

# **Analyzing the Effects of Urban Sprawl on the Physical Environment in the case of Kyrenia**

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## **ABSTRACT**

The formation of urban planning can be dating back to the primary cities in previous centuries. Throughout the last decades, urban population has been rapidly increased due to urbanization in developing countries. Excessive growth of population due to urbanization led to upward growth of cities, which as consequence cities missed their realms and boundaries and produced variety of urban forms that took a little consider of their affects upon the environment. Thus, this century experienced the miracle of urban sprawl as the initial primary urban form. The urban sprawl and the expansion of urban areas are the concerns of today's cities due to social, environmental and economic negative impacts that has in the cities. According to these impacts, it is believed that urban sprawl demonstrates a threat for urban sustainability, since it indicates high level of land, water and energy consumption, as well as increase pollutants and wastes.

In the today's world the best way to implement sustainability is the urban development and overcoming the consequences of rapid urban planning such as urban sprawl. Hence, sustainable urban forms would be a solution for this phenomenon to achieve sustainability in all three dimensions in the contemporary cities.

Accordingly, the focus of this study is analyzing the types and costs of urban sprawl in Kyrenia's physical environment. The problem area and field study of this research will be East side of kyrenia city along coastal line in the North Cyprus.

Based on initial discussion, the thesis will have five chapters. In the first chapter, the introductory part will be given. In the second chapter, this study reviews urban sprawl within coastal line by concentrating on sustainable urban form. Hence, this research first gives knowledge about definition, types and effects/costs of sprawl on the physical, natural and social environmental of the cities then in the third chapter reviews the concept of sustainability and identified sustainable urban forms. Afterwards, in chapter four all dimensions of urban sprawl on the east side of Kyrenia along coastal line as case study and problem area will be measured in order to achieve the main aim of this thesis which is to analyze the types and costs of urban sprawl on Kyrenia city and to evaluate the physical problems in line with the sustainability. Finally, the effects of sprawl in the case study will be presented with special reference to coastal area and then the most suitable urban form will be suggested for eliminating these negative effects of sprawl in the city. Legal and administrative failure including street and building regulations (cap 96), 1993 environmental conservation plan Notice and many notices up to now; as well as Annan Plan (2002) are factors that accelerate urban sprawl in Kyrenia.

The methodology of this study is based on qualitative technique. The data evaluation will be collected through literature survey and field studies. Accordingly, literature survey includes reviews on the sources, which are about the subject/keywords of the thesis. Field study will be done in Kyrenia along the coast area. It will consist of observations, photographs, maps, analyzing of the land-use changes, urban pattern and population growth. According to analysis, leapfrog development of urban sprawl in Kyrenia will be act as a factor for future likelihood environmental problems such as high energy and land consumption, loss of agricultural land and loss of green

areas. To put in the nutshell, the data which examined and evaluated in the last part will be concluded to suggest smart growth for future expansion of Kyrenia in order to achieve achieve sustainability in the urban development which is the main aim of this study.

**Keywords:** Urban Sprawl, Sustainable Urban Forms, Leapfrog Development, Smart Growth, Kyrenia

## ÖZ

Kent planlaması ilk yerleşimlerin oluştuğu yüzyıllara dayanan bir olgudur. Son on yıllar boyunca, kentleşmenin etkisiyle tüm dünyada kentlerin demografik, ekonomik ve mekansal yapılarında önemli değişimler meydana gelmiştir . Kentleşmenin etkisiyle oluşan aşırı nüfus artışı kentlerin büyümesine, sınırlarının değişmesine ve farklı tiplerde kentsel biçimlere sahip olmalarına neden olmuştur. Bundan dolayı, bu yüzyılda kentlerin büyümesi kentsel saçaklanma şeklinde olmaktadır. Kentsel saçaklanma ve genişleme bugünün kentlerinde olumsuz yönde değişen sosyal, çevresel ve ekonomik yapılar sonucu ortaya çıkmaktadır. Toprağın, suyun ve enerjinin aşırı tüketimi, kirliliğin ve çöplerin artması gibi olumsuz etkiler nedeni ile kentsel saçaklanma, kentsel sürdürülebilirlik için bir tehdit oluşturduğu tartışılmaktadır.

Bugünün dünyasında kentlerde sürdürülebilirliği sağlamanın en iyi yöntemi hızlı kentsel gelişmenin ve dolayısıyla kentsel saçaklanmanın olumsuz sonuçlarının üstesinden gelmektir. Bundan dolayı, sürdürülebilir kentsel biçimler, kentlerin ekonomik, sosyal ve çevresel yapılarında sürdürülebilirliği elde etmek için çözüm olabilmektedir.

Bu çalışmada Kuzey Kıbrıs'ın sahil kenti olan Girne 'nin doğu sahil şeridi çalışma alanı olarak seçilmiştir. Bu bağlamda, tez kapsamında Girne kenti doğu sahil şeridindeki kentsel saçaklanmanın çeşitleri ve kentlere etkileri araştırılacak ve daha sonra sürdürülebilir kentsel biçimler tartışılacaktır. Buna bağlı olarak, çalışma beş bölümden oluşmaktadır. Birinci bölümde, giriş verilmektedir. İkinci bölüm tez

araştırmasının kavramsal ve kuramsal kısmını oluşturmaktadır. Burada kentsel saçaklanma, tipleri, nedenleri ve etkileri yanında kentsel saçaklanmanın farklı ölçme/değerlendirme metodları tartışılmaktadır. Kentsel saçaklanmaya bir çözüm olarak görülen sürdürülebilir kentsel biçimler ise üçüncü bölümde gözden geçirilmektedir. Dördüncü bölümde mevcut yasal ve idari yapıdaki yetersizlikler, sıkça değişen yasalar ve 2002 yılında Anan Planı sonucu hızlı, kontrolsüz ve dağınık gelişen bir yapıya sahip olan Girne kentin'deki kentsel saçaklanmanın biçimi ve çevresel etkileri ortaya konmaktadır. Sonuç, öneriler ve bu çalışmanın devamı niteliğinde olabilecek çalışmalar dile getirilmiştir.

