are approved by Tulkarm Municipality for the years 2005 and 2016. They determined the Land use and distribution, as well as corrected images (Orthophoto), which cover the areas that are not identified by the zoning maps during the digitizing process.
	2-Agricultural Areas	Area specified for agricultural purposes as: various forests , herbs, olives trees and main crops	Square kilometer	
	3-Industrial Facilities	Area specified for industrial purposes, where the manufactured raw materials are converted into to other products	Square kilometer	

Table (4.2) Proposed Framework of Urban Carrying Capacity Factors.

Subject	Required Data	Brief Description	Measuring unit	Measuring methods and data collection
2-Land and Natural resources	5- Recreational Areas	Area specified to entertainment such as Public parks and archaeological sites	Square kilometer	It depends on depend on Zoning Maps, which are approved by Tulkarm Municipality for the years 2005 and 2016. They determined the Land use and distribution, as well as corrected images (Orthophoto) , which cover the areas that are not identified by the zoning maps during the digitizing process.
	6-Fallow land	Areas of land are abandoned and uncultivated	Square kilometer	
	7- Israeli Settlements	Built up area with Israeli settlements	Square kilometer	

Table (4.2) Proposed Frame work of Urban Carrying Capacity Factors.

Subject	Data Required	Brief Description	Measuring unit	Measuring methods and data collection
3-Transportation	The Road network	Lengths of Roads	kilometer	Identified by Corrected aerial photographs,(Orthophoto 2005-2016) for the study period , and through available data in the Ministry of Transportation
4-Air Quality	PM10, PM2.5, NO2,CO, SO2, O3, H2S	Any substance entering an air environment in an amount which exceeds the minimum level mentioned in the standard metrics for ambient air quality	µg / m or part of Billion (PPBV) or part in Million (PPMV) by Measurement	Data were not available in the Ministry of Environment, and lack of measurement tools to measure the percentage of the excess of air pollutants, so they will not be used as the main factor of urban carrying capacity, but they can be taken as one of the important factor for future capacity to achieve a sustainable step in the environmental planning.
5- Soil	Types of soil			There was no change in the type and characteristics of soil through the data collected from soil maps and literature review during the period of study (2005-2016), which was explained in chapter two, so it will not be used as the main factor of urban carrying capacity.

4.2 Building a Spatial Database

In this study, the researcher built a spatial database for all framework criteria for land use classifications, after converting it into shape file. It will be represented as maps for the periods of study in the program (Arc Map 10.1); the other part is the descriptive tables for each factor of urban carrying capacity collected from the available data from the ministries and municipalities and from the Palestinian Central Bureau of Statistics

All GIS programs at all levels follow the digital numbering function of maps, which is the main task, through which the data and maps are entered and then built and stored in the database.

The digitizing system varies according to the type of data and maps, where the linear data (Vector Data) is numbered with coordinates (X.Y.Z), where the point is represented by a single coordinate (X.Y), and the line is a set of points, area, and cutters with a set of lines. Another type of Aerial data is a raster, which consists of a matrix of cells (or pixels) organized into rows and columns (or a grid), where each cell contains a value representing information, such as temperature. The rasters are digital aerial photographs, imagery from satellites, digital pictures, or even scanned maps.

There are two types of data: Spatial data, which is entered by the digitizing or scanner, and the other, which is descriptive data that is found in the form of (names, dates, percentages, tables, reports), is entered by the keyboard (User guide using a program Arc GIS 9.X. Department of

Geographic Information Systems, Department of Information Technology, Ministry of Municipalities and Public Works, Al-Riyad, 2009. P. 6).

Based on the above aerial photo was used for the governorate for 2005 and 2016, the images were connected to the computer and linked to the coordinates, where the aerial image was linked to the same coordinates of the map by using Georeferencing, which is the ground reference of the aerial images which is connected to local or international coordinates (latitude and longitude).

Then the researcher digitized the process by converting paper maps (images, coordinates) to digital maps through which several digital files (layers) can be created.

After the completion of the digitizing process, the classification of all land uses was carried out in a form of a tables and maps; each area of the classified areas was calculated and the results were analyzed, discussed and evaluated, and the changes in these lands were calculated during the period between 2005-2016 as explained in the conceptual model (4.1) below.

4.2.1 Collection and Organization of Data

The spatial and descriptive required data were collected by the official authorities in the governorate to get maps (Maps Zoning) in the form of (DWG-Draw) in Auto CAD program for Tulkarm, as well as the aerial photographs Orthophoto (2005, 2016) from Ministry of Local Government.

Other data is collected from municipalities in the governorate, the Palestinian Central Bureau of Statistics, Geomolg system, Ministry of Agriculture, Ministry of Works, Ministry of Transportation and Environmental Quality Authority.

Table (4.2.1) presents data collection to support the interpretation of the intensity of urban development.

Table (4.2.1) Data Collection and Specifications.

Data	Year	Format	Resolution
Zoning Maps	2005\ 2016	DWG	—
Orthophoto	2005\ 2016	JPG	75cm
Statistical Data	2005\ 2016	PDF&XLS	—

4.2.2 Corrected Aerial Images (Orthophoto-2005\2016)

Orthophotowith 75 cm resolution and the coordinates in aerial photographs, which were("ITM" ,Israel TM Grid) and these images, which were "JPG",whose abbreviationis "Joint Photographic Experts Group" were used. The original images were in the form of ("ECW", Enhanced Compression Wavelet) and were converted to "JPG" for technical reasons. These images are grouped into a "mosaic data set", so all images are grouped in one template for the entire West Bank.

These images, which were used to determine the land use change in the governorate for the areas, were not covered by zoning maps. Instead, the aerial photographs were captured by an aircraft flying above the ground, at a constant height, and at a specific path in the form of overlapping strips in both the longitudinal and the lateral directions. The aerial images showed

all the ground details. The most important utility of the aerial photographs is that they make spatial analyses, and site-specific evaluation, to begin producing high-resolution maps of the site. It is important to note that some engineering corrections must be made for the aerial photos before using them as a source for the production of maps, where errors are expected to result from the earth sphere, which does not provide opportunities to portray a vertical image on the site, resulting in distortions in the dimensions of the parameters of the floor on the image. These engineering corrections have fixed steps, specific theories and rules, which depends on many factors, including: flight height, focal length of camera lens, and the amount of image interference (Ghneim, 2002).

4.2.3 Outputs

Corrected aerial photographs (Orthophoto), which were used for review, audit, addition and confirmation of all categories, have covered all parts of Tulkarm governorate . The digitizing has been used to cover areas that are not covered by zoning maps, by using corrected aerial photographs for the periods of study. The data extraction process, resulted in two maps for the study periods 2005\2016, as shown in maps (8 and 9). Each period contained eleven of classifications for land uses, including : Urban areas , Industrial areas ,Various forests, Olives trees, Main crops , Natural herbs, Fallow land, Recreational areas, Quarries, Israeli settlement and Roads. Figure (4.2) explain the determining factors of carrying capacity to assess the development density in the Governorate according to data availability,

and table (4.3) presents different classifications of Land uses, areas, lengths and trends.

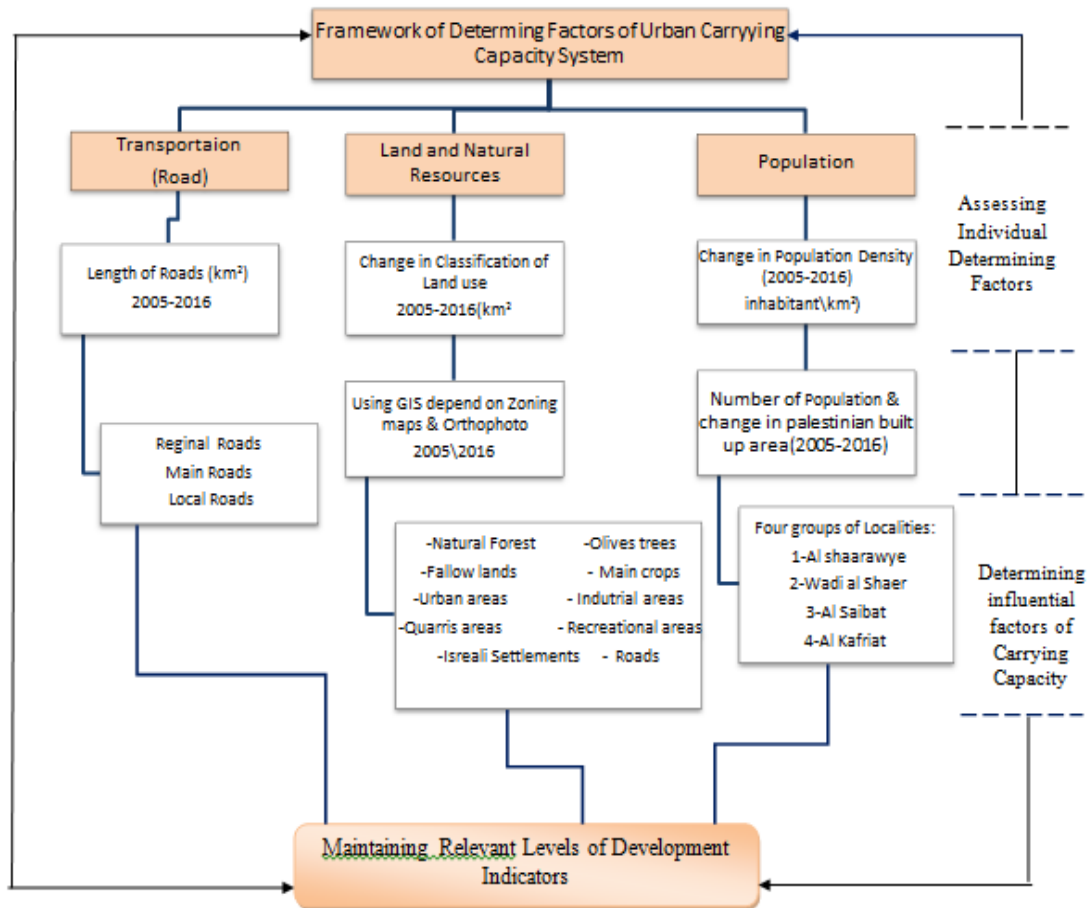
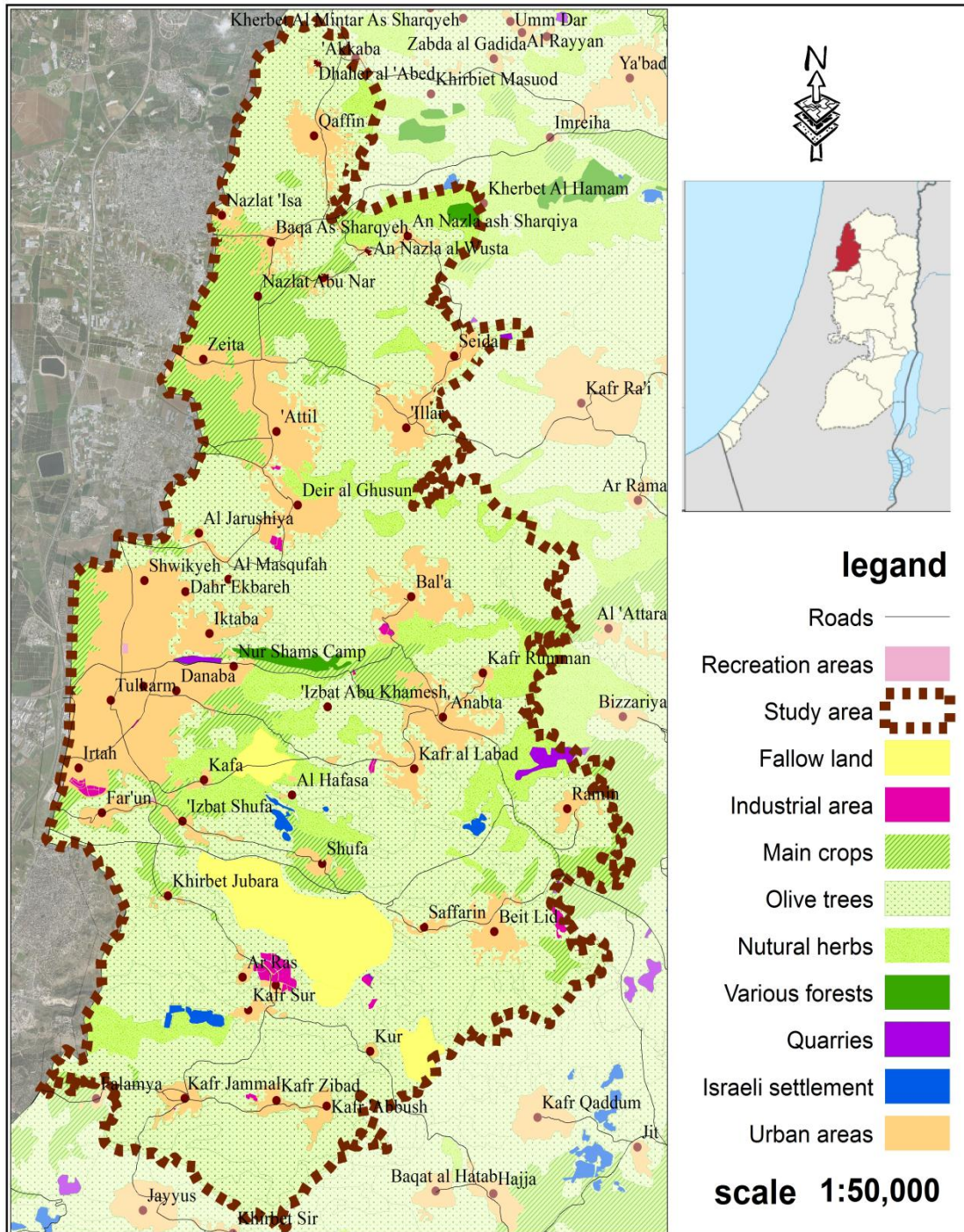
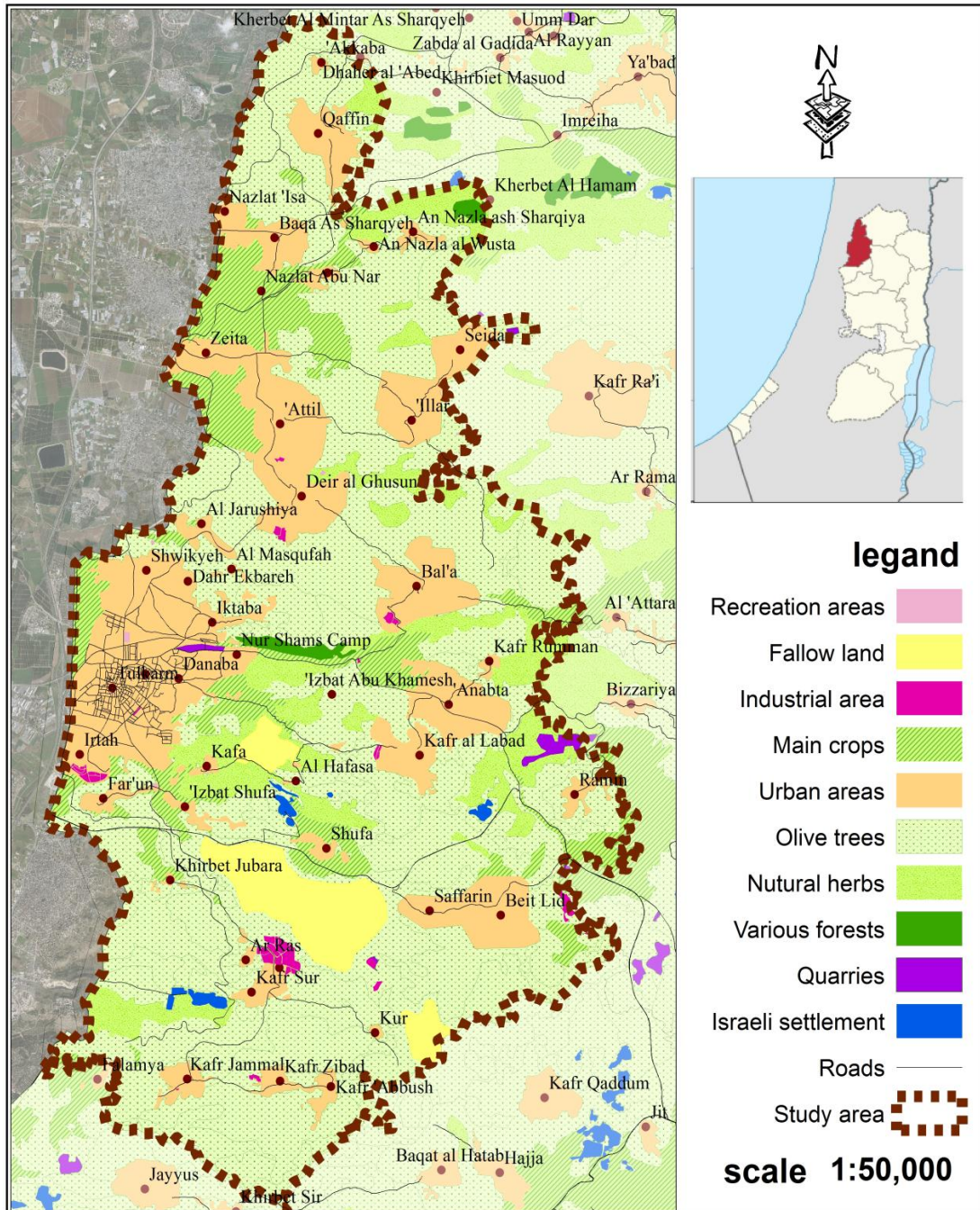


Figure (4.3): Conceptual Model of Carrying Capacity Factors to Assess the Development in the Governorate.



Map 8: Land use Classification 2005 for Tulkarm Governorate.

Source :Depending on Orthophoto 2005.



Map 9: Land use Classification 2016 for Tulkarm Governorate.

Source: Depending on Orthophoto 2016.

Table (4.2.2) Different Classifications of Land uses, Areas, Lengths and Trends.