Bu çalışmada nitel ve nicel araştırma teknikleri kullanılmıştır. Konu ile ilgili literature ve saha çalışması yapılmıştır. Yapılan analizler sonucunda, Girne kentinin doğu sahil şeridindeki kentsel saçaklanmanın, sıçrayarak büyüme şeklinde olduğu tespit edilmiştir. Bu büyüme şekline göre ise yüksek oranda arazi ve enerji kullanımı/tüketimi, tarımsal arazi ile yeşil alan kaybı yaşandığı gözlemlenmiştir. Buna göre, daha düzenli ve kaynakları fazla tüketmeden yayılması için akıllı büyüme olarak gelişmesi gerektiği önerilmiştir.

**Anahtar Kelimeler:** Kentsel Saçaklanma, Sürdürülebilir Kentsel Biçimler, Sıçrayarak Büyüme, Akıllı Büyüme, Girne.

**To My Family with Endless Love**

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# Chapter 1

## INTRODUCTION

### 1.1 Introductory Section

During the last decades, urban population has been rapidly increased due to urbanization in developing countries. This sudden growth rate produced variety of urban forms. Moreover, urban planning matured over the twentieth century providing different types of urban forms, which often took a little consider of their affects upon the environment. Thus, this century experienced the miracle of urban sprawl as the primary urban form of urban development (Daneshpour & Shakibamanesh, 2011). Since World War II, this universal phenomenon has been a main feature of urbanization process in several advanced countries such as “USA, Australia, Canada” and some industrialized European countries (Gill, 2008). The urban sprawl and the expansion of urban areas are the concerns of today’s cities. However, when the growth is rapidly increasing, the city will confront new problems. In the previous decades, cities had distinguished and defined boundaries, however they have lost their realms by extremely growth rate today (Habibi & Asadi, 2011).

The urban sprawl phenomenon is defined as a certain form of urban development with low density, scattered, car-dependent and negative environmental, social and economic impacts (Hass & Lathrop, 2003). According to these impacts, it is believed that urban sprawl demonstrates a threat for urban sustainability, since it indicates

high level of land, water and energy consumption, as well as increase pollutants and wastes (Mohammadi & Zarabi & Mobaraki, 2012). However, achieving sustainability in all aspects of contemporary cities is extremely essential. Thus, Brundtland commission gave a definition of sustainable development as “development that meets the needs of the present without compromising the ability of future generations to meet their own”. Furthermore, the form of a city has potential to affect its sustainability. Nevertheless, it is extensively accepted that there is a connection between the form, size, density and uses of a city and its sustainability (Morgan, 2011).

## **1.2 Problem Statement**

Based on initial discussions, the focus of this study is evaluating the variety and impacts of urban sprawl on the cities structure. The problem area and field study of this research will be Kyrenia city in the North Cyprus. Kyrenia is a touristic harbor city which is located on the north of the island. Earlier, the town was a commercial port but latter, this function altered to a tourist center today. Currently, suburbanization in the coastal part of the city, which is an overwhelming outline of urban growth and rapid population, has influence on the city’s image (Oktay, 2009; Hoskara & Doratli, 2007). There are two main reasons for having this rapid development in the Kyrenia. The first reason is the second homes, due to being touristic and coastal city of the island many residents from inland cities prefer to have second homes along coastline. The second reason is the impact of Annan Plan in Northern Cyprus. In 2002, United Nation prepared Annan Plan which suggested restructuring the Republic of Cyprus as a “United Republic of Cyprus”, that would be a federation of two states. After having a referenda process in 2004 haphazard physical development due to the construction boom started to be seen especially

along the shoreline of the city. Urban sprawl in Kyrenia is not matched by social and environmental advances; it carries out environmental effects and leads to degradation of resources instead, due to lack of management and planning strategies in the city. As a result, this research plans to put forward the impacts of urban sprawl that the town of Kyrenia experiences along with its coastal line and to debate the effects behind this unhealthy and un-sustainable growth on city's image.

### **1.3 Aims, Objective and Research Question of the Study**

The aim of this study is to analyze the types and costs of urban sprawl on Kyrenia city's physical environment. Based on this aim, the main question and sub questions of this research are given in the following part which will form the framework of the study.

Main question:

- What is the type and characteristics of urban sprawl in Kyrenia?

Sub questions:

- What is urban sprawl?
- What are the types and costs of urban sprawl?
- What are the impacts of the urban sprawl?
- What is sustainability?
- What is sustainable environment?
- What is the characteristic of urban sprawl in Kyrenia?
- What type of physical problems has been occurred in Kyrenia due to the sprawl?
- What is needed to have sustainable development in the city?

The objectives of this research, therefore, listed as follow:

- To understand the concept of urban sprawl, its types and costs
- To understand the impact of urban sprawl
- To understand the concept of sustainability and sustainable urban forms
- To define the characteristics of urban sprawl in Kyrenia
- To find the physical problems in Kyrenia due to the sprawl
- To determine sustainable urban form principles for mitigating urban sprawl impacts in Kyrenia

### **1.4 The Research Design & Method Section**

The thesis will have five chapters. In the first chapter, the introductory part will be given. As most research on sprawl uses the effects of sprawl as indicators, this study will do the same. In line with the main aim, the study first reviews urban sprawl, types and the effects/costs of sprawl on the physical, natural and social environment of cities. These effects are used to develop the methodology for assessing the effects/costs of it. In the third chapter, concept of sustainability and sustainable urban forms will be discussed. In the fourth chapter, Kyrenia will be introduced and each selected indicators for determining the environmental/physical costs of sprawl have been measured by using the series of analyses results. Finally, the effects of sprawl in the case study will be presented with special reference to coastal area and then the most suitable urban form will be suggested for eliminating these negative environmental/physical effects of sprawl in the city.

The data will be collected through literature survey and field studies.

- Literature survey and reviews on the sources, which are about the subject/keywords of the thesis.

- Field study will be done in Kyrenia along the coast area. It will consist of observations, photographs, maps, analyzing of the land-use changes and urban pattern.

## Chapter 2

### THE CONCEPT OF URBAN SPRAWL

#### 2.1 Introduction

The formation of urban planning can be dating back to the primary cities in previous centuries. On the other hand, the contemporary theory of urban design initiated to develop in Britain after the mid nineteenth century “...as a reaction against the industrialization which had created such great inequalities in living conditions by exploiting for profit whatever did not have to be paid for directly, such as housing, air, water and workers’ health” (Relph, 1987, p.49).

Elkin et al., (1991) believes that before the industrial revolution, people much preferred to live in rural areas. Although cities had been planned for decades, but after the industrial revolution only a small percentage of people lived in cities (Arbury, 2005). After the Industrial Revolution urban areas extended further than any other era in the history. This process was named *urbanization*. This phenomenon is taking place in developed or developing countries where human beings live. Most countries have the basic potential to this universal phenomenon that is mainly responsible for increasing the number of population and economy (Sudhiraa & Ramachandraa & Jagadishb, 2004). Excessive growth rate of population as a result of urbanization has led to upward growth of cities, which as consequence cities missed their realms and boundaries (Habibia & Asadib, 2011; Daramola & Ibem, 2010). Unplanned urbanization and dynamic urban development led to different

types of urban forms that urban sprawl is a primary form of urban development (Bhatta, 2010; Sudhira, 2008; Arbury, 2005). The word sprawl is given birth in the North America during the mid of 60's, when characteristics, determinants and results of this strange phenomenon of rapid urban expansion became a subject of the interest among planners and policy makers and started to be formally analyzed (e.g. Real Estate Research Corporation, 1974; Altshuler, 1977; Windsor, 1979).

Urban sprawl has been the main feature of Urbanization since World War II in several advanced countries such as “the USA, Australia, Canada,” and some industrialized European countries (Gill, 2008). According to what mentioned above, the aim of this chapter is clarifying definitions and characters of urban sprawl. Besides, different spatial forms, driving forces and costs of this phenomenon are discussed in this chapter. Finally, for ameliorating sprawl's costs, various ways for measuring urban sprawl is evaluated in this part.

## **2.2 Defining Urban Sprawl**

Based on extensive studies, urban sprawl is extremely difficult to define. The urban sprawl phenomenon has been discussed intensively by North American researchers (e.g. Downs 1999, Ewing et al. 2002, Hasse and Lathrop 2003, Lopez and Hynes 2003). Cervero (2000) believes that urban sprawl is in the parallel with pornography as it is hard to be defined however you know it whenever you see it, although other people see sprawl as a broad and general concept. There are innumerable reasons for these difficulties. One of these reasons is that the word “sprawl” is used in different discussions such as science, public and policy. Therefore, there are countable definitions on urban sprawl (Maier& Franz & Schrock, 2006). In oxford dictionary the term has been defined as “the disorganized and unattractive expansion of an

urban or industrial area into the adjoining countryside”. Sprawl has been expressed in the “European Environment Agency” (EEA) as the physical plan of low-density growth of large urban zones, under market requirements, chiefly in to the surrounding agricultural zones (Habibia & Asadib, 2011).

Many scholars tried to define urban sprawl. Brueckner (2000) described urban sprawl as an excessive spatial expansion of cities. “Sprawl ... is composed of areas of essentially urban character located at the urban fringe but which are scattered or strung out, or surrounded by, or adjacent to undeveloped sites or agricultural uses” (Harvey & Clark, 1965). “The scattering of new development on isolated tracts, separated from other areas by vacant land” (Ottensmann, 1977). According to Ewing (2008) viewpoints, sprawl can be introduced in four aspects which can be evaluated and criticized: residential density; neighborhood composed of houses, job and facilities; strength of activity centers; also ease of movement. In another study, Ewing (1997) claims that the main indicators can be defined as poor accessibility and less functional open spaces. “Continuous low density residential development on the metropolitan fringe, ribbon low density development along major suburban highways, and development that leapfrogs past undeveloped land to leave a patchwork of developed and undeveloped tracts” (Altshuler & Gomez-Ibanez, 1993. P.67). In other research, Song and Zenou in Sierra Club have described urban sprawl as low density expansion in the border of cities. In this development, the use of land is more than the growth of population. Sierra club define sprawl in their report of *The Dark Side of the American Dream* as “low-density development beyond the edge of service and employment, which separates where people live from where they shop, work, recreate and educate—thus requiring cars to move between zones”.

Therefore, scholars in Sierra Club believe that definition of sprawl is not only based on its characteristics, but also is based on its effects. Longley et al. (2002) interpreted that based on numerous crucial elements a definition of urban sprawl can be fed accordingly. Based on the last interpretation of sprawl, urban sprawl can also be defined in these ways:

*Sprawl definition based on form:* With respect to this type of definition, sprawl is not a particular urban form, but ranging from strip to scattered development. Accordingly, Ewing (1994) and Pendall (1999) refer these types of urban sprawl over a linear pattern of compact development to scattered development (Maier & Franz & Schrock, 2006).