Land use Classification		Area(km ²)		Change in Area(km ²) (2016 – 2005)			Trend of Change for Study Period
		2005	2016				
1. Urban Areas		42.619	54.749	12.131			↑
2. Industrial Areas		1.030	1.280	0.25			↑
3. Natural Herbs		23.106	22.215	0.891			↓
4. Olives Trees		140.8032	131.7445	9.0587			↓
5. Main Crops		25.331	23.858	1.473			↓
6. Various forests		1.115	1.115	0			↔
7. Recreational Areas		0.045	0.075	0.031			↑
8. Quarries		0.808	0.808	0			↔
9. Israeli Settlements		0.694	0.855	0.161			↑
10. Fallow land		10.45	9.453	0.997			↓
11. Roads		Lengths of Roads 2005(km)		lengths of Roads 2016 (km)			Trend of Change
	Regional	Main	Local	Regional	Main	Local	↑
	53.793	17.795	78.388	44.719	51.333	124.736	
		Total : 149.976		Total : 220.788			
		Change in lengths :70.812					

↑ : Increase development

↓ : Decrease development

↔ : Stable developmen

4.3 Summary

In this chapter, the researcher explained how to build a spatial database of all of the framework components for land use classifications, which were classified into eleven categories, as well as how to collect the data and its specifications from different ministries based on the corrected aerial images (Orthophoto2005 and 2016), whose type was JPG with the resolution of 75 cm for auditing and accuracy. Then the digitizing process was used for the areas not covered by Orthophoto. As a result, land uses during the study period were classified as follows: Urban areas, Industrial zones, Agricultural areas, Various forests, Olive trees, Basic crops, Natural herbs, Fallow land, Recreational areas, Quarries, Israeli settlements and Roads. Then a number of factors have been chosen to construct a framework of urban carrying capacity system that determines and evaluates the development in the governorate, which is intended in this study, as an increase in population density and allocated spaces for land uses for the total area of the governorate. These factors will contribute to describing the current state of resources to facilitate their management, which helps in the process of analysis and evaluation and comparison, to achieve the goals of the sustainable development. This is presented in the fifth chapter of the study, which analyzes the urban carrying capacity factors of population density and built-up areas of the population in Tulkarm governorate, which includes four main localities. It also compares the changes in the population density among these localities during the study period, analyzes and evaluates the different land use classifications and the changes that

occurred during the period of study. In addition, an analysis is made about the roads and the changes in their total lengths during the study and the potential development trends of the governorate based on previous data.

Chatter Five

Analyzing The Factors of Urbn Carrying Capacity System

5. Analysis of Urban Carrying Capacity Factors

The data in the Table (4.2.2) shows an increase in the allocated spaces for urban areas, and a shortage in the Agricultural areas in the period of study (2005-2016) as shown in Figure(5).

Therefore, a number of factors have been chosen to construct a framework that defines and evaluates the development in the governorate, which is intended for this study, as an increase in population density and allocated spaces for land use of the total area of Governorate, these factors contribute to describing the current state of resources to facilitate their management, which helps in assessment, analysis and comparison to achieve development objectives.

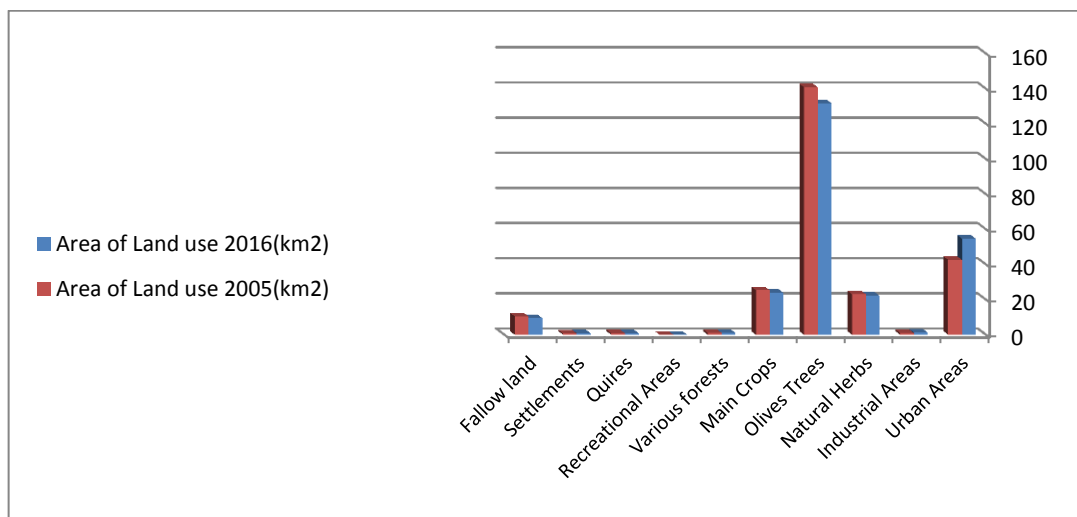


Figure (5) : Area of Land use Classifications in Square kilometers for the Period of study

Source: Prepared based on the data analysis.

5.1 Population Growth and Population Density

The population growth rate is an indicator of the increase in population over a specific period of time , so the population growth rate(r) between the times(t_1) and (t_2), and the population during(P_1)and (P_2), which is calculated as an exponential growth rate , is expressed by :

$$r = 100 \text{ Ln } (P_2 / P_1) / (t_2 - t_1)$$

According to the results of the census 2007, the population of the governorate grew to 156,792 with a growth rate of about 2.0%, while the population of the city reached about 50,912 with a larger contribution (32.5%). In the period of study **2005**, the number of population was 150,227 with a growth rate 2.0% (Palestinian Central Bureau of Statistics, General Population and Housing Census 2007, Tulkarem Governorate, 2009).

In addition, the number of population of Tulkarm governorate in the period of study **2016** was estimated to be 185,314 people, constituting 6.4% of the total population of the West Bank. That is, during the 2005-2016 of study period, the population growth rate increased by about 2%. (Palestinian Central Bureau of Statistics, Book of the Northern Governorates of the West Bank, Statistical 2013, 2014)

The Population density in **2005** as shown in the previous table(5.1) was estimated to be **611** inhabitant / km² and the population density in the mid of 2009 in the governorate was 661 inhabitant / km² ,while the population

density increased in **2016** to **753** inhabitant\km² ,and the increase in population density was estimated between **2005-2016**to be **124** inhabitant\km² as explained in the table (5.1)below.

Table(5.1) Change in the Population Density in Tulkarm Governorate.

Period of Study	Number of Population(inhabitant)	Area (km²)	Population Density inhabitant / km²	Change in Population Density inhabitant / km²
2005	150,227	246	611	124
2016	185,314	246	753	

5.1.1 Change in the Population of the Localities in the Governorate during 2005-2016.

The locality is a populated area with official administrative authority, or it is an area of land that is permanently populated and separated geographically from any adjacent community; it is traditionally recognized, and has no independent administrative authority (SSaedi, 2000).

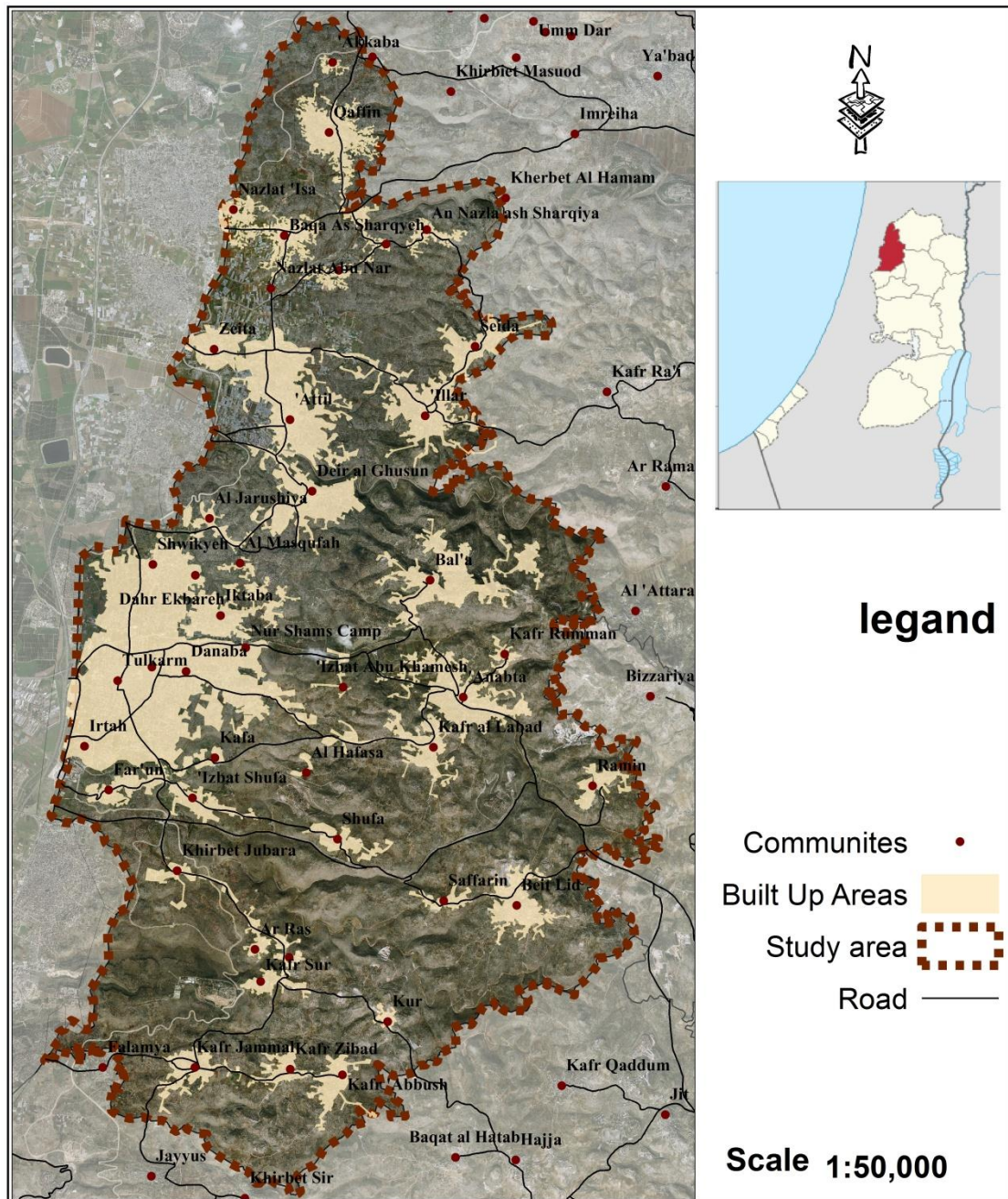
The localities in the governorate is divided into three categories: urban, rural, and camp. The urban center is the main city of the governorate. Geographically, it is any gathering with a population of 10000 people or more, and all the centers of the governorate regardless of size, and all communities with a population of between 4000 to 9999 people, on condition that these communities should contain at least four elements of the following basic elements: (public electricity network, public water network, post office, full-time health center for a doctor throughout the week, and a secondary school with a general secondary certificate).The

second category is the rural, which is defined as each group with a population of 4000-9999 without the four elements, and the camp is all localities supervised by UNRWA (Palestinian Central Bureau of Statistics, General Population and Housing Census 2007, Tulkar Governorate, 2009) .

In this study, the researcher did not limit the population communities and the consumed buildings from the land to the residential communities only, but the researcher also examined the built-up area as a whole, including the residential use, a commercial use, public facilities, industrial use, , and the Israeli settlements that take up space from the Governorate. The following table(5.1.1) and map (10) show the population of localities in the Governorate which includes 37 localities:

Table (5.1.1) Names of Localities in Tulkarm Governorate.

Saffarin	Kafr al Labad	An Nazla al Wusta	Zeita	Khirbet Jubara
Qaffin	KafrJammal	Iktaba	Al Haffasi	ArRas
Tulkarm	Beit Lid	Tulkarm Camp	Bal'a	Kafr 'Abbush
Ramin	Kur	Al Jarushiya	'Akkaba	'Anabta
'IzbatShufa	Far'un	KafrZibad	'Illar	Nazlat 'Isa
Nur Shams Camp	Shufa	Kafr Sur	Deir al Ghusun	An Nazla ash Sharqiya
Kafa	An Nazla al Gharbiya	An Nazla al Wusta	Attil	Seida
			Al Masqufah	Baqal al Sharqyeh



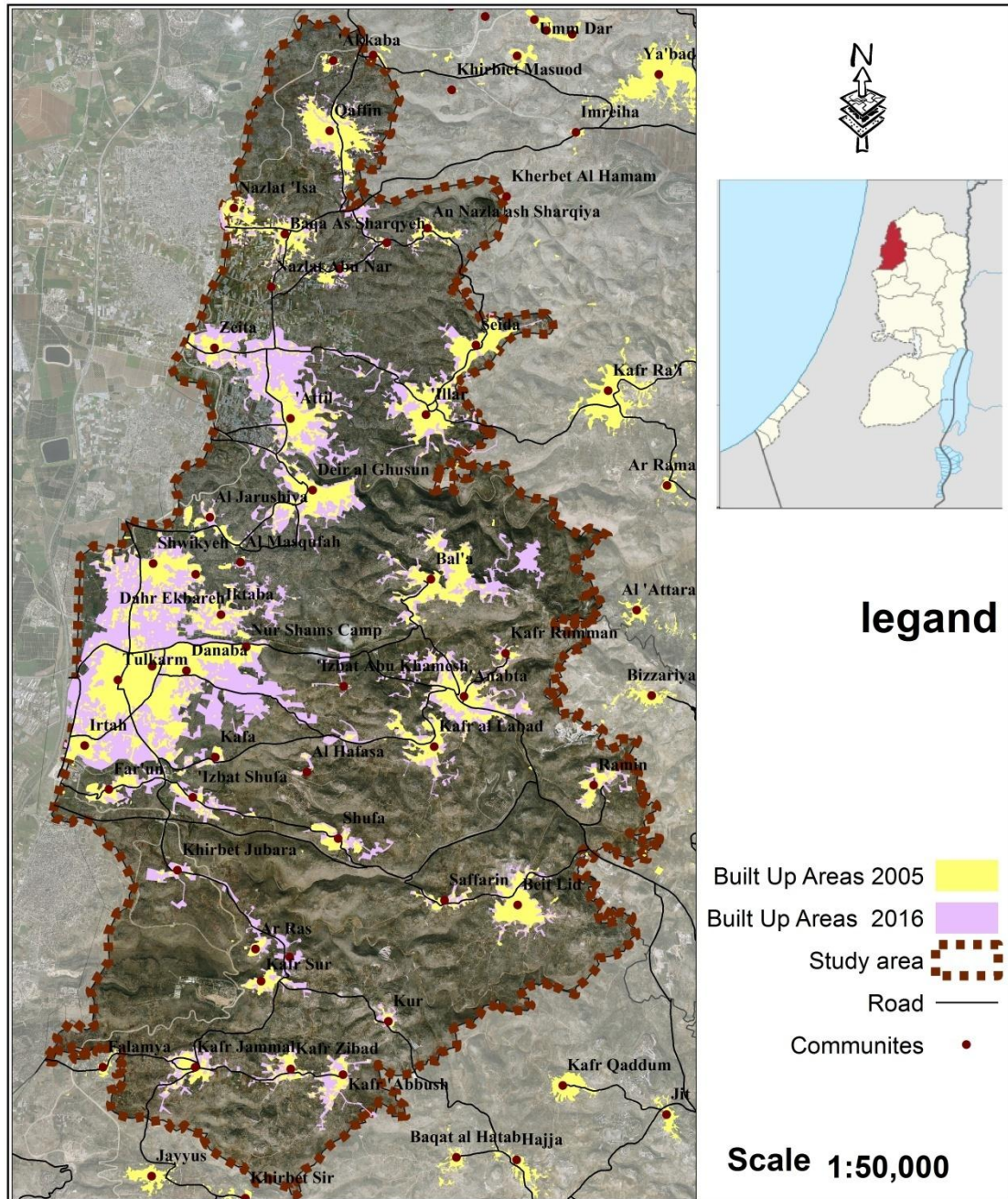
Map 10:The Sites of Localities in Tulkarm Governorate

Source:(An-Najah National University,Urban and Regional Planning Unit, 2017)

The table(5.1.2) below shows the population of the localities in Tulkarm governorate, which contains 37 localities for the two years 2005 and 2016, and the change in the built up area for the two years, and (Map 11) shows the built-up areas of the governorate during 2005-2016 .

Table (5.1.2) Population and the Change in Built up Area in Tulkarm Governorate at 2005 and 2016.