*Sprawl definition based on land use:* Another criteria for defining urban sprawl is land use layouts. In (1998), “The Transportation Research Board” has listed the characteristics of urban sprawl such as low density housing expansion, single family houses with dispersed blocks, mixed of uses such as shopping malls and etc. As a whole, the essence of this approach is that sprawl is defined as low density urban development with a separation of functions (Maier & Franz & Schrock, 2006).

*Definition based on impacts:* Ewing (1994) and Johnson (2001) believe that different urban forms including sprawl are extremely debatable and important. Therefore, these terms are not distinguishable and it is suggested, that urban sprawl be defined by its costs and negative impacts. Al Gore (cit. in Wassmer 2002) believes that in such a circumstance, all negative impacts of urban form could be referred to urban sprawl, as the “enemy”.

*Definitions of sprawl based on density:* Scholars and researchers gave much more definitions of sprawl based on the density criteria. Generally, sprawl is directly related with low density urban growth. In many definitions, density in urban sprawl acts as an indicator of land use intensity which represents the ratio between the inhabitants of an area and a given land area (Maier& Franz & Schrock, 2006).

Varied definitions of urban sprawl have been mentioned, but still there is a lack of a precise definition. Although, there is an absence of clear definition of urban sprawl, however, few definitions have gotten general acceptance defining a number of characteristics. In this respect, urban sprawl defines as a certain form of urban development that described by low-density, leapfrog, commercial strip expansion and discontinuity (Ewing, 1997; Downs 1999; Galster et al., 2001; Malpezzi and Guo, 2001).Therefore, based on studies and researches a beneficial definition of urban sprawl could be provided with a measure that lets us clearly distinguish time and place of urban sprawl. Unfortunately, scholars believe that none of the commonly used definitions fulfills this requirement (Maier& Franz & Schrock, 2006).

### **2.3 Characteristics of Urban Sprawl**

In notes mentioned above, innumerable of the sprawl's characters have been mentioned indirectly. Burchell et al. (1998) gives a list of following characteristics of urban sprawl:

- “Low residential density,
- Unlimited outward extension of new development,

- Spatial segregation of different types of land uses through zoning regulations,
- Leapfrog (discontinuous) development,
- No centralized ownership of land or planning of development,
- All transportation dominated by privately owned motor vehicles,
- Fragmentation of governance authority over land uses between many local governments,
- Great variances in the fiscal capacity of local governments because the revenue- raising capabilities of each are strongly tied to the property values and economic activities occurring within their own borders,
- Widespread commercial strip development along major roadways,
- Major reliance upon the filtering or “trickle-down” process to provide housing for low-income households”.

Accordingly, a broad wide of discussion will be brought with this classification – the main problem with this list is that the limitation and distinction between causes, characteristics and consequences of sprawl is vague (Maier& Franz & Schrock, 2006). Galster et al (2001) gives the most explicit delineation of characteristics of urban sprawl. Galster characterizes sprawl in 8 dimensions:

- *Density*: is a widely used indicator of sprawl whereby different types of density can be described.
- *Continuity*: is the degree to which the unused land has been built densely in an unbroken fashion. Sprawl can be continuous or discontinuous in other places.

- *Concentration*: describes the degree to which development is located disproportionately rather than spread evenly.
- *Clustering*: sprawl is frequently clustered what means that it only occupies a small portion of the respective land area.
- *Centrality*: the loss of centrality is one of the most serious concerns about sprawl.
- *Nuclearity*: describes the extent to which an urban area is characterized by a mononuclear pattern of development.
- *Mixed uses*: sprawl is seen as a process that separates the different kinds of land uses (separation of homes, workplaces, conveniences, income segregation along residential communities).
- *Proximity*: proximity is the degree to which land uses are close to each other (housing, work, shopping, etc.). (p. 11-12)

Beside what mentioned earlier as the characteristics of urban sprawl, some scholars characterized urban sprawl as different spatial forms which will be discussed in the next section (Harvey and Clark 1971; Gillham 2002).

## **2.4 Different Spatial Forms of Sprawl**

Researchers and scholars over a period of time tried to understand the nature and growth of urban sprawl. As a whole, urban sprawl refers to the expansion of urban areas affected by uncontrolled, uncoordinated and unplanned growth. There are different types for urban sprawl development. For instance, Harvey and Clark (1971) have categorized urban sprawl in three basic spatial forms, namely: leapfrog development sprawl, ribbon sprawl and low density continuous sprawl (Barnes, & Morgan, & Roberge, & Lowe, 2000). However, according to Gillham (2002) together with these three characters there is a fourth characteristic of sprawl which is single use development that each of them will be explained in the following.

### 2.4.1 Leapfrog Development

Leapfrog development is one type of dispersed form of urbanization development when developers build new residential area some distance from existing urban area. In other words, extenders jump from a built-up urban area to another area by lay away vacant lands which located near the built-up urban area (Figure 1). Besides, it can be mentioned developers decide to build new urban areas on less expensive lands in some distance from existing urban area rather than on expensive lands closer (Holcombe & Pope& Bast, 1999).



Figure 1: Leapfrog Development (Source: Ewing & Pendall & Chen, 2003)

This kind of sprawl development is caused by various factors include physical geography such as “rough land, marshes, mineral lands, or water bodies” may avoid continuous development or make it extremely costly ( Figure 2) (Barnes, & Morgan, & Roberge, & Lowe, 2010). However, costs of lands outside of an urban area are cheap and built residential units in these developments is affordable. In such a condition, many of people accepted longer transportation in commute for more comfortable and easy access to much cheaper residential units. Moreover, leapfrogged development generate vacant lands where a perfect position for commercial activities such as offices, shops, cafe and restaurant is created (Holcombe & Pope& Bast, 1999). However, there are other factors which encourage

leapfrog sprawl development but they are not definitely physical for example special land-use strategies may conductance development to “jump” to one which is arranged for development (Barnes, & Morgan, & Roberge, & Lowe, 2010).