Locality	Population by locality (inhabitant) in 2005	Built up Area at 2005\km ²	population by locality (inhabitant) in 2016	Built up Area at 2016\km ²	Change in Built up Areas during 2005-2016\km ²
Saffarin	760	0.277047	891	0.331408	0.054361
Qaffin	8387	1.698927	9838	1.740559	0.041632
Tulkarm	15300	3.409187	60173	6.917498	3.508311
Ramin	1806	0.460641	2188	0.548788	0.08814
'IzbatShufa	1000	0.530411	1500	0.711649	0.181238
Nur Shams Camp	6479	0.456432	7600	0.503738	0.047306
Kafa	404	0.232221	474	0.264255	0.032034
Kafr al Labad	4074	0.732106	4779	1.301191	0.569085
KafrJammal	2424	0.585152	2843	0.885124	0.299972
Beit Lid	4994	0.998845	5858	1.333954	0.335109
Kur	262	0.2064311	307	0.2067931	0.000362
Far'un	3100	0.495132	3636	0.826159	.331027
Shufa	1194	0.343079	1073	0.634691	0.291612
An Nazla al	937	0.367906	1099	0.371736	0.00383
An Nazla al	340	0.090435	399	0.316207	0.225772
Iktaba	2665	0.657233	3126	1.544976	0.887743
Tulkarm Camp	10641	0.181036	12482	0.189649	0.0085454
Al Jarushiya	932	0.746057	1093	0.870467	0.12441
KafrZibad	1078	0.694278	1264	0.728432	0.034154
Kafr Sur	1117	0.418123	1.310	0.430586	0.012463
Zeita	2852	0.8014673	3.345	0.990915	0.189448
Al Haffasi	157	0.042221	184	0.105513	0.063292
Bal'a	6604	1.229994	7746	2.455996	1.226002
'Akkaba	254	0.194366	298	0.292743	0.098377
'Illar	6190	1.469687	7.261	2.35685	0.887163
KhirbeJubara	293	0.173529	344	0.246754	0.073225
ArRas	540	0.214933	633	0.274538	0.059605
Kafr 'Abbush	1457	0.290005	1709	0.781478	0.491473
'Anabta	7329	1.758880	8597	2.831412	1.072532
Nazlat 'Isa	2334	0.318875	2738	0.554514	0.235639
An Nazla ash	1514	0.297578	1776	0.353651	0.056073
Seida	2929	0.918389	3436	0.996349	0.07796
Deir al Ghusun	8242	1.822801	9668	2.358167	0.535366
Attil	9038	2.246424	10601	4.301876	2.055452
Al Masqufah	260	0.109849	305	0.121907	0.012058
Baqa al Sharqyeh	4101	1.583818	4810	1.809229	0.226949



Map 11: Built-up areas of Tulkarm Governorate during 2005-2016.

Source: Depending on Orthophotos 2005 and 2016.

Table (5.1.2) shows that the most significant change in the built area during the period of study is the city of Tulkarm, which is 3,083,311 km². This is the largest change and increase in the governorate as a whole in terms of the built up area, which includes the population localities. The city center is characterized by a number of specifications and standards that assist the urban development, economy, entertainment and tourism development. It is the link between rural areas ,and plays a complementary role in the commercial market. It is the retail market for people who do not find their needs in the village. The rural-urban population is characterized by a vital relationship: permanent migration from the rural to the city, and the daily movement between work and housing. These factors attract the rural population to live in the city and this results in the population growth in the city.

In terms of expansion in the built-up area, Anabta occupies the second place due to the location of this area and its proximity to the city. The commercial, economic and social activity in the region helped to speed up its urban development compared with other areas within the governorate, regardless of whether the use of these lands conforms to the national spatial plan.

Shaarawya , which is considered the largest of the localities ,comes in the third place. It is located in the north of the governorate. It is connected with the city and provides various services to the region as one administrative unit. Figures (5.1.1.1) and (5.1.1.2.) explained the change in the built up

areas for Al-Sharawya localities during 2005-2016, which show the expansion of the built-up area within this area was somewhat similar. The largest change of expansion is Atil, Illar and Deir al Ghusun; the smallest expansion was in Al-Masqufah and al Nazla al Wusta, due to its small area, small number of population and the limited activities.

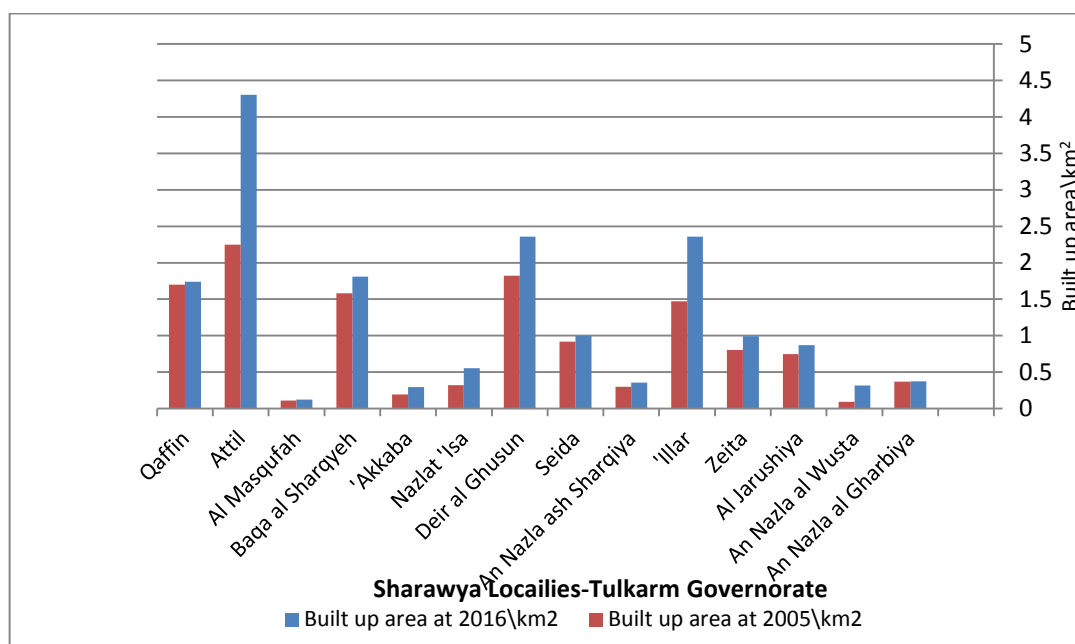


Figure (5.1.1.1): Built up area for Shaarawya localities during 2005-2016 Source: Depending on data analysis.

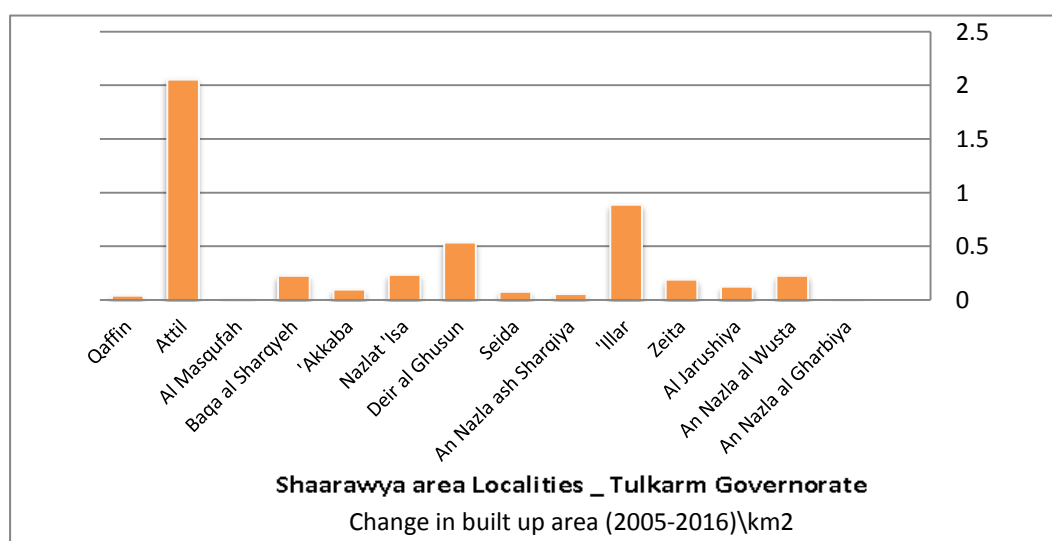


Figure (5.1.1.2) : Change in built up area for Shaarawya localities and changes obtained during 2005-2016. Source: Depending on data analysis.

The locality of Wadi Al-Shaer Valley, which also varies in the amount of change in the built-up area, includes 7 localities :Saffarin, Beit Lid, Bal'a, Ramin, 'Anabta, Kafr al Labad ,as explained in the Figures (5.1.1.3) and (5.1.1.4).

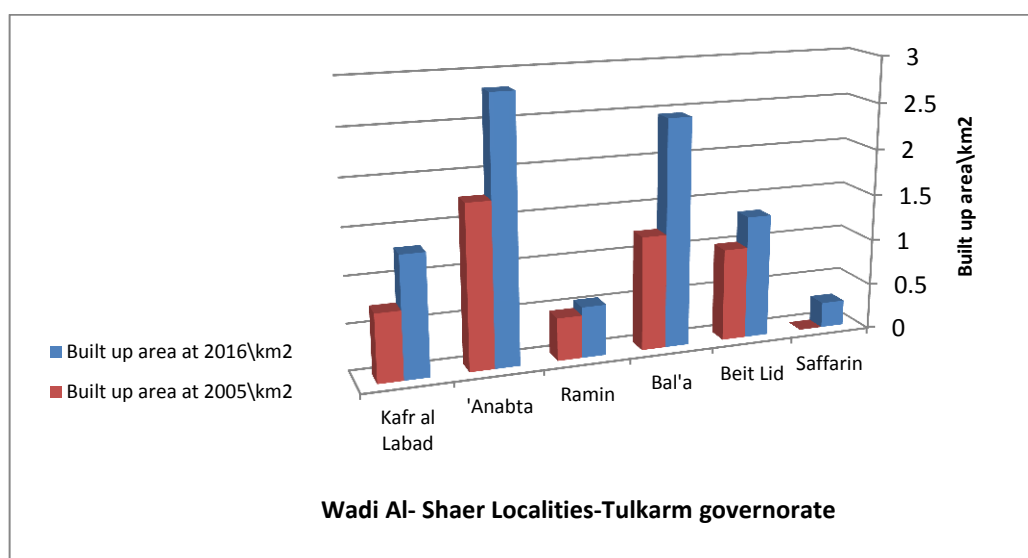


Figure (5.1.1.3): Built up area for Wadi Al-Shaer Valley localities during 2005-2016\km²

Source: Depending on data analysis

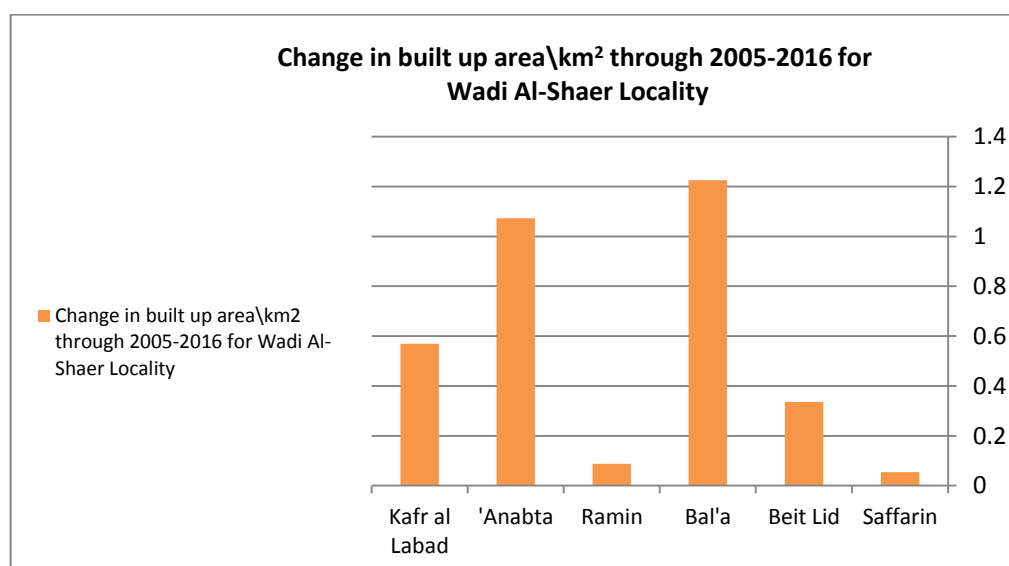


Figure (5.1.1.4) :Change in built up area for localities of Wadi Al-Shaer Valley during 2005-2016\km². Source: Depending on data analysis.

Al-Saibat locality which includes four localities: (Al Haffasi, Izbet Shoufa, Kaffa and Shoufa), where Al Haffasi is seen with the least expansion in the built-up area, due to the presence of settlements. Figures (5.1.1.5) and (5.1.1.6) below explain the change in built up area in Al-Saibat localities during 2005-2016.

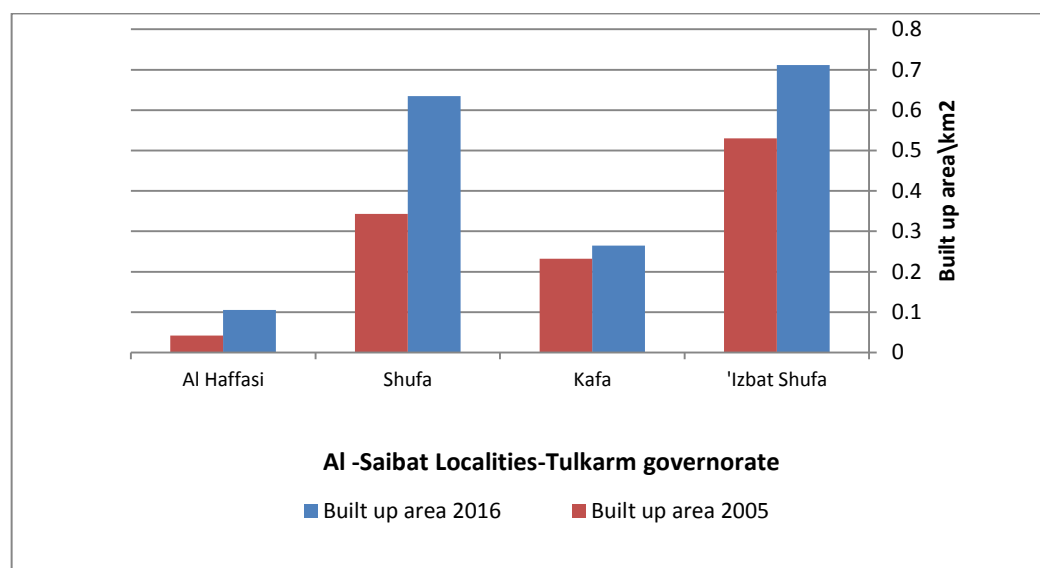


Figure (5.1.1.5): Built up area for Al-Saibat localities during 2005-2016\km²

Source: Depending on data analysis.

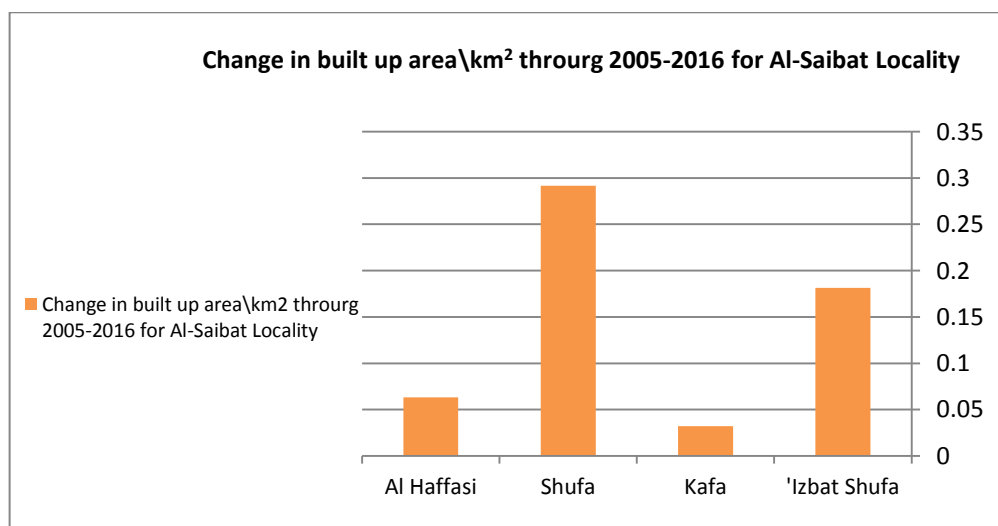


Figure (5.1.1.6): Change in built up area for localities of Al-Saibat during 2005-2016\km².

Source: Depending on data analysis

The last one of the population localities in the governorate is Al-Kafriat locality, which is located in the south of the governorate and includes six localities: (Kafrsur, KafrAbush, Kafr Gamal, Kafr Zeibad, Kor, and Al-Ras). The expansion in the built up area of these localities is small, but (Kafr Zeibad, Kafr Jamal, KafrAbush) had a greater expansion in built up area compared to the neighboring areas. This small expansion is attributed to the presence of the Israeli settlement "Salait" near this locality as this settlement took up part of the land of this locality and put a set of obstacles that prevent the construction , development and urban expansion. Figures (5.1.1.7) and (5.1.1.8) showed the change in built up area\km² for Al- Kafriat locality during 2005 -2016 .

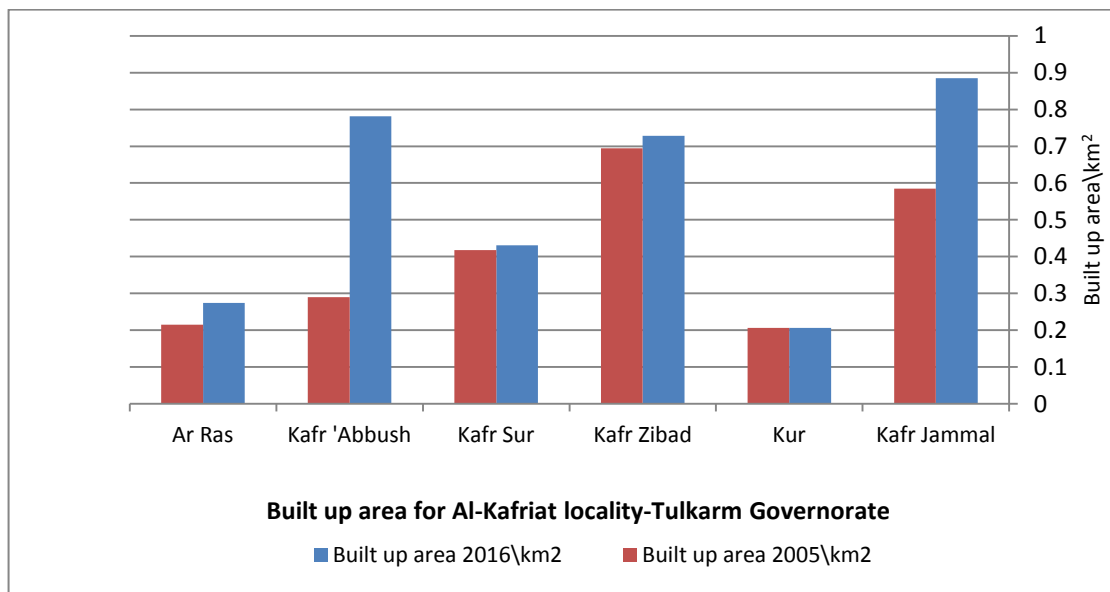


Figure (5.1.1.7): Built up area for Al-Kafriat localities during 2005-2016\km²

Source: Depending on data analysis

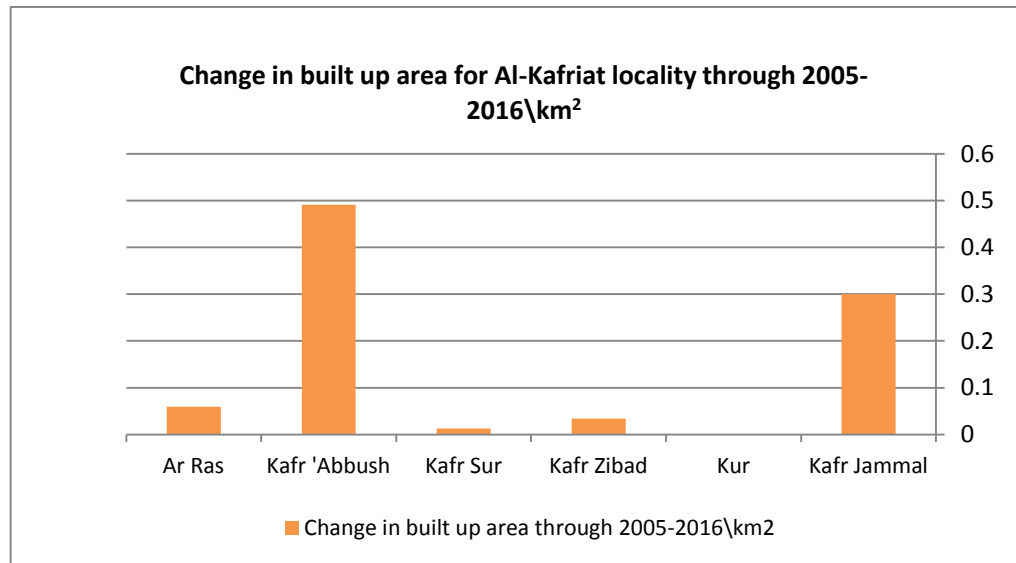


Figure (5.1.1.8): Change in Built up area for Al-Kafriat localities during 2005- 2016\km²

Source: Depending on data analysis.

The researcher also calculated the change in the population density (inhabitant\km²) for the mentioned localities in the governorate during the period 2005-2016, as explained in the table (5.1.3). In addition, the list of charts diagnose and analyze the state of population density and the change in population density during 2005 -2016 of the above-mentioned localities in Tulkarm governorate (Shaarawya, Wadi Al-Shaer, Al-Saaibat, Kafriyat). These showed the variations in the population density of the four localities and the negative values of the change in the population density during the years 2005 and 2016, depending on the change in the built-up area of the localities and the variation in the population' proportion to the area therefore, this disparity in the area and population density of the communities in the governorate is a continuous pressure on the distribution and classification of land uses in the

governorate, especially in the use of land for urban expansion and the establishment of new residential areas, as shown in the figures below:

Table (5.1.3) The Change in Population Density(inhabitant / km²) for built up areas in Tulkarm Governorate through 2005 – 2016.

Locality	Population Density inhabitant / km ² at 2005	Population Density inhabitant / km ² at 2016	The Change in Population Density inhabitant / km ² through 2005-2016
Saffarin	2.543213	2.68885	0.145637
Qaffin	4.936645	5.652207	0.715562
Tulkarm	4.478135	8.698665	4.22053
Ramin	3.926321	3.977856	0.051535
'IzbatShufa	1.885329	2.107781	0.222452
Nur Shams Camp	14.193915	15.087208	0.893293
Kafa	1.739722	2.320628	0.580906
Kafr al Labad	5.56476	5.399243	-0.165517
KafrJammal	4.142513	3.211992	-0.930521
Beit Lid	4.99977	4.391485	-0.608285
Kur	0.0540849	1.4845756	0.773677
Far'un	6.260949	4.401089	-1.85986
Shufa	3.48024	1.690584	-1.789656
An Nazla al Gharbiya	2.546862	2.959391	0.412529
An Nazla al Wusta	3.7596	1.268316	-2.491284
Iktaba	4.05487	2.023341	-2.031529
Tulkarm Camp	58.778364	65.833333	47.519503
Al Jarushiya	1.249232	2.32322	1.073988
KafrZibad	1.552692	1.735311	0.182619
Kafr Sur	2.671462	3.042365	0.370903
Zeita	3.560549	3.37566	-0.184889
Al Haffasi	3.7185286	1.743860	-1.974669
Bal'a	5.3691318	3.1539139	--2.21521798
'Akkaba	0.0013068	1.0179577	1.016651
'Illar	4.211782	3.080807	-1.130975
Khirbet Jubara	1.688478	1.754781	0.066303
ArRas	2.512411	2.305758	-0.206653
Kafr 'Abbush	5.024051	2.187101	-2.83695
'Anabta	4.16685618	3.03629425	-1.13056193
Nazlat 'Isa	7.319482	4.937692	-2.38179
An Nazla ash Sharqiya	5.087741	5.021901	-0.06584
Seida	3.189281	3.448621	0.25934
Deir al Ghusun	6.946733	4.099911	-2.846822
Attil	4.023283	2.464327	-1.558956
Al Masqufah	2.366885	2.502051	0.135166
Baqa al Sharqyeh	2.589312	2.658591	0.069279

From the previous table(5.1.3), a list of figures that diagnose and analyze the state of population density and the change in the population density during 2005 -2016 of localities in Tulkarm governorate (Shaarawya, Wadi Al-Shaer, Al-Saaibat, Kafriyat) were drawn. They show the variations in the population density of the four localities and some of the negative values of the change in the population density during the years 2005 and 2016, depending on the change in the built-up area of the localities and the variation in the population' proportion to the area as shown in the charts below.

Nizlet Issa and Deir Ghosun of Al- Shaarawya locality received the highest population density compared with the other neighboring areas within the same locality, due to the small built up area and the increase in the population in these localities, whereas Al-Jarushiya and Al-Nazala Al-Wosta were the lowest in the population density in Al-Shaarawya locality due to the decrease in population compared to the built-up area.

It is worth mentioning that the negative values in the population density refer to the difference in the density between 2005 and 2016, where the population density in 2005 was more than in 2016 due to the lack of the built up area compared with the increase in the population during this period, as shown in the Figures(5.1.2.1)and (5.1.2.2) :

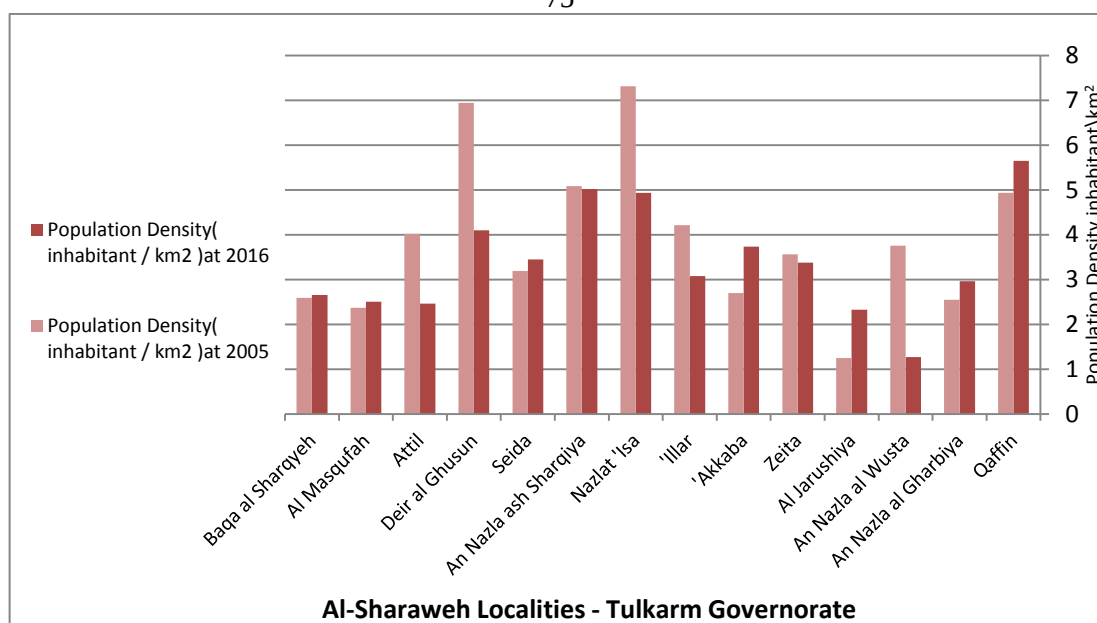


Figure (5.1.2.1):Population Density for Al-Shaarawya locality of Tulkarm Governorate during 2005-2016. Source: Depending on data analysis.

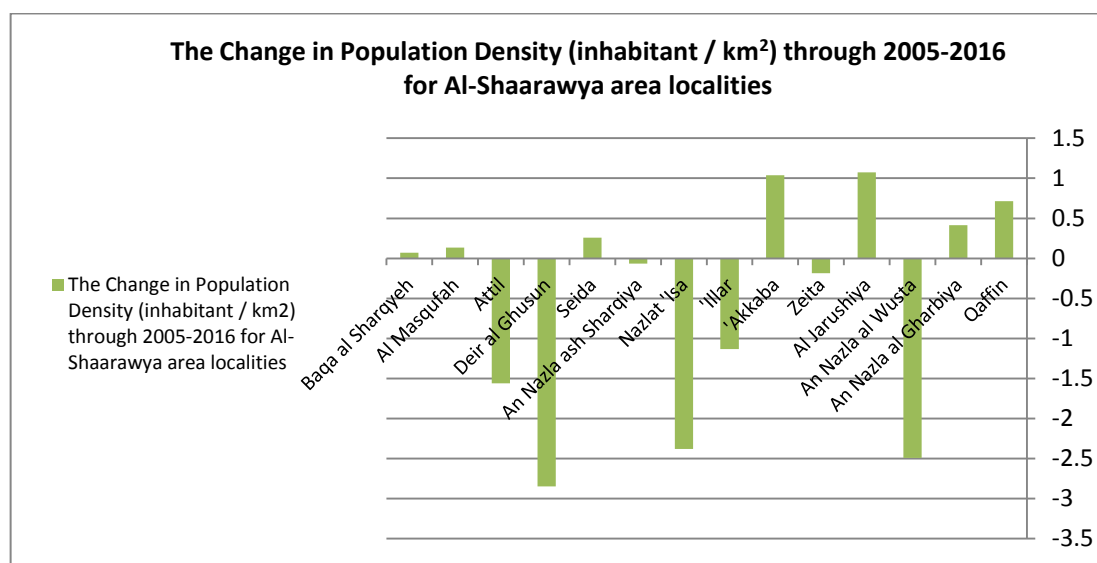


Figure (5.1.2.2):Change in Population Density for Al-Shaarawya locality of Tulkarm Governorate during 2005-2016. Source: Depending on data analysis.

In Wadi Al-Sha'er locality, the population density of the locality was fairly close. Kafra Labad and Bal'a recorded the highest population density, while Saffarin had the less population density. The figures (5.1.2.3), (5.1.2.4) showed that the population density in Wadi Al-Shaer in 2005 was higher than in 2016, due to the increase in the built-up area in 2016 than in 2005, which was reflected on the change of population density during this period.

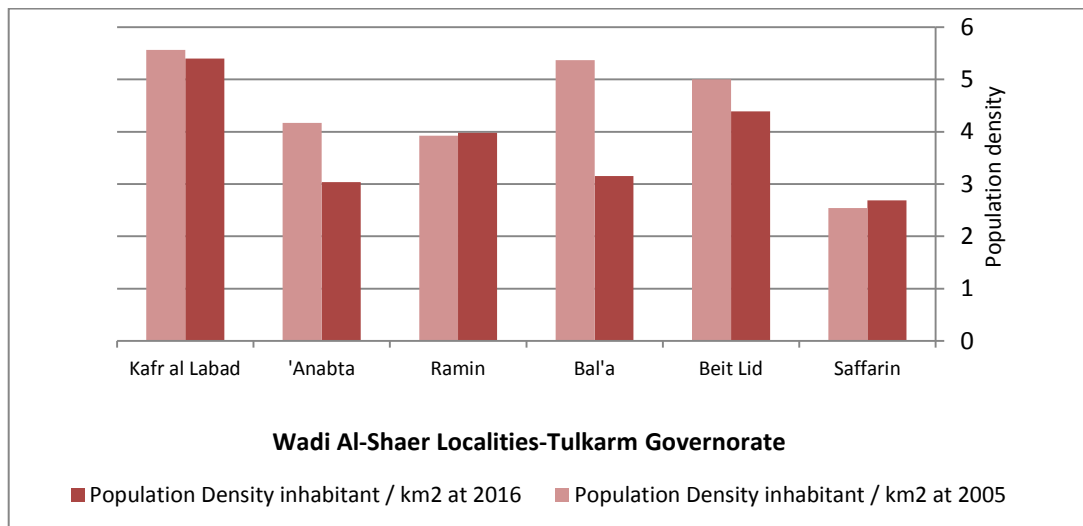


Figure (5.1.2.3) :Population Density for Wadi Al-Shaer locality of Tulkarm Governorate through 2005-2016. Source: Depending on data analysis.

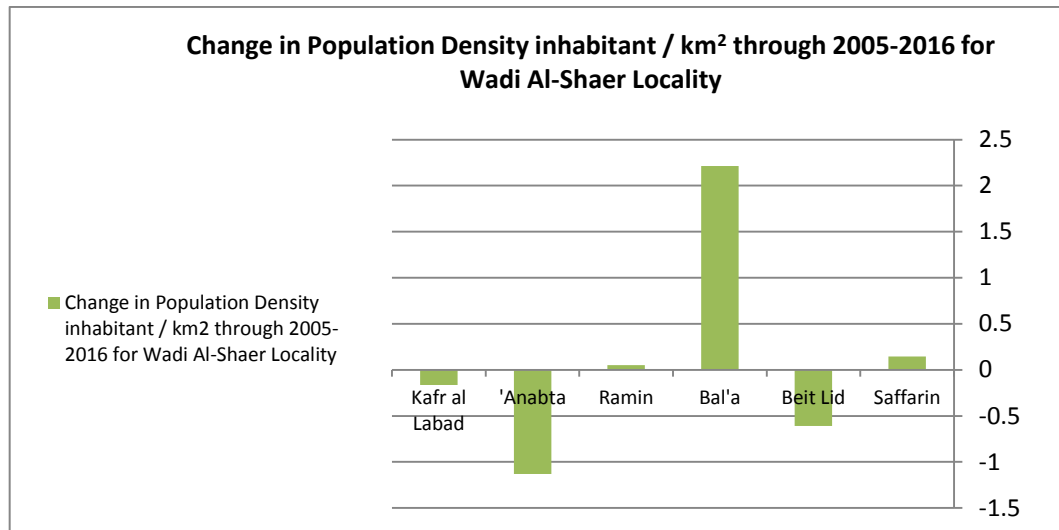


Figure (5.1.2.4): Change in Population Density for Wadi Al-Shaer locality of Tulkarm Governorate during 2005-2016. Source: Depending on data analysis.

Figure (5.1.2.5) for Al-Saibat locality shows that Al-Haffasi and Shufa, recorded the highest population density in the locality and population density in 2005 was significantly higher than in 2016, due to the presence of Israeli settlement "Avni Hefetz" near its lands and has taken control over parts of their lands of these communities, and put obstacles to prevent expansion of built-up area. While the population density in Izbet Shufa in 2016 is relatively high compared to 2005 despite the increase in its built up area, this due to the high increase in inhabitants for the year 2016 and the migration of some of the population from neighboring communities to it.

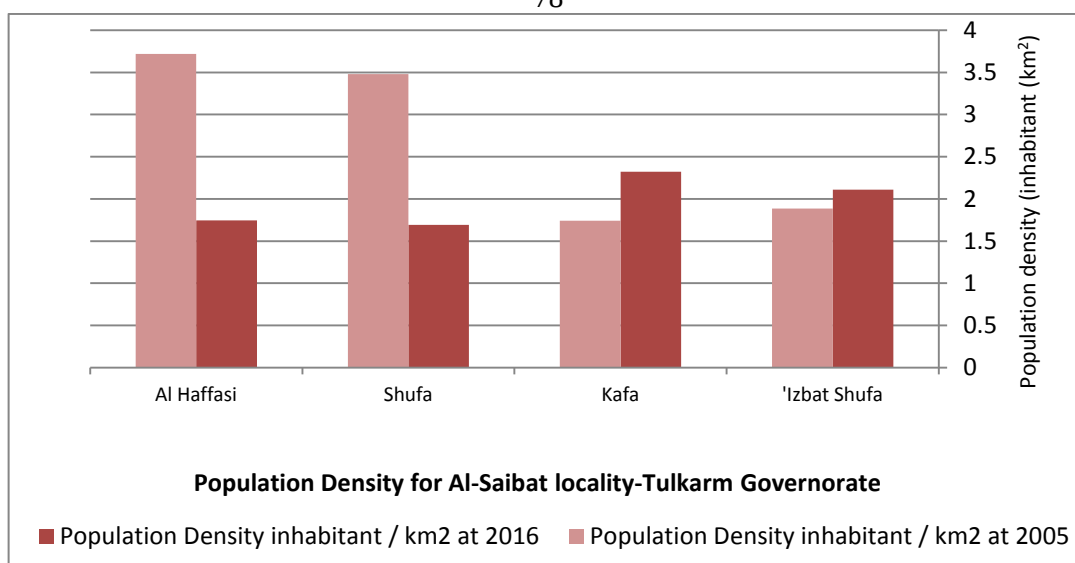


Figure (5.1.2.5): Population Density Al-Saibat locality of Tulkarm Governorate during 2005-2016. Source: Depending on data analysis.