According to numerous research that scholars did, leapfrog development due to its infrastructure and basis of development led to several issues such as some extra costs, create longer distance and longer commutes from origin to distance, and more traffic congestion (Holcombe & Pope & Bascreate t 1999). Accordingly, one of the main problems with leapfrogging is that auto dependency increases and people prefer to use car instead of walking or biking when they want to travel between the two developed areas (URL 1).

#### **2.4.2 Strip or Ribbon Developments**

Commercial strip development is another type of urban sprawl which characterized by “...huge arterial roads lined with shopping centers, gas stations, fast food restaurants, drive-through banks, office complexes, parking lots and many large signs” ( Figure 2) (Gillham, 2002,p. 5). ‘Strip development’ is very low density and car dependent that lead people out of the main city, with retail in long, small blocks which are constantly surrounded by large parking lots and causing more miles to be used for roads (Arbury 2005). This kind of development has its own advantages include bringing together businesses for example “fast-food restaurant and big chain stores that depend on high auto traffic” as well as this kind of sprawl development decline distances which cars shall commute from store to another store or office to office; therefore, this kind of development has directly effect on overall traffic and reduce it.



Figure 2: Uncentered Strip Development (Source: Ewing & Pendall & Chen, 2003)

. In this regard, suburban roads among the commercial arteries have quite little traffic. According to the recent research, strip development is caused several problems but the main reason is weak planning. Hence, this kind of sprawl development with “spread out” nature, like other types cause road traffic because customers and employees are entering into and exiting from roads as well as trips among retails are done by automobile and pedestrians’ needs are not considered at all (Arbury 2005; Holcombe & Pope& Bast 1999).

### **2.4.3 Low Density Development**

The most commonly recognized and important aspect of urban sprawl is known as low density (Figure 3). Low density sprawl development is caused by external dispersing of low-density outlying land uses which many of American towns and their residents have experienced. Generally, buildings in ‘sprawl’ developments have defined characters including one-storey dwelling with wide open spaces which can be used for off-street parking or roadways. According to approved researches, density is usually measured based on population density, or in the other way according to dwelling units per area.



Figure 3: Low Density Development (Source: Ewing & Pendall & Chen, 2003)

Accordingly, “low density” happens when a population density of an urban area is fewer than 25 people in each hectare. With respect to extensive research and earlier explanation most “North American, Australian and New Zealand cities” are low density, but many cities in Europe and Asian respectively with density of around 50 and over 100 people per hectare (Elkin et. al., 1991).

#### **2.4.4 Single Use Development**

Single-use development and growth is the consequence of zoning laws that separate land uses. Accordingly, this means one function can be used for the land (Figure 4) (Holcombe & Pope & Bast 1999). This provides a barrier to access and live in a close neighborhood with commercial establishments (URL 1).



Figure 4: Single Use Development (Source: author)

Accordingly, single-use development as another type of urban sprawl is originated as a potentially positive response to the great problems of primary industrialized cities (Arbury, 2005).

## **2.5 Driving Forces for Sprawl**

According to statements of scholars in various researches, sprawl is a feature of development on urban settlements that focuses on essentially expansion of land and changes in land uses. In this respect, millions of separate choices that have been made by individuals and governments are the end result of transformation of land uses. There is a wide range of driving forces of urban sprawl in different debate which will be mentioned a summary of these causative agents as below.

### **2.5.1 Urban Expansion and Population Growth**

As a whole, increasing the population of urban settlements (or cities) is the primary and foremost reason of expansion of urban areas throughout the world. Hence, there is no doubt that growing of population is an indisputable fact and majority of this population are becoming urbanized. In this regards, can be noted rapid expansion of cities is dominated by two factors: immigrations and the natural population growth (Bhatta, 2010 & Günay, 2007).

Generally, cities provide better opportunity for residents including higher wage rate, better services and lifestyles so, urban areas perceive as demanding places where one could have a better quality of life. Moreover, the perceived better access to services stimulates poor people from rural areas. Thus, seeking better economic prospects is one of the reasons that people mainly move into urban areas. Also, these conditions

dramatically increased throughout revolution era from a pre-industrial society to an industrial one (Bhatta, 2010).

By and large, the rapid urban population growth may be a crucial factor contributing to cause unplanned and uncontrolled urban expansion such as sprawl. The explosive growth of urban areas put increasing strain beyond their capacity to provide basic amenities such as energy, public services (health care and education), public transportation, sanitation infrastructure and physical security. Since the growth of government revenue have declined to spend on the basic maintenance of cities and the provision of public and utility services, urban settlement turn into areas of massive sprawl and major environmental issues (Bhatta, 2010).

### **2.5.2 Consumer Demand**

There is no doubt that rather than two other factors, finding a definition for social factors and understanding their ultimate impacts on land-use pattern is extremely difficult, due to, being personal and eclectic. The transformation of land use at urban fringe is not always depending on environments factor but also human decisions play a pivotal role in the development of an area. For instance, the outward extension of housing areas which are the major underlying factors for the development of sprawl are closely associated with the households' demand. Therefore, increasing in large houses in secure and natural environment is closely associated simultaneously with high level of income and changes in life style (Velibeyoğlu, 2004). Besides changes in lifestyle, major environmental issues in cities such as increased air pollution, noise and crime in center gave rise to move to suburbs (Günay, 2007).