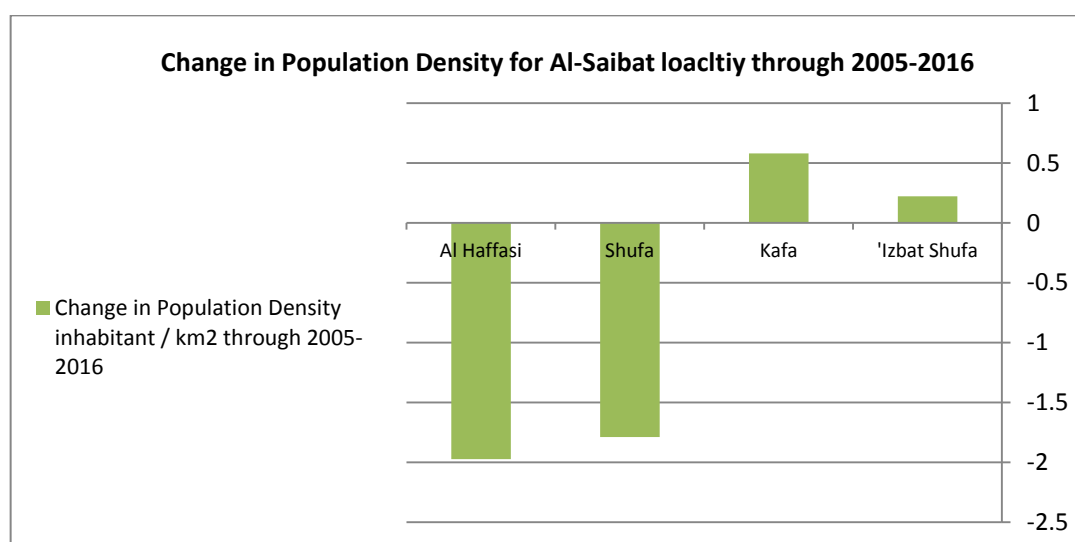


Figure (5.1.2.6): Change in Population Density for Al-Saibat locality of Tulkarm Governorate during 2005-2016. Source: Depending on data analysis.

In Al-Kafriat locality, Kafr Abbush and Kufr Jammal had the highest population density during the period, where the population density in 2005 was high compared to 2016 due to the lack of the built-up area in 2005 and increased in 2016, while Kur was the lowest in the population density in 2005, but increased in 2016 due to the increase in the number of population and thus the increase in human activities and the built up area.

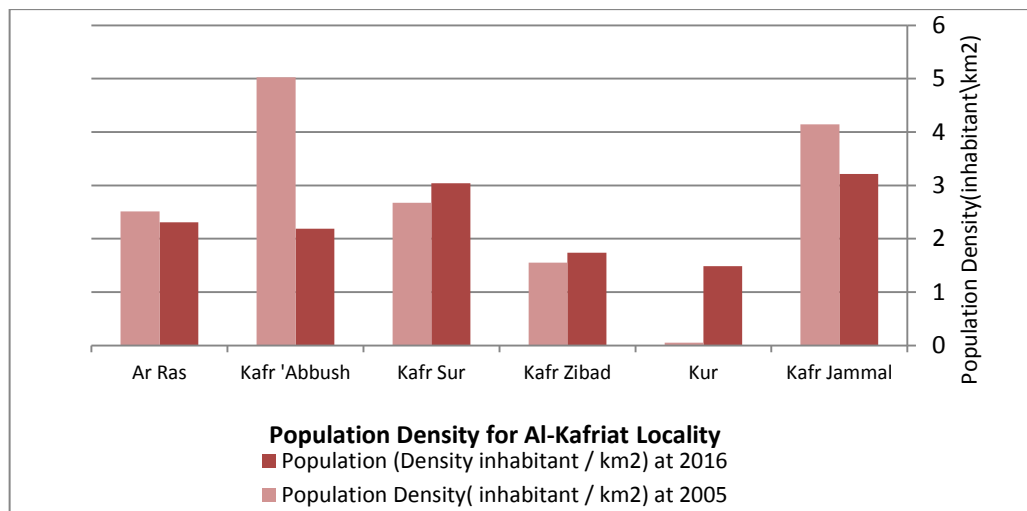
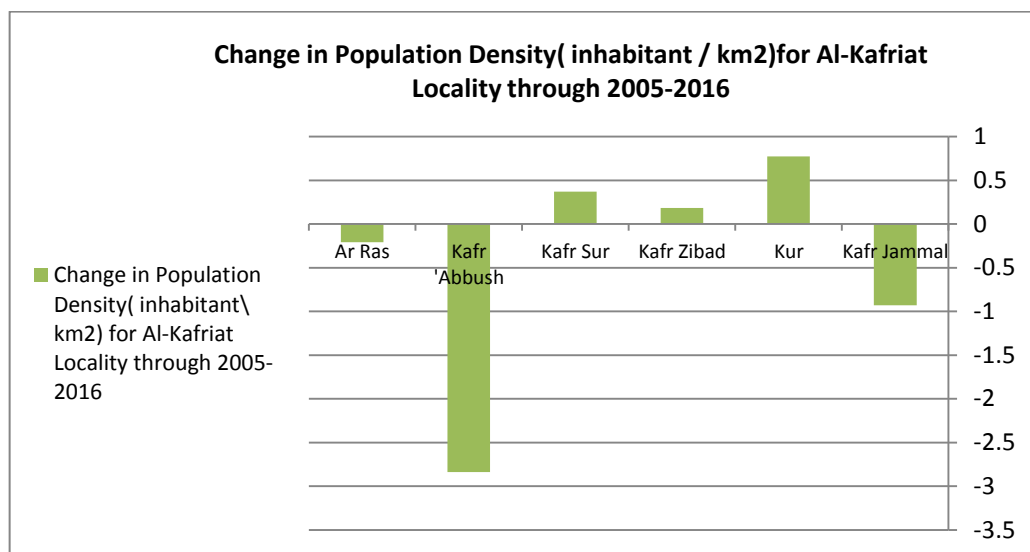


Figure (5.1.2.7):Population Density for Al-Kafriat locality of Tulkarm Governorate during 2005-2016. Source: Depending on data analysis.



Figure(5.1.2.8):Change in Population Density for Al-Kafriat locality of Tulkarm Governorate during 2005-2016. Source: Depending on data analysis.

5.2 Land and Natural Resources

5.2.1 Urban Areas

Due to the increase in the population density in the Governorate ,it became necessary to establish new residential areas throughout the governorate. That is, the area of the urban areas was 42.619 Km² in 2005, which was equivalent to 17.3% of the total area of the governorate, while in 2016 the area was 54.749 Km², which was equivalent to 22.2% of the total area of the governorate as shown in table (5.2.1)

It is clear that there is a clear trend in increasing land use of urban areas during the study period, which expanded in 2016 at the expense of the agricultural areas in Tulkarm governorate.

Table (5.2.1):Change in the urban areas during the periods of study

Periods of study	Area km ²	% Urban areas of the total area of the Governorate	Total change km ²
2005	42.619	17.3 %	12.131
2016	54.759	22.2%	

5.2.2 Agricultural Areas

Due to the fertile soil and its suitability for agriculture , agricultural use is the most predominant in Tulkarm governorate and the main source of income for most of the population in the governorate. Table(5.2.2) shows the classifications of the agricultural uses in the governorate which are : Natural herbs, Olive trees, Main crops and Various forests.

The data indicate that there was a decrease in the agricultural lands area in Tulkarm governorate from 2005 to 2016. An important factor in the decline of the agricultural area is the urban sprwal as a result of the steady increase in population growth as shown in the table and figure(5.2.2):

Table (5.2.2): Change inthe area of Agricultural land uses during the study periods.

Agriculture land use classifications	Area of land use 2005 km ²	Area of land use 2016 km ²	%Agriculture land use of the total area of the Governorate 2005	%Agriculture land use of the total area of the Governorate 2016	Total Change km ²
Natural Herbs	23.106	22.215	9.4%	9.1%	- 0.891
Olives Trees	140.8032	131.7445	57.2 %	53.5%	- 9.0587
Main Crops	25.331	23.858	10.3%	9.7%	-1.473
Various Forest	1.115	1.115	0.5%	0.5%	0

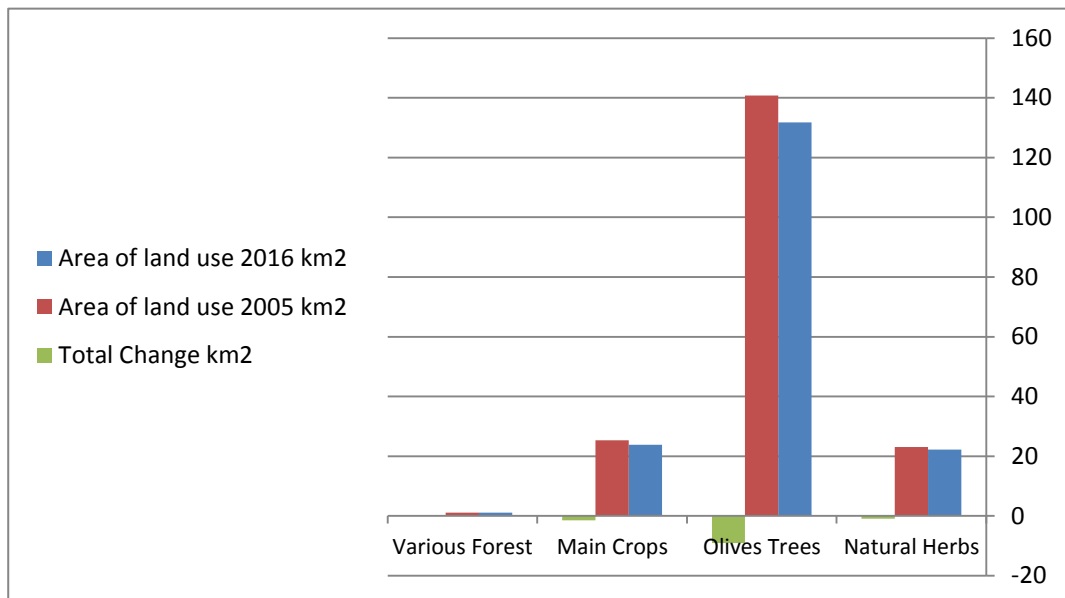
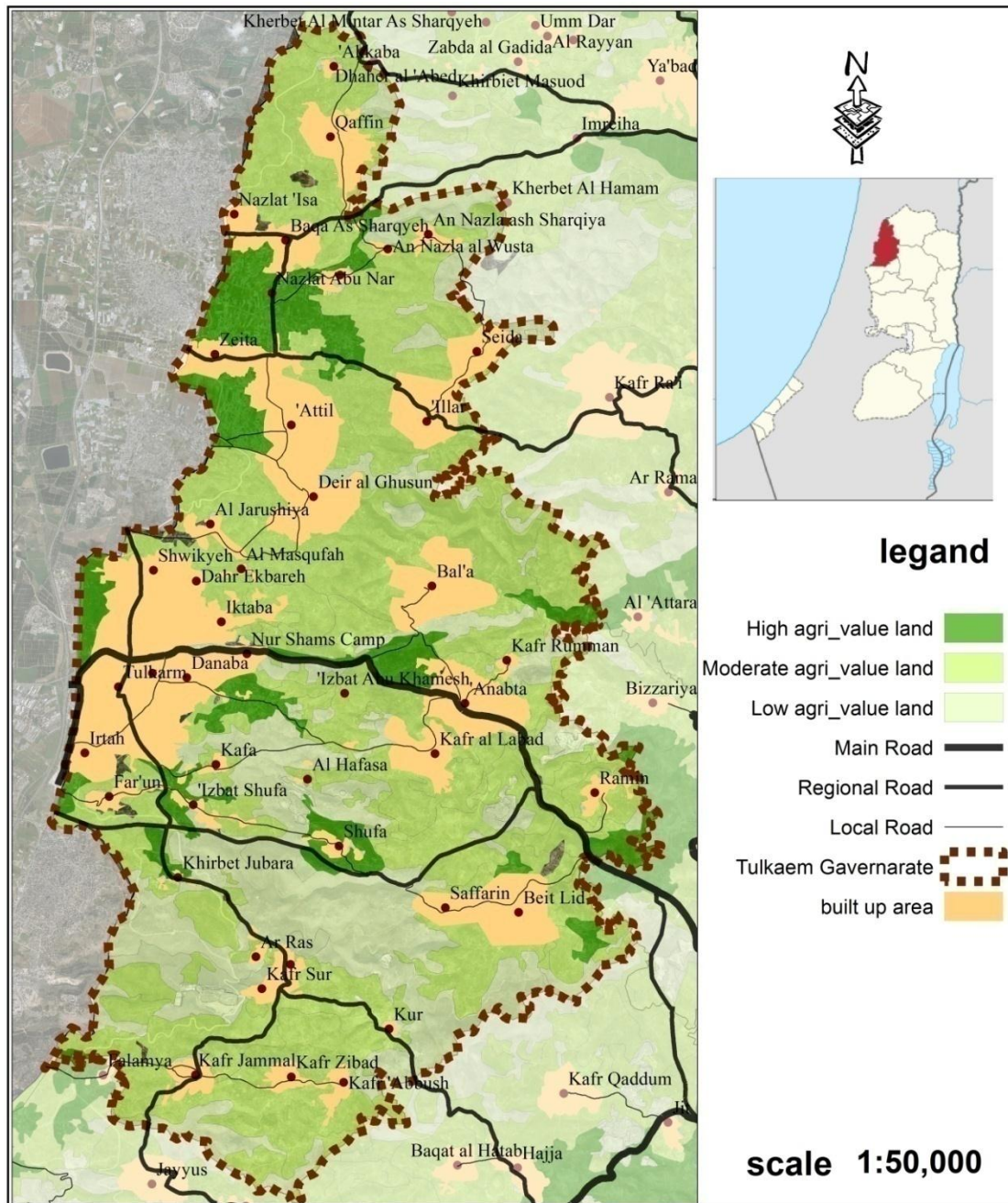


Figure (5.2.2): Change in Area of the Agricultural land use classifications during the Study Periods. Source : prepared by the researcher depend on the data analysis.

The data analysis in the table and figure (5.2.2) showed that there was a decrease in the use of natural herbs and main crops in different proportions, while the various forests did not change. However, the olives trees achieved the highest change in area among the agricultural uses. In 2005, the area of olives trees in the governorate was 140.8032 km² equivalent to 57.2% ,while in 2016 the area of Olives trees was 131.7445 km² equivalent to 53.5% .This decrease in the areas of land use is due to that the olives trees are the most cultivated crop in the governorate , and these lands are with medium or low agricultural value. This, in turn, allows urban expansion, while the natural herbs and main crops are cultivated with high agricultural value; therefore, there are challenges for the expansion there. Map (14) shows the classification of the agricultural land use in the Governorate according to the National Spatial Plan.



Map (12):Classification of Agricultural Land use in the Governorate according to the National Spatial Plan

Source : (An-Najah National University, Urban and Regional Planning Unit, 2017)

5.2.3 Industrial Areas

As for the industrial areas in Tulkarm governorate, the expansion in area was limited and within the master plans of the localities. It should be noted that there is a tendency to create industrial areas, especially in Al- Kafriyat and Irtah localities, as shown in table (5.2.3). In 2011, an agreement was signed to launch an industrial zone within the boundaries of the Tulkarm Municipality, Irtah. This project aimed to improve the economic situation in Tulkarm in particular and the national economy in general, signing the agreement of the industrial zone project in Tulkarm (www.wafa.ps).

For industrial uses in the Governorate, there are lands on which industrial compounds are constructed, as workshops of Blacksmiths, Marble scissors, Dairy Factories and Olive presses.

Table (5.2.3) indicates that the industrial areas in 2005 were 1.030 km², which was equivalent to 0.4%, and in 2016 the area was 1.280 equivalent to 0.5%. Thus, the change in the uses of the industrial areas during the study period was limited and the change was not noticeable; it was only 0.25 km². This indicates the absence of the planned industrial zones in Tulkarm governorate.

Table (5.2.3): Change in the Industrial areas during the study period.

Periods of study	Area km ²	% Industrial areas of the total area of the Governorate	Total change km ²
2005	1.030	0.4	0.25
2016	1.280	0.5	

As a result of the absence of a classification of industrial zones in the plans of Tulkarm region, most of these industries have spread within and between residential areas, resulting in environmental and health problems for these communities as well as the destruction and depletion of the fertile agricultural land and water contamination.

5.2.4 Recreational Areas

The table(5.2.4), shows that there is a clear change in the recreational areas in Tulkarm governorate, due to the development of the governorate in the field of tourism and its needs to develop tourist places within the governorate to attract tourists and support the economic respect in the governorate. For example, some small recreational places have been set up to serve more local areas such as, I'llar Park, Beit Led Tourist Club Village and Rock Park in Bala.

According to the results of the table below, the allocated spaces of recreational areas have increased clearly with an area of 0.045 km² in 2005 to 0.075 Km² in 2016, so the change in the increased by 0.03 km².

These results indicate an increase in the recreational areas by 0.02% in 2005 , and 0.03% in 2016. This result demonstrates that the governorate interest in providing and allocating recreational areas in line with the population growth.

Table (5.2.4): Change in the Recreational areas during the study period

Periods of Study	Area km ²	% the Recretional areas to the total area of the Governorate	Total Change km ²
2005	0.045	0.02%	0.03
2016	0.075	0.03%	

5.2.5 Quarries Areas

A quarry is a place from which stone, rock, construction aggregate, riprap, sand, gravel, or slate has been excavated from the ground. The quarry has played a major role in the Palestinian economy in terms of production, employment and export. However, in Tulkarm governorate, the quarry area has not changed as shown in Table (5.2.5), where the area of quarries in 2005 was equal to the area in 2016, which was about 0.808. It is worth mentioning that the increase in the quarries' areas to the total area of the governorate is zero. This is due to several reasons: the policy of the siege on the Palestinian economy by the occupation, the imposition of Israeli licensing restrictions, and the confiscation of land in the first place, then comes the huge capital required for the establishment and investment in quarries. In addition, restrictions have been placed on the

expansion of quarries due to their environmental hazards on human, plants and air. Therefore, quarries were constructed in two regions: Kur in the south of the governorate and Ramin in the east.

Table (5.2.5):Change in Quarries areas during study period

Periods of Study	Area km²	%The Quarries areas to the total area of the Governorate	Total Change km²
2005	0.808	0.0	0
2016	0.808	0.0	

5.2.6 Israeli Settlements Area

Changes in the Built up Area of the Israeli Settlements during 2005 -2016

The Israeli settlements in Palestine are as old as the Zionist movement, which was established in the nineteenth century. The Israeli government used all means of force on the Palestinian residents to enforce them to leave their lands ,and clear the land of any Palestinian presence using all powers to achieve its objectives (Abu Saa, 2014).

With regard to the settlements established in Tulkarm governorate ,they are as follows (Asida, 2012):

- **Avni Hefetz Settlement** : established by the occupation authorities in 1987, and in 1990, it was turned into a permanent colony. It was built on

the land of the village of Shufah ,in the area of Al-Haffasi, 4 km away from Tulkarm city.

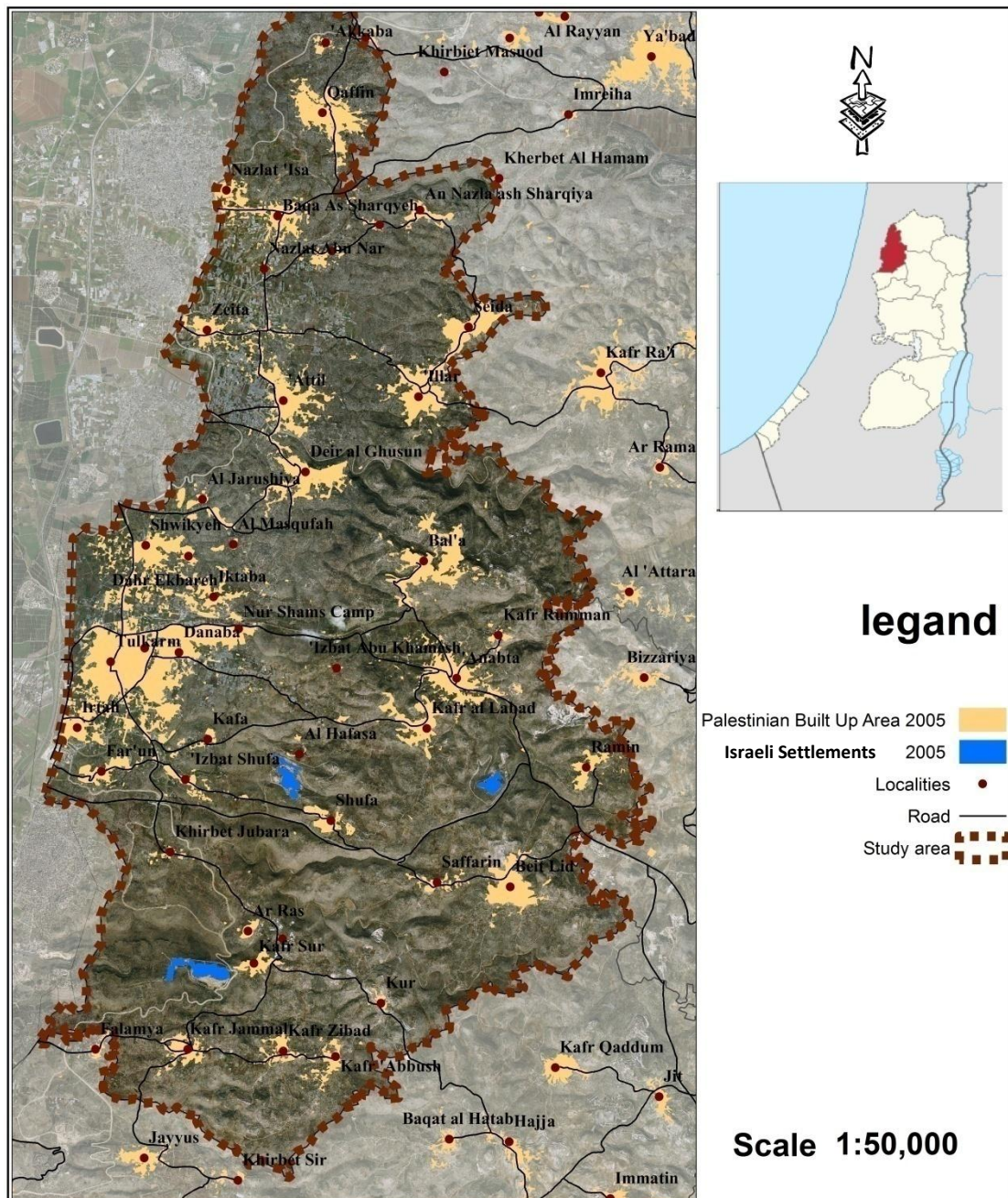
Its lands, 0.750 km^2 , were confiscated, and then linked to the colony of Einab , then to the colony of Shafi Shamronto be the link between the colonies in north of Nablus with the colonies in the lands of 1948 (Asida, 2012) .

The results of the study analysis using orthophotos 2005 and 2016 showed that there was an expansion of this settlement during the period (2005 – 2016) ,where the area in 2005 was 0.246 km^2 ,while in 2016 became 0.281 km^2 , so the amount of expansion of the area is 0.035 km^2 .

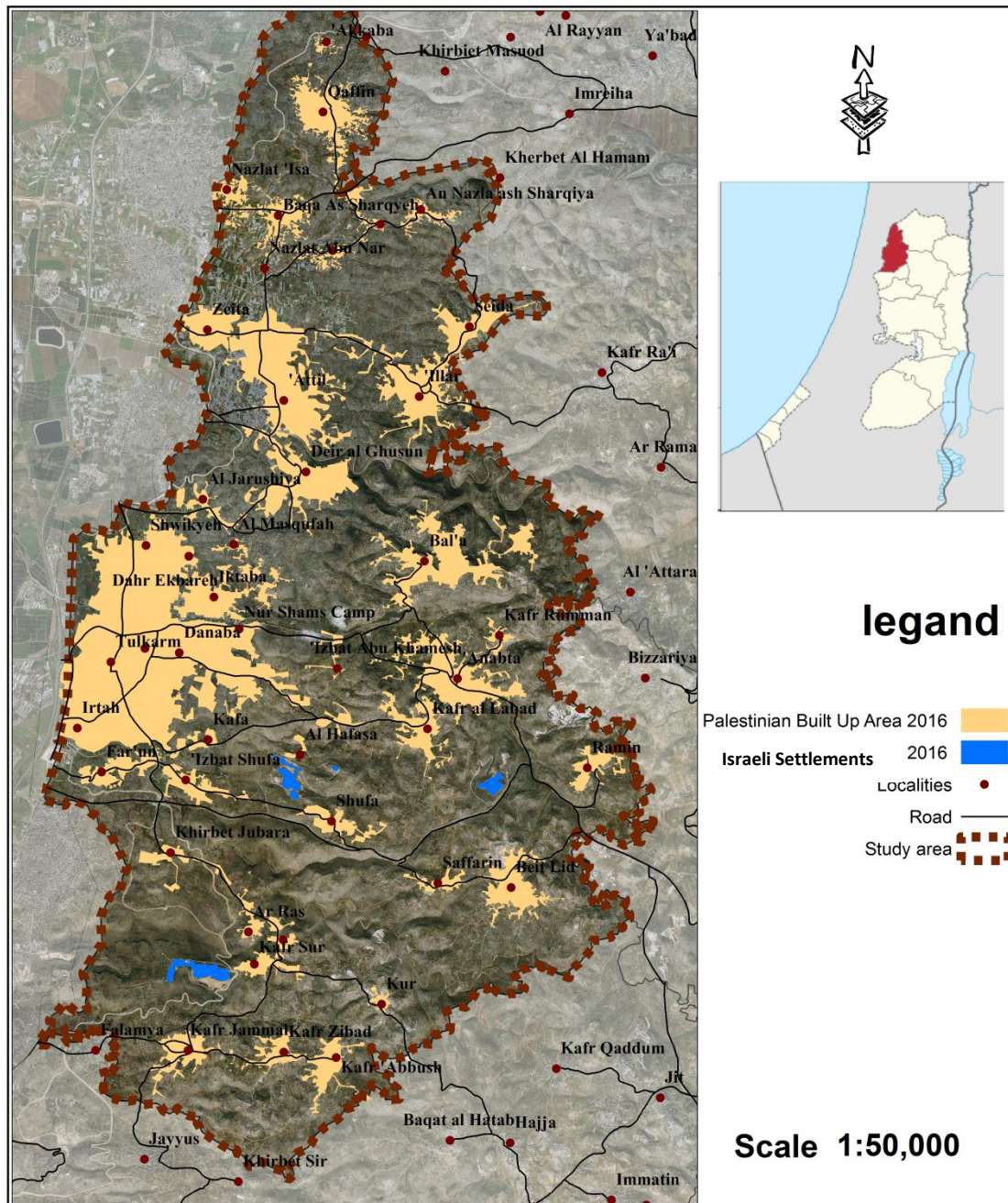
-Salait Settlement:It is an agricultural settlement located one kilometer away from the armistice line. It was established by the occupation authorities on the land of Kafr Sur village, from which 1.300 km^2 , were confiscated; the colony did not change in its size during the period of the study . There was no expansion of this settlement during the period of study, where the area was for the two years 0.402 km^2 .

- Einab Settlement :The Israeli occupation authorities established this settlement in 1981 on the land confiscated from the villages of Kafr El-Labad, Ramin and Beit Lid in the east of Tulkarm (Ministry of Palestinian State, Settlements in the West Bank, Information Center for Wall and Settlement Affairs, 2011).

There was no expansion of this settlement during the period of study, where the area was for the two years 0.167 km^2 . Maps (10 ,11) show the change in the Palestinian built up area and the Israeli settlements, based on aerial photos of 2005 and 2016.



Map 13 : Change in the Area of Built up of Palestinian localities and Israeli Settlements for 2005. Source : Depend on Orthophoto 2005.



Map 14 : Change in the Area of Built up of Palestinian localities and Israeli Settlements for 2016. Source : Depend on Orthophoto 2016.

Thus, the total amount of changes in the built-up area of the Israeli settlements and Palestinian localities during the period (2005-2016) as shown in Table (5.2.6.1) below :

Table (5.2.6.1) The Total amount of change in the Palestinian Built up area and Israeli settlements.

Localities	Number of Localities	The Amount of Change in the Built up area(km ²) during the period (2005-2016)
Israeli Settlements	3	0.035
Palestinian Localities	37	27.370

Table (5.2.6.2) below shows the changes in the area of the Israeli settlements during 2005-2016; the area of settlements in 2005 was 0.694 km², which equivalent to 0.3% , while in 2016 the area was 0.855 km² equivalent to 0.34% of the total area of Tulkarm governorate. Thus, the total change in area is 0. 04 km² .

This increasing change in the area of settlements was due to the expansion of the Avni Hefetz settlement only ,during the study period, where the area of Avni Hefetz in 2005 was 0.246 km², while in 2016 it became 0.281 km², so the amount of expansion is 0.035 km², ,while the settlements of Einab and Salait had no changes during the study period.

Table (5.2.6.2):Change in Israeli Settlement area during study period.

Period of Study	Area km ²	%Israeli settlements to the total area of the Governorate	Total Change km ²
2005	0.694	0.3%	0.161
2016	0.855	0.34%	

5.2.7 Fallow land

Most of the fallow lands were concentrated in the southern part of the governorate, in area with low agricultural value and far from the high fertility areas, which are also near the Israeli settlements .

Table (5.2.7) shows that the area of the Fallow Land decreased by 0.997 km², where its area was 4.2% in 2005 and 3.8% in 2016. This decrease in the area is due to the reclamation of this lands; the aerial photos showed that these lands were planted with olives, which covered a large part of them. Some people cultivated olive trees in the land adjacent to the Israeli settlements to discourage the Jews from building more settlements in the pretext that they are empty.

Table(5.2.7): Change in the Area of the Fallow land Area during Study Periods.

Periods of Study	Area km ²	% of Fallow lands to the total area of the Governorate	Total Change km ²
2005	10.45	4.2%	-0.92
2016	9.53	3.8%	

5.2.8 Roads

Transport play an important role in determining the use of land in the cities and the surrounding areas and also it affects the value of the land and determines its prices. In addition, it affects the location of the industrial establishments, as well as the distribution of the population at the global, regional, and national levels. (Al-Muslah, 2006).

Table (5.2.8) shows the change in the length of roads during the study period in accordance with GIS and Orthophoto of 2005 and 2016 .

The roads are classified as follows: Regional roads, Main roads and Local roads; the Regional road is the road that connects the governorates with the communities and then connects them to the main roads ; the Main road is the road that links all governorates or several governorates; the local road connects one or more community and connects these communities with a main or regional road .

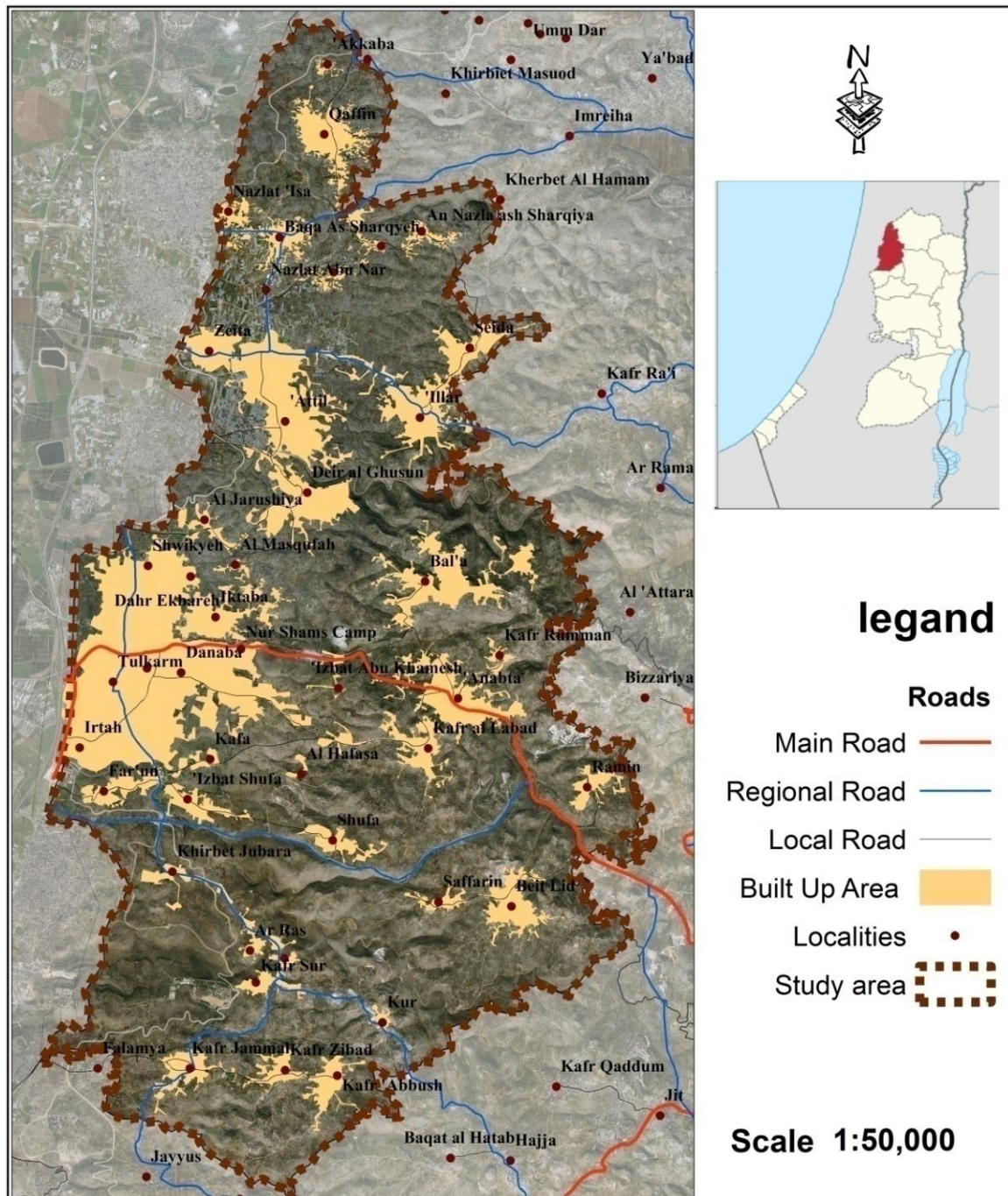
The most change was on the lengths of the local and main roads, where the length of the main roads in 2005 was 17.795km and increased to 51.333 km in 2016; the lengths of local roads were 78.388km and increased to 124.736 km in 2016.

The regional roads did not increase during the study period; the length of the regional roads in 2005 was about 53.793km and in 2016 the length was 44.719 km. The decrease in length of the roads was due to the presence of the separation wall, which eliminated the regional roads that were open to the occupied territories⁴⁸, and prevented the occupation from building new roads.

The total length of roads in 2005 was 149.976 km ,and the total length of roads in 2016 was 220.788 km . This shows that there is a clear increase in the length of roads during this period with about 70.812 km.