### **2.5.3 Employment, Economic Development, and Technology**

In general, rapidly expansion in economic base (such as higher wage rates, increase in number of employed persons) can contribute to higher aggregate demand for new housing or more living space for individuals (Boyce 1963; Giuliano 1989; Bhatta 2009b). “Developments in information and communication technology have been a major driver in economic expansion. New technologies have changed the economics of spatial decisions, both for consumers and businesses, and are facilitating the existing trend toward a more dispersed economy. Although the new technologies will technically enable firms and residents to disperse to rural areas, they are more likely to relocate both to lower cost metropolitan areas and to suburban and exurban locations within metros” (Heimlich and Anderson 2001).

### **2.5.4 Infrastructure and Transportation**

Evidence of urban planning shows that organically growing cities have tangible and predictable stages of development. After constructing new houses, people demands for having convivial life style such as new schools and the primary infrastructure is increased. As a consequence density rose. The new housing developments are built and occupied, the new residents realize they need new schools and improvements in the roads, sewers, and water supplies servicing the new housing; the expanded infrastructure then attracts more housing at higher densities. When a critical mass is reached, shopping centers and businesses follow the population, to serve them and to be closer to the labor force. Since infrastructure provides the base framework for new development, investments in this field is act as one of the most important feature of urbanization and urban sprawl (Heimlich and Anderson 2001). With extensive explosion of population, wide main roads such as expressways and highways can act as the causative reason for congestion (Harvey and Clark 1965). It is

important to realize that transportation facilities are vital elements for cities and its surrounded neighborhoods (Bhatta, 2010). So, high level of population growth and demand on land requires closer access to the better-serviced areas which are along the roadsides. Due to this reason, sprawl firstly occurs through transportation axes in general.

### **2.5.5 Poor planning and Management**

In many cases, there is a debate that, absence of consistent and well-experimented planning and development strategies may also contribute urban sprawl (Bhatta, 2010). Local governments have minimal policy instruments to appreciate coming growth facing them, and there has generally been a lack of adequate planning policies and programs before population growth overcomes them (Günay, 2007). In some cities, authorities use exclusive zoning regulations; this means separation of land uses. Zoning ordinance and regulations created isolated island fabrics of each type of development. Accordingly, in most cases, reliance on the automobile had become a mass-consumption commodity for transportation between residential units and the separate types of land uses, generating major issues of automobile dependency and excessive use of fossil fuels raise environmental concerns such as pollution (Bhatta, 2010). As mentioned earlier, poor planning policies cause changes in landscape and with growth of population people's tendencies to move to suburb has been increased, hence, population growth, basic demands and land use change are connected (Günay, 2007).

### **2.5.6 Lack of Affordable Housing**

Increasing costs of living is another reason of urban sprawl. "Affordable housing is a term used to describe dwelling units whose total housing costs are deemed affordable

to those that have a median income ” (Sani et al., 2012). Commonly community-wide affordability can be measured as the number of homes which a household with an average percentage of median income and property can afford. For instance, in a well-balanced real estate market, the median household income (and as well as the half of the households that have greater income) could officially afford the median price of housing option, while those with lower wage-earner than the median household income could not afford to buy the median home. As a result, a shortage of affordable housing in cities drives people to set their residences out of the communities in the countryside (Bhatta, 2010).

## **2.6 Costs of Sprawl**

Burchell et al. in (1998) characterized urban sprawl as “relatively low-density, noncontiguous, automobile-dependent, residential and non- residential development that converts and consumes relatively large amounts of farmland and natural areas”. According to varied studies, concern about urban sprawl is not completely new, however the magnitude and the nature of this universal discussion have evolved through time. Based on recent debates and discussion, urban sprawl as a pattern of growth, has been often the subject of criticism for its extensive negative Impacts (Günay, 2007). In recent years, scholars believe that the phenomenon of urban sprawl has been strongly linked to a broad array of environmental, economic and social network of impacts (Fan& Bengston& Potts& Goetz, 2004).

### **2.6.1 Environmental Costs of Urban Sprawl**

Urban sprawl may be an attractive phenomenon for public and private sectors such as homeowners and developers at the individual consumer level; however it does incur particularly severe environmental costs (Guiliano and Narayan, 2003; Garcia

and Riera, 2003; Anderson et. al., 1996; Kenworthy and Newman, 1990). Based on extensive studies environmental costs is the widespread concern that sprawl leads to excessive environmental damage including “higher energy and land consumption, loss of heritages, loss of agricultural land, climate alteration, decreased air and water quality, and loss of biodiversity” (Table 1) (Newman and Kenworthy, 1989; Burchell, 1998; Benfield et al., 1999).

#### ***2.6.1.1 Energy Consumption***

There is some evidence that demonstrate on beliefs of Ewing (1997) and many other scholars which growth in automobile use, causes high level of energy usage in urban sprawl (Burchell et al, 1998). When investigating and assessing the cost of this universal phenomenon on energy consumption patterns, changes in land use such as housing/working and/or accessibility including transport/mobility patterns are expected to have effect on the environment. Urban planners with accurate and precise point of view believe that changes in housing developments (e.g. separated housing, alternative technology) may lead to a change in the amount of energy consumed. In more detail, it has been expected that urban sprawl led to (Nuissl & Rink & Steuer, 2005):

- (a) An increase in the total use of fuels and resources due to excessive regional development in terms of residents, houses, industry, etc;
- (b) An increase in the household consumption of fuels for each household (household energy consumption in a detached house will be higher than a block of flats);

© A change in the consumption of total energy mix, including the mix fuel used for heating (e.g. consumption of more advanced heating technology led to alteration in heating patterns);

(d) An increase in the energy use especially petrol and gasoline due to high level of transport demands (particularly for commuting).