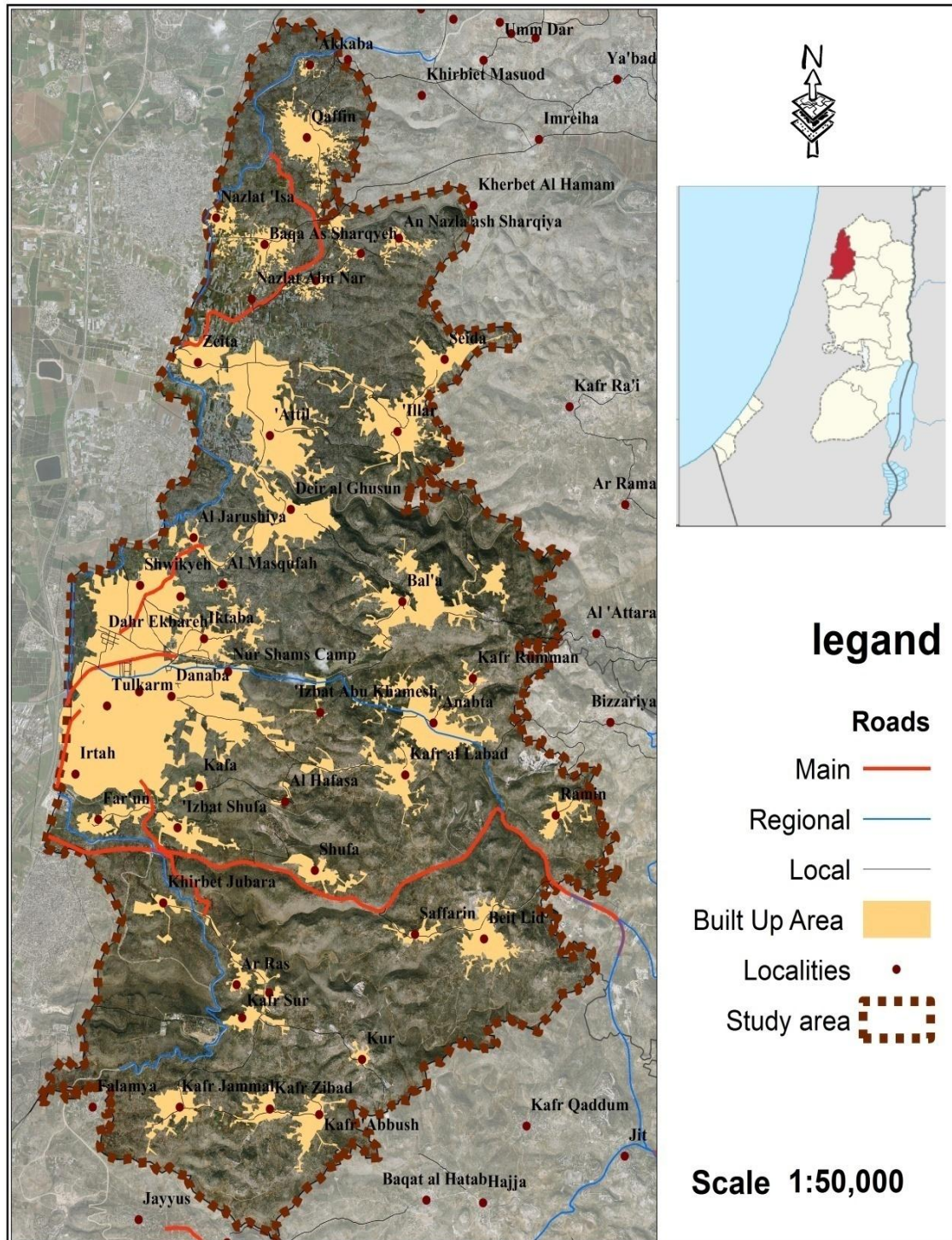
Roads	Lengths of Roads 2005 (km)			Lengths of Roads 2016 (km)			Trend of change
	Regional	Main	Local	Regional	Main	Local	+
	53.793	17.795	78.388	44.719	51.333	124.736	
	Total : 149.976			Total : 220.788			
	Change in length:70.812						

Roads	Lengths of Roads 2005 (km)			Lengths of Roads 2016 (km)			Trend of change
	Regional	Main	Local	Regional	Main	Local	+
	53.793	17.795	78.388	44.719	51.333	124.736	
	Total : 149.976			Total : 220.788			
	Change in length:70.812						



Map 15 : Roads 2005 in Tulkarm Governorate.

Source: Depend on Orthophoto 2005.



Map16: Roads 2016 in Tulkarm Governorate.

Source : Depend on Orthophoto 2016

5.3 An analysis of the developmental trends of the governorate in terms of the Urban Carrying Capacity

5.3.1 Assessment of the Urban Carrying Capacity

In this study, the researcher used the urban carrying capacity to determine the development and the extent to which the targeted regions can be expanded to contain new activities. Based upon the results of the analysis of the five determining factors, it was clear that the urban carrying capacity of the Governorate was mainly determined by population and land and natural resources.

The development of the entire study area is controlled by the primary determining factors of population density and agricultural land's area . According to the data analysis in the previous chapter, the increase in the population density in the Governorate led to the increase in the built up areas, which expanded at the expense of the agricultural areas. Thus , the important factor in the decline of the agricultural area is the urban sprwal , which resulted from the steady increase in the population growth as explained in Table (4.2.2) in chapter four.

The researcher used a World Bank index to assess the urban carrying capacity in the Governorate. This index is a collection of developmental indicators, compiled from officially-recognized international sources, which present the most current and accurate global development data available (<https://data.worldbank.org/indicator>). According to the overall previous analyses, Table (5.3.1) below shows the most important indicators

of the population density and agricultural land area, which determine the development in Tulkarm governorate and compare it with the global development index. Such an index can play a key role in the urban management at the governorate level; thus, development should be controlled properly within the capacity that the environment can be sustained.

Table (5.3.1) The influential determining factors to assess the urban carrying capacity in the Governorate.

Indicator	Standard value	Value	Evaluation
Population density (people per sq. km of land area)	734.6*	753	Bad
Agricultural land (% of land area)	43.5*	72.3	Good

* As given in the world bank indicators

(<https://data.worldbank.org/indicator>)

According to table (5.3.1), the increase in the population density in Tulkarm governorate was 753 (inhabitants\km²) in 2016, which was considered significant compared with the area of the governorate. In terms of the standard value of population density, this increase exceeded the limit of the indicator's value, which indicates that the population density has exceeded the governorate's population's capacity.

It is worth mentioning that Tulkarm camp was with the highest population density during the period of study since in 2016 the population density was 66 inhabitants\km² in, and then Nur Shams camp with 16 inhabitants\km² (see chapter four) . Consequently, the distribution and classification of land uses in the Governorate were affected, especially in the use of land for urban expansion, the construction of new residential areas and the availability of the agricultural land area.

The indicator is also shown the availability of the agricultural land area, Tulkarm governorate is distinguished for its agricultural and fertile areas according to Palestinian Central Bureau of Statistics, 2016, therefore, regarding the availability of the agricultural land areas in comparison to other classifications of land use, the agricultural land use area has the highest ratio of about 72%, which it is an acceptable ratio despite its high percentage which doesn't conform to the global standard.

The table (5.3.1) assess the urban carrying capacity of the governorate, it is underline whether current the development exceeds or within the urban carrying capacity of the two main determining factors: the population density and agriculture land area, where this agricultural area which are available at a high rate can be exploited in the governorate for potential future development, taking into account the determinants of natural and political expansion, and this will be discussed later.

5.3.2 Scenarios for Future Spatial Development

As a result of the previous analysis on the changes of the development during the period of study in the governorate, which has shown an increase in the development in the governorate in terms of population, population density and built up area of the localities, the researcher will work on two future development scenarios. The first scenario will guide the future development of the governorate in terms of urban carrying capacity and land availability in light of the current geopolitical situation and thus to show the impact of the political factor in restricting the potential development in the governorate. In addition, in the second scenario, the researcher will work on the development trend in case of the absence of the political factor in the governorate and thus the ability to expand and accomplish the desired development activities in the governorate.

Figure (3.5) represents the area of the future expansion of the localities in the governorate, which vary from one locality to another depending on the data analysis (see chapter four) of population growth rate of the localities for the two years 2016 and 2032 according to the master plan of the area, which is 16 years. In addition, some localities have a larger master plan that can cover a larger part of the expansion, such as Saffarin and Beit Lid.

The population's projection of the localities in the governorate was calculated based on the following equation:

Population in base year $(\text{average growth rate} + 1)^{\text{Difference of the number of years}}$ where the base year is 2016 and the difference is 16 years.

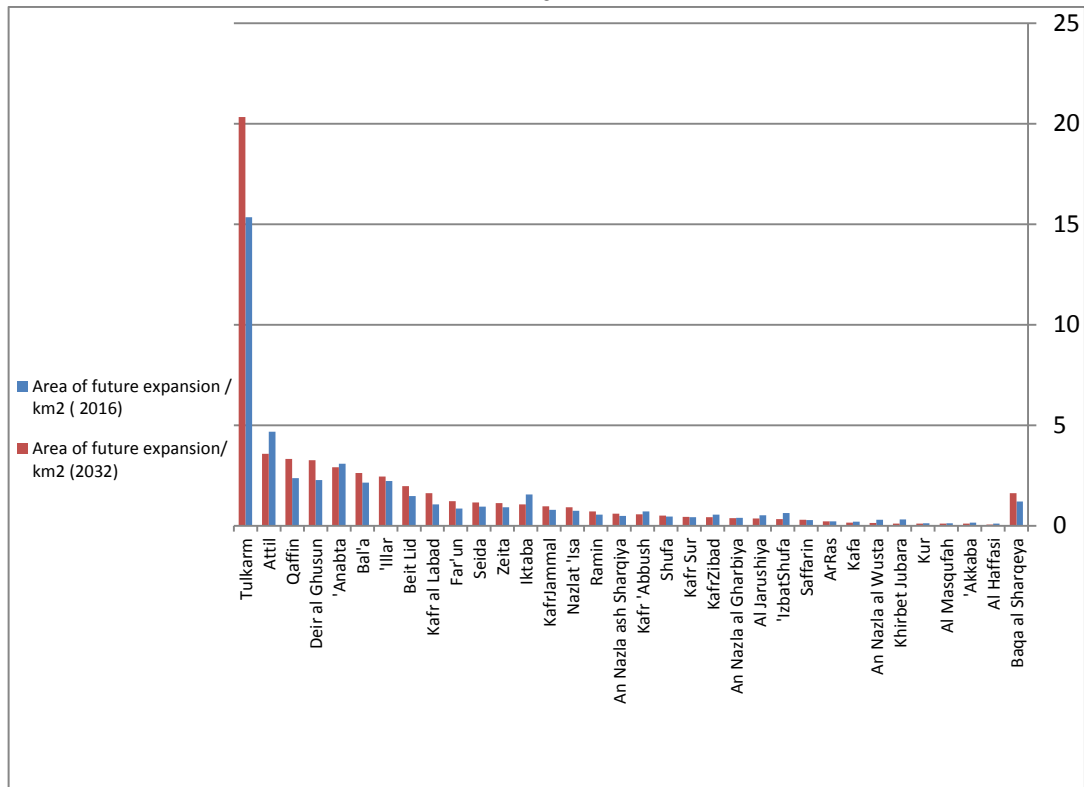


Figure (5.3): The Area of future expansion of the localities in Tulkarm governorate. Source : Depending on data analysis.

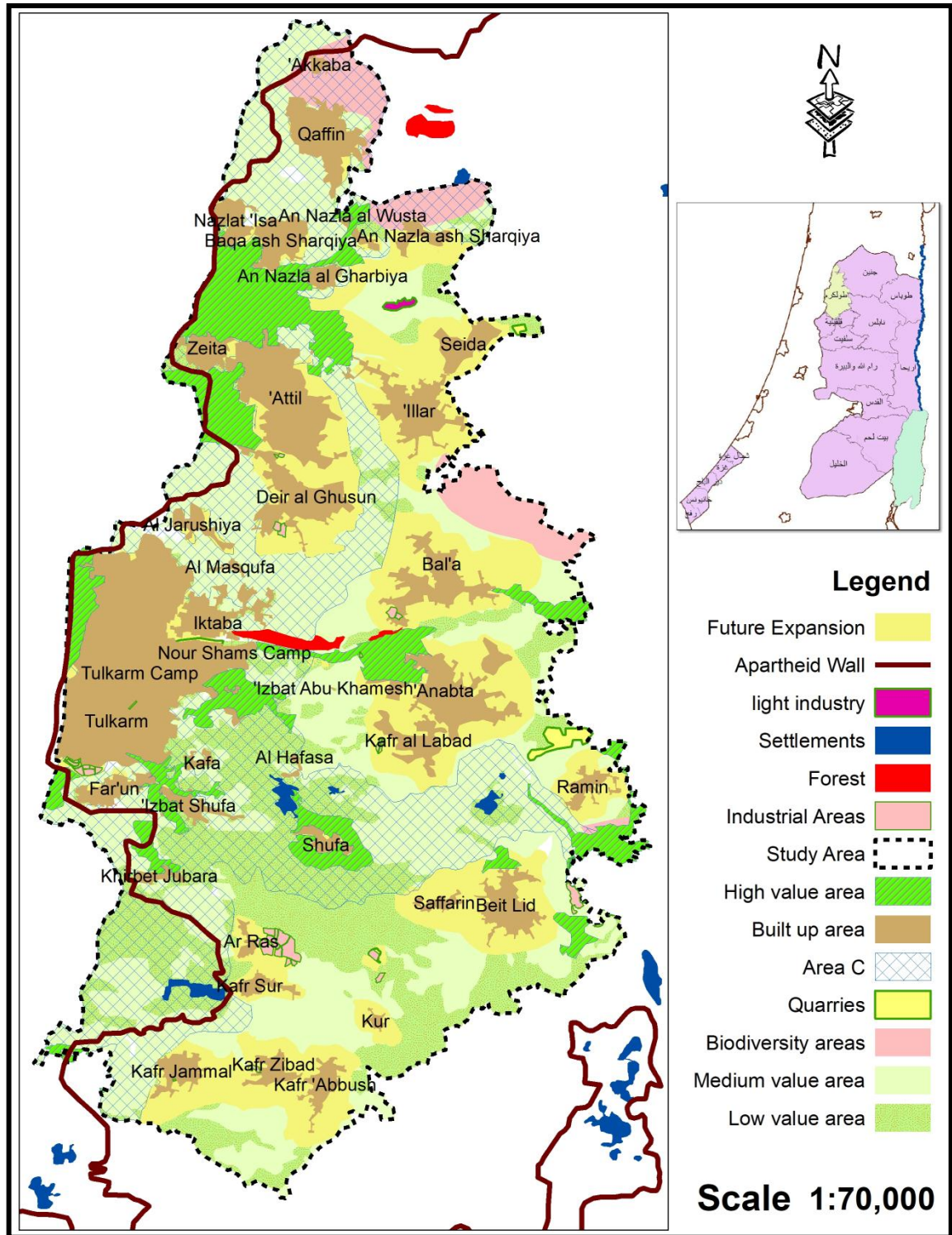
Scenario 1: Future development with the geopolitical situation

The political factor remains the primary determining factor in the land use planning and impedes the achievement of the principle of sustainable development in the Governorate in particular and in Palestine in general . That is, the independent state usually participates in the formulation of public policies, evaluation and implementation and uses of the land properly. However, in the Palestinian case, the state is still under occupation, so everything related to land use is chaotic and arbitrary , in addition to the threatening divisions of areas into : (A, B, C) which were discussed in the third chapter of the study.

The first scenario represents the potential spatial development under the current political situation in the governorate, represented by : Area C, the settlements and the apartheid wall, which are defined as political determinants of development in terms of the capacity and land availability of the future expansion of the localities in the governorate in particular and the future development in the governorate in general.

In Tulkarm governorate, the land classified as (C) holds the largest proportion about 43.4% which is equal to 104.9 km² of the governorate's area including apartheid wall and settlements (data from Geomolg), which contains most of the agricultural and open areas, this area occupied by area C is significant if compared to the total area of the governorate. This means that the security control is in the hands of the occupation, laws and regulations are violated, and lead to indiscriminate overlap between different land uses especially the residential and industrial uses.

Map(17) represents the potential development for the governorate with the current geopolitical situation , taking into account the natural and political determinants of development which are: C area ,forests, high agricultural value, industrial area and quarries.



Map (17): Scenario of future development of Tulkarm governorate in terms of urban carrying capacity with the geopolitical situation.

Source: (An-Najah National University, Urban and Regional Planning Unit, 2017).

By looking at the map (17) of the first scenario, we notice that the political situation is limiting the expansion of the localities which are located on the borders of the area C. In addition ,the existence of settlements adjacent to some localities, such as the settlement of Saleit, which is adjacent to Kafr sur, and the settlement of Avni Hefetz, which is adjacent to Shufa, constrained the expansion of these localities.

These localities are surrounded by a high rate of lands which are classified as C, as shown in the map (17) above, where there is no enough space for future expansion. The presence of C areas will limit the urban carrying capacity in terms of land availability and suitability for future development of the governorate , and thus will lead the development in the direction of difficult topographic areas or to areas of high agricultural value.

Based on these external threats , the researcher suggests that the structural plans should be updated based on principles of planning , and the emphasis on vertical construction of the urban development in the governorate. The researcher also suggests applying the approach of compacted cities, especially for localities that are difficult to expand under the political situation.

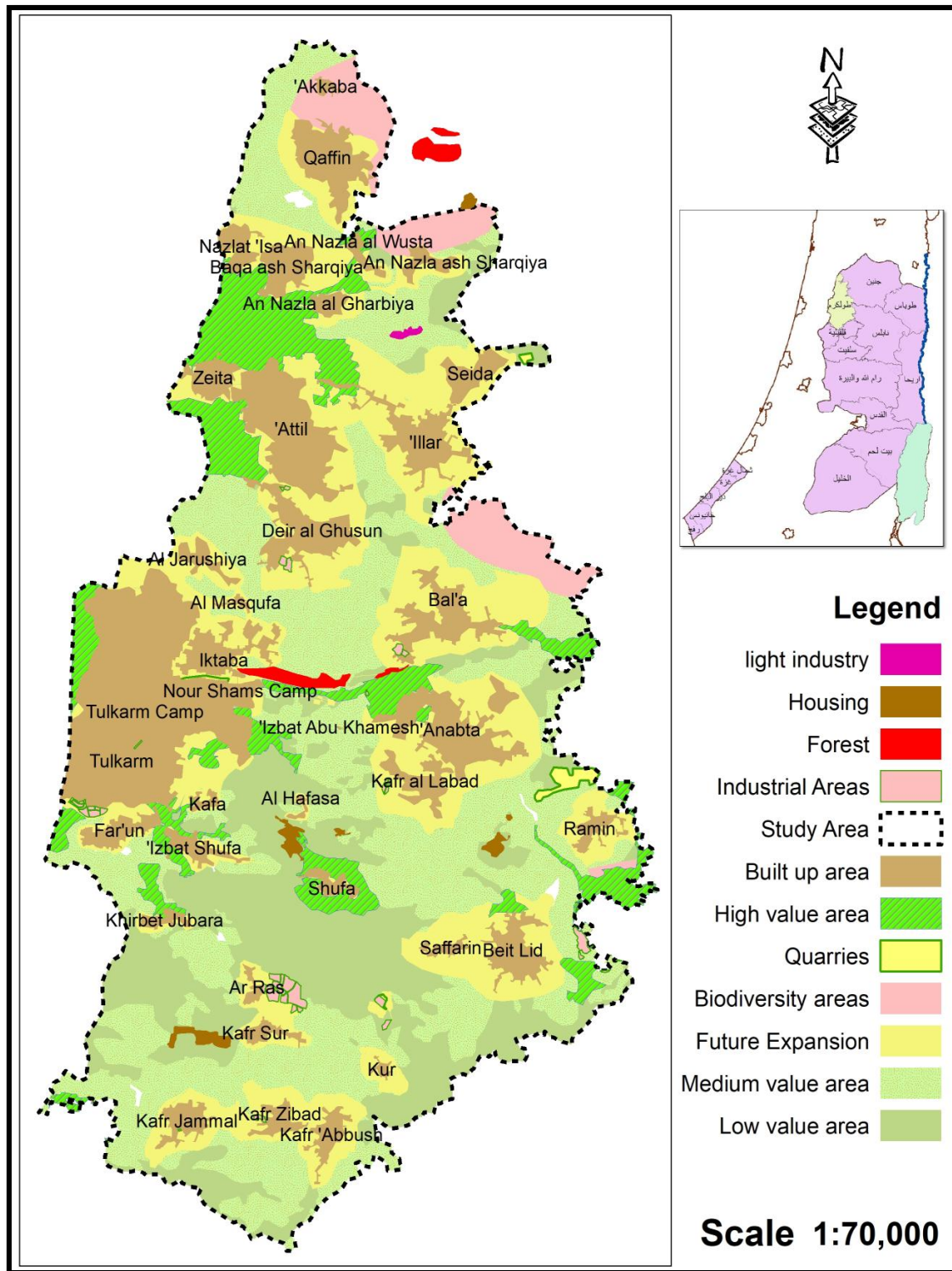
The compact city concept was seen as an approach that could end “the evil of urban sprawl” ; it aims at a high-density mixed-use, and intensified urban form. The idea emphasizes that urban activities should be located closer each other to ensure better access to services and facilities via public

transport, walking, and cycling, and more efficient utility and infrastructure provision (Hideki,2003) .

Scenario 2: Future development without the geopolitical situation

Map (18) below, shows the possibility of the future expansion in the governorate in the case of the scenario without area C.

It is clear that most of the localities have achieved the desired expansion in terms of the urban carrying capacity of the available area ,and the direction of the best development , taking into account the natural determinants that must be preserved like forests and high agriculture value area, natural reserves and areas of biodiversity, and also in terms of extension for low agricultural value land and then to medium value agricultural land.



Map (18): Scenario of future development of Tulkarm governorate in terms of urban carrying capacity without the geopolitical situation.

Source: (An-Najah National University, Urban and Regional Planning Unit, 2017).

In the case of the potential development of land uses, it is better to exploit the empty settlements since they are relatively ready in terms of infrastructure, and simultaneously guide the expansion of the localities to the adjacent areas for the sake of building more housing areas. This expansion will be evident in the settlements of Salit and Avni Hefetz, while Einab settlement will be exploited for other uses, such as industrial, recreational, vocational or service areas. This will reflect positively on the provision of suitable areas for expansion and also can provide more green areas to prevent the urban sprawl.

Comparison between the two scenarios in terms of Urban Carrying Capacity of the Governorate

To calculate the carrying capacity through the area of the available land in both scenarios, Table (5.3.2) shows the area of the political and natural determinants of the development in the governorate which are taken from the data analysis in the previous chapter: The geopolitical situation, forest, biodiversity, high agriculture value and built up area.

Table (5.3.2) : Areas of determinants of political and natural development in the Governorate

Determinant of development	Scenario 1 (km ²)	Scenario 2 (km ²)
Forests	1.12	1.12
High agricultural value	23.86	23.86
Biodiversity	10.887	10.887
Geopolitical situation	104.9	-
Built up area	27.370	27.370
Total	168.12	63.237

According to the previous table (5.3.2) :

The Urban Carrying Capacity = Available area = Total Area of Governorate - Total area of development determinants

- For scenario 1(with geopolitical situation) :

The UCC = available area = $246 - 168.12 = 77.88 \text{ km}^2$. This means that the governorate has space in terms of carrying capacity, which is equal to 77.88 km^2 of the total area of the Governorate, i.e., the governorate has this capacity for potential development in the future according to its current political status.

- For Scenario 2 (without geopolitical situation):

The UCC = available area = $246 - 63.237 = 182.763 \text{ km}^2$, which means that the Governorate has a large available space in terms of urban carrying capacity which is equal to 182.763 km^2 of the total area of the Governorate, i.e., the governorate has enough capacity for potential development in the future if there is no political determinants on the land of the governorate.

Based on the previous analyses of both scenarios, the political factor limits and prevents the achievement of the potential development, which is compatible with the urban carrying capacity of the governorate ,where there is enough area that can be exploited in the case of absence of the occupation to guide and achieve the best development that preserves the governorate in a sustainable manner.

5.4 Summary

In this chapter, the researcher analyzes the urban carrying capacity factors of population density and built-up areas of the population in Tulkarm governorate, which includes four main localities. It also compares the changes in the population density among these localities during the study period, analyzes and evaluates the different land use classifications and the changes that occurred during the period of study. In addition, an analysis is made about the roads and the changes in their total lengths during the study period , and another is made about the development trends of the governorate in terms of carrying capacity based on the previous data, where two scenarios have been developed for the potential development of the governorate and a comparison was made between them in terms of the urban carrying capacity and the available area in the governorate in the event of the presence or absence of the geopolitical political situation.

Chapter six will present the conclusions and recommendations of the study.

Chapter Six

Conclusions and Recommendations

6.1 Conclusions

1. The urban carrying capacity of the Governorate was determined mainly by two factors: population density and agriculture land use.
2. The political factor limits and prevents the achievement of the potential development, which is compatible with the urban carrying capacity of the governorate ,where there is enough area that can be exploited in the case of absence of the occupation to guide and achieve the best development that preserves the governorate in a sustainable manner.
3. The increase in the population density in Tulkarm governorate reached to 611(inhabitant\km²) in 2005 and 735 (inhabitant\km²) in 2016; the increase in the population density during the study period was about 124 (inhabitant\km²) which is a significant increase compared with the area of the governorate.
4. In comparison with the standard value of population density, it is exceeded the limit of the indicator value, this indicates that the population density has exceeded the governorate's population capacity.
5. Tulkarm camp was with the highest population density during the period of study, in which the population density reached to 66 inhabitants\km², then Nur Shams camp reached to 16 inhabitants\km².

6. The largest expansion in the built-up area is Anabta due to the location of this area and its proximity to the city, followed by Al Sha'arawiya localities, which includes 15 localities. However, the largest expansion is Attil, and the smallest expansion is Nazlat Issa because of its small area.
7. The disparity in the area and population density of the communities in the governorate constitute a continuous pressure on the distribution and classification of land uses in the governorate, especially in the use of land for urban expansion and the establishment of new residential areas.
8. The increase of urban areas during the study period (2005-2016) was about 12.13 km² equivalent to 4.9% of the total area of the governorate.
9. Tulkarm governorate is distinguished for its agricultural and fertile areas. Therefore, regarding the availability of the agricultural land areas in comparison to other classifications of land use, the agricultural land use area has the highest ratio of about 72%, which is globally acceptable despite its high percentage.
10. The decrease in the area of the natural herbs and main crops, while the various forests did not change; the olives trees achieved the highest change in the area. In 2005, the area of the olives trees in the governorate was 140.8032 km² equivalent to 57.2%, while in 2016 the area of olives trees was 131.7445 km² equivalent to 53.5%.

11. The change in the industrial areas during the study period was limited and not noticeable with only 0.25 km^2 ; the area of industrial areas in 2005 was 1.030 km^2 equivalent to 0.4% ,and in 2016 the area was 1.280 km^2 equivalent to 0.5%.

12. The absence of planned industrial zones in Tulkarm governorate, and the spread of different industries between the localities and the agricultural lands, which cause negative effects on the environment and population.

13. A clear change was noticed in the recreational areas in Tulkarm governorate ,with an area of 0.045 km^2 in 2005 and increased to 0.075 km^2 in 2016, so the change in the area increased by 0.031 km^2 .

14. The quarry area in the governorate has not changed ,where the area of quarries in 2005 was equal to the area in 2016 which was about 0.808 km^2 ; the increase and density of quarry area is zero.

15. The increase in road lengths during the study period (2005-2016) from 149.976 km in 2005 to 220.788 km in 2016; the increase of road lengths was about 70.812 km .

16. The results showed that the most types of roads which changed in the length during study period were the local roads, the length of which reached 78.388 km in 2005 and increased to 124.736 km in 2016.

17. The main roads came in the second; they reached 17.579 km in 2005 and increased to 51.333 km in 2016.

18. The regional roads , the length of which was about 53.793km in 2005 and in 2016 was 44 .719 km, did not increase during the study period,. This decrease of the length of the roads was due to the presence of the separation wall, which eliminated the regional roads that were open to the occupied territories 48, and prevented the occupation from building new roads .

19. The increase in the area the of Israeli settlements during 2005-2016 ; the area of settlements in 2005 was 0.694 km²equivalent to 0.3% , while in 2016 the area was 0.855 km² equivalent to 0.34% of the total area of Tulkarm governorate .Thus, the total change in area is 0.161 km².

20. Expansion of Avni Hefetz settlement during the study period. That is to say, the area of Avni Hefetz in 2005 was 0.246 km², while in 2016 it increased to become 0.281 km² , so the amount of expansion is0. 035 km², while the settlements of Einab and Salait had no change in its area during the study period.

21. The area of the fallow land decreased by 0.997 km². Specifically, the density of its area was 0.042% in 2005 and 0.038% in 2016,.This decrease in area is due to the reclamation of these lands.

22. The Carrying Capacity Assessment System (CCAS) demonstrated in this research can play a pivotal role in planning and managing the development more effectively in Palestine as a whole .

23. Such an approach is meaningful, because it is it is useful to identify which factor(s) are most influential for determining the carrying capacity of an area. also, problematic area(s) can be delineated and the nature of such problems can be analyzed.

6.2 Recommendations

1. Development of strategies for improving urban carrying capacity of an area of Palestine if developments already exceed its capacity such as developing or adopting better technologies for environmental treatment and pollution control in conjunction with supplying additional public facilities.
2. Prepare ways to control possible future developments if the area is not yet overly developed and more facilities cannot be provided in the near future.
3. Calculating the urban carrying capacity for air concentration by measuring the emissions from the activities and increasing the number of measurement stations, which would contribute to the assessment and analysis of the changes in the concentrations of different gases.
4. Increasing the green areas in the governorate, and adopting new agricultural methods to increase the agricultural land focusing on the cultivation of roofs and walls and others because of the importance of these green areas in the disposal of air- pollutants and carbon dioxide absorption.

5. The need for all relevant institutions to establish a geospatial database and Remote Sensing, which deals with the classification of land uses accurately for long periods of time.
6. Relying on vertical expansion rather than horizontal expansion in the coming years to provide new urban areas.
7. Because there is an area of fallow land, so it is necessary to exploit these areas more for agriculture , recreational use or tourist use.
8. Planners should develop strategic development plans, and development projects within the governorate and promote joint planning within the governorate.
9. Preserving the arable land for agriculture, and increasing its area through reclamation and rehabilitation of land that is not arable.
10. There should be a well-organized industrial zone in the governorate to prevent overlapping uses, especially commercial and industrial uses, and to prevent the existence of the industrial areas in the residential neighborhoods.
11. Providing all kinds of support to the individuals affected by the separation wall and colonies to strengthen their steadfastness on their land.
12. An environmental impact assessment should be carried out by the specialists, when planning for industrial, educational or any other uses; the agricultural lands should not be changed or replaced.

13. Further research should be conducted to assess not only with the dimensions of urban carrying capacity employed in this research, but also with other dimensions related to public perception and institutions.
14. Application of this approach on urban environments with different characteristics and scales.

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كلية الدراسات العليا

تحليل وتقييم التنمية في فلسطين باستخدام نظام تقييم قدرة التحمل
الحضرية : محافظة طولكرم حالة دراسية

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قدمت هذه الأطروحة استكمالاً لمتطلبات الحصول على درجة الماجستير في هندسة التخطيط الحضري والإقليمي، بكلية الدراسات العليا، في جامعة النجاح الوطنية، نابلس-فلسطين.

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حالة دراسية

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الملخص

تبحث هذه الدراسة في تحليل وتقييم التنمية في محافظة طولكرم باستخدام نظام تقييم قدرة التحمل الحضرية خلال الفترة (2005-2016)، والتي تعرف بأنها المستوى الأقصى للأنشطة البشرية، مثل نمو السكان واستخدام الأراضي والتطوير المادي الذي يمكن ان تتحمله البيئة دون الحاق ضرر او تدهور دائم.

تكمن المشكلة في هذه الدراسة في أن محافظة طولكرم قد تطورت بشكل كبير ومكثف خلال الفترة (2005 - 2016)، وبالتالي تم فرض المزيد من الضغوط على الموارد الطبيعية، وبالتالي قد يصبح هذا التطور السريع لا يتناسب مع قدرة التحمل الحضرية في المحافظة. وهذا بدوره يؤدي إلى مشاكل دائمة ودائمة، لا سيما تلك المتعلقة بالسكان واستخدام الأراضي المتداخلة، مما يعرض الموارد الطبيعية للخطر. بالإضافة إلى تأثير العامل السياسي الذي يحد ويمنع تحقيق التطور المحتمل، والذي يتوافق مع قدرة التحمل الحضرية للمحافظة، حيث توجد مساحة كافية يمكن استغلالها في حالة غياب الاحتلال لتوجيه وتحقيق أفضل تطور يحافظ على المحافظة بطريقة مستدامة.

هدفت الدراسة اولا الى تحليل وتقييم التنمية في محافظة طولكرم باستخدام قدرة التحمل الحضرية وذلك من خلال بناء إطار عمل يتناسب مع ظروف المحافظة خلال فترة الدراسة (2005-2016). ضم الإطار المقترح أحد عشر معياراً، أهمها النمو السكاني والكثافة السكانية

واستخدامات الأراضي بجميع تصنيفاتها وذلك من أجل تحديد مستوى التنمية في محافظة طولكرم، كما تم إجراء تحليل آخر حول اتجاهات التنمية المحتملة للمحافظة من حيث قدرة التحمل الحضرية بناءً على بيانات التحليل في الدراسة، حيث تم وضع سيناريوهين للتنمية المحتملة للمحافظة وتم إجراء مقارنة بينهما من حيث قدرة التحمل الحضرية والمساحة المتاحة للتنمية في المحافظة في حالة وجود أو غياب الوضع الجيوسياسي.

قامت الباحثة بتقسيم الدراسة وفقاً للبيانات المتوفرة إلى فترتين (2005 و 2016)، واعتمدت الباحثة على خرائط تصنيف الأراضي (zoning maps) من البلدية ووزارة الحكم المحلي في المحافظة، واستخدمت نظم المعلومات الجغرافية لجمع وتخزين وتنظيم وتحليل وبناء قواعد بيانات مكانية لفترات الدراسة، واستخدمت الصور الجوية المصححة (Orthophot 2005\2016) للمراجعة والتدقيق.

وأظهرت النتائج زيادة في التنمية في المحافظة بالنسبة لمساحتها الكلية من حيث الكثافة السكانية والمساحة المبنية للتجمعات السكانية في المحافظة خلال فترة الدراسة (2005-2016)، بمعنى أن قدرة التحمل الحضرية للمحافظة تتأثر بشكل أساسي بعاملين: الكثافة السكانية ومساحة الأراضي الزراعية في المحافظة. كما أظهرت النتائج أيضاً وفقاً للتحليلات كل من السيناريوهين المحتملين للتنمية أن العامل السياسي يحد ويمنع تحقيق التنمية المستقبلية المحتملة، والتي تتوافق مع قدرة التحمل الحضرية للمحافظة، حيث يوجد مساحة كافية يمكن استغلالها في حالة غياب الاحتلال لتوجيه وتحقيق أفضل تطور يحافظ على المحافظة بطريقة مستدامة.

بناءً على هذه النتائج خرجت الباحثة بالتوصيات التالية: إنشاء قاعدة بيانات جغرافية مكانية تعتمد على تقنيات نظم المعلومات الجغرافية (GIS) لتصنيف الأرض بشكل دقيق ومفصل. كذلك توصي الباحثة بإعداد طرق للتحكم في التطورات المستقبلية للتنمية لأي منطقة في فلسطين بحيث تكون ضمن حدود قدرة تحملها الحضرية، وتطبيق هذه المنهجية على مستويات وخصائص مختلفة للبيئات الحضرية في فلسطين لتحقيق مبدأ الاستدامة المنشودة.