### ***2.6.1.2 Land Consumption***

By and large, the rapid development of land for ‘urban’ multiple purposes including housing, production, retail, leisure and the following loss of built heritage, natural open spaces and agricultural land and pristine green spaces are universal effects and consequences of urban sprawl trend(cf. Chin 2002).

According to recent debates, the simple exploitation and consumption of more land is not only the problem but also the future pattern of land development is an issue. Commonly, since World War II every new development has been planned and built for ease of auto travel. In the last half of the 20<sup>th</sup> century, authority of cities strictly divided land into single-family-home on large-lot, subdivisions which are linked by major and wide arteries such as highways and streets to large shops and shopping center, under such a circumstance, citizens have made car ownership and driving mandatory in virtually all new urban built development in many metropolitan areas. In fact, this urban development pattern means stimulation of auto travel even for short trips (Benfield, et al. 1999; Oge 1995).

In many communities with regard to future trends, rapid urban development has led to growing concern that in the close future; ultimately “open space” will be more remote and inaccessible to most city dwellers. Among other areas, loss of prime

agricultural land is a great recurring concern of residents (Goldberg, 1999). Most planners and policy makers believe that sprawl eliminates more farm land from agricultural uses than other compact forms of expansion. Scholars have mentioned three significant reasons for this event. First, in residential development of low-density sprawl pattern, requirements of more space for directly settlement of dwelling units are inherently essential. Second, the settlement of scattered dwelling units far beyond the built-up edges renders to the much more consumption of agricultural land inefficiently that is adjacent to the scattered dwellings under significant development pressure. Third, in the light of obtaining high prices for land, farmers and land speculators have been motivated to assemble large tracts of contiguous farmlands which can be bought in bulk (Burchell et al, 1998).

Loss of green areas is another impact of land consumption which causes by urban sprawl. Green spaces perform an important role in the environment of urban are by providing a wealth of opportunities for varied outdoor recreation, wild life habitat value and improving environmental quality (Stepheson 1999, Stole 1999).

#### ***2.6.1.3 Loss of Heritage Sites***

Loss of heritage sites is the view as the inevitable outcome of metropolitan that sprawl threatens historic and cultural sites and milieu such as historic and prehistoric buildings and downtown areas as well as historic districts, archaeological sites and landscape (Fan et al., 2005). Sprawl makes it extremely difficult to protect and restore historically significant older city structures. Sprawl makes it extremely difficult to protect and restore historically significant older city structures. Besides, sprawl development in urban areas has created a condition to companies and families to leave older cities and inner ring's suburb areas as well as gave permit to them for

moving to the exurban areas sans any determinative rules to pay the peripheral costs of what they doing. Due to existence of regulations and policy barriers simultaneously the economic base condition, supporting and formulation of strategies to revitalize historic core structures is weakened. Besides, increasing concentration of poverty has led to worsen neighborhood condition in the immediate vicinity of such historic structures that caused eventually to consumption of old structures in that location by these forces (Burchell et al, 1998).

#### ***2.6.1.4 Air Pollution***

Sprawl worsens the overall air quality in a city. Sprawl is alleged to create more demand vehicle for automobile travel than other types of urban development that results in producing more total vehicle emissions. So, local climatic conditions can intensify total amount of air pollution, although it may lead to less intense local pollution where the urban areas have high density in compact regions (Burchell et al, 1998).

Air pollution has tremendous implications for human health. Carbon monoxide reduces executive functions such as work capacity, manual dexterity and learning ability as well as makes difficulty in performing complex tasks. Besides, contaminations in the air pose significant health hazards and risks for different age of groups including the elderly, the young, and to those who are suffering from respiratory problems. In addition to human health risks, it damages and irritates lung tissue, aggravates or leads to asthma, and includes choking, coughing and burning throat, and tearing in eyes (Benfield et al, 1999, 56-58; Office of Air and Radiation, 1995; Office of Mobile Source, 1993).

#### ***2.6.1.5 Water Pollution***

Urban sprawl can affect quality of water in several ways. Causes of water pollution can be categorized in two different ways: the most well-known type is “point source,” that discharges of sewage treatment plants or factories flow directly into water bodies such as river, stream, lake or reservoir. However, on the other hand “non-point source” pollution is a more difficult issue (Gurin, 2003). Non-point source water pollution is caused by runoff (rainfall or snowmelt) moving across the land surface, picking up pollutants and sediments and finally depositing them into watersheds (lake, river, wetland and marshes). There are various types of non-point source pollution. Accordingly, the growing form of source pollution is the ones from oil, grease and poisonous chemicals which can be produced in different surfaces such as road ways, parking lots and the other form includes sediment from improperly new development and construction sites. As a result, by better controlling “point source” water pollution, “non-point source” pollution has been identified as the major source of threat to water supplies (Frumkin, 2001).

#### ***2.6.1.6 Biodiversity***

Destruction of habitat is the primary contributor to the extinction of most terrestrial animals and plants species (Baillie and Groombridge 1996), however the effect of human development or roads construction may lead to much greater extinction than the immediate habitat loss (Forman 2002). The main reason why sprawl is such a greatest threat to biodiversity and global species is not only due to the conversion of habitat to road or building construction, but also the level of human disturbances is higher on the larger landscape (Forys & Allen, 2005).

Many species of animals simply avoid using areas with even moderate human settlements development or extreme activity levels. Furthermore, alteration of land use and land cover poses significant barriers to the movements of animals, and fragments existing landscape. Road networks, habitat fragmentation and literal barriers restrict movement of animals by blocking migratory movement of species and dispersal patterns within populations. Road may be constructed to create a major barrier for animal movement and also preempt some wildlife habitat (Fahrig et al., 1995, Forman, 2002). Movement of terrestrial animal may be affected and changed by corridors and fragmentation. Decreased connectivity contributes to increasing isolation of many populations which result in a loss of genetic variation and population viability (Lande and Shannon, 1996, Hale et al., 2001).

To put it in the nutshell, these potentially damaging activity include roads and new development have significant negative impact on the natural ecosystem that can lead to the dramatic increase in the non-native invasive organisms in the surrounding area (Elton, 1958; Simberloff, 1981; Rejmánek, 1989).

### **2.6.2 Economic Costs of Urban Sprawl**

According to the recent researches, one of the most controversial, a contentious and confusing issue in the sprawl discussion is economic cost of rapid, low-density growths of land (Goldberg, 1999). Hence, sprawl economic costs classified as “increased infrastructure costs and public operating costs, high- priced housing and higher aggregate land costs” (Table 1) (Burchell et al., 1998; Downs, 1973; Schafer, 1975).

### ***2.6.2.1 Higher Infrastructure Costs***

Urban researchers and authorities believe that Infrastructure such as roads, water and sewerage lines, and schools, is more cost demanding under sprawl than under higher density urban development (Frank, 1989; Duncan, 1989; Archer, 1973; Duensing, 1977). This claim refers to two groups of infrastructure that is primarily public as “state, county, or local government roads and highways; public utility systems; and public schools” and infrequently private as “privately owned utility systems and subdivision- level roads that are not dedicated to the public sector”( Burchell et al., 1998).

There are several reasons which caused costs of infrastructure in urban sprawl. At sprawl’s low density style of development; various elements of infrastructure in a linear pattern including “sidewalks, curbs, subdivision-level roadways, and water and sewer mains” work as a lesser expansion of development than one’s in a higher levels of density”( Burchell et al., 1998).

Infrastructure costs would be further increased with spatially segregation of types of land uses in urban sprawl. With regard to distinct separation among residential and non-residential land uses, a balanced infrastructure system has to be provided for two groups of land uses. However, fragmented development and governance, usually leads to “duplicative city halls, police stations, courts, fire houses, schools, water/sewer treatment facilities, and so on” ( Burchell et al., 1998).

### ***2.6.2.2 High Housing Costs***

Sprawl causes increasing in the costs of construction and housing occupancy due to larger layout and lot also structure size in the urban location. Costs of development

are associated with land along with improvement costs that scale of each is taken to consideration (Burchell et al., 1998).

The most cost-demanding type of housing is commodious single-family dwellings which are sited on the large lots; similarly, large tracts of land have been devoted to excessively spread-out, low-rise commercial and/or industrial development which is considered as the most expensive type of non-residential uses. These two categories have been included as low-density pattern of development (Burchell et al., 1998). Downs (1973), Schafer (1975), Seidel (1978), and other scholars have reached to a common decision that large-lot zoning and minimum constructed found that large-lot zoning and minimum building size increase the costs of new housing. This same type of analysis applied to nonresidential development has produced similar findings (Burchell 1992- 1997).

Residential and nonresidential development costs are affected by two factors such as: 1) the total amount of available zoned land for new development with respect to zoning regulations; and 2) time-consuming procedure of development to engage permitting process (which is underlined on the local land-use laws) (Burchell et al., 1998).

### ***2.6.2.3 Higher Aggregate Land Costs***

High urban land cost is another symptom of urban sprawl. This is happening in urban sprawl pattern where the average rate of land may be lower, due to occupying more suburban land by total population (Burchell et al., 1998).

Sprawl development pattern incurs never ending upward costs. Many authorities have particularly emphasized on physical costs which are associated with land, namely inflated costs of infrastructure in urban sprawl settlement (Burchell et al, 2005; Wassmer & Bass, 2004). According to extensive research in previous decades, sprawl comes with a high level of price tag (Osman & Nawawi & Abdullah, 2008).

### **2.6.3 Social Costs of Urban Sprawl**

There is a growing concern among officials and scholars about the social impact of urban sprawl in recent years. (Fan & Bengston & Potts & Goetz, 2005). The most damning evidence of sprawl's unsustainability is societal effects of this phenomenon which are difficult to include all measures factors accurately. Hence, urban sprawl has adversely effect on social sustainability through "negative health impact, a loss of community, foster spatial mismatch, foster residential segregation and inner-city decline" (Table 1) (Gillham, 2002; Hillman, 1996; Deal and Schunk, 2004; Sturm and Cohen, 2004; Song and Knaap, 2004; Duany et. al., 2000).

#### **2.6.3.1 Public Health**

Public health is another major issue associated with urban sprawl (Randolph, 2004). By and large, travel in sprawl development generates multiple health hazards. In more sprawling communities, travel will be increased because the places where individuals live, work, shop and recreate are far from each other. Thus, a major source of increased vehicle use is sprawl due to increasing dependence on the automobile and traveling longer distances. Vincent et al. (1994) & Ray et al. (1994) & Novaco et al. (1990) found that increased commuting is associated with increased levels of stress. According to statistical analysis which has been done by Koslowsky

and Krausz (1994) there is a strong linkage among “commuting time, stress, and workers’ attitudes toward their jobs”.

In such circumstances, current residential choices as a reaction to the existence condition are believed to have effects on the population’s health in various ways such as reductions in level of physical activity, high rate of automobile crashes and pedestrian fatalities and increasing air pollution (Frumkin, 2002).

#### ***2.6.3.2 Weakened Sense of Community***

Some authors have made debates that sprawl leads to social problems such as declining social capital and personal neighborhood ties between residents (Burchell et al., 1998; Ewing, 1997; Calthorpe, 1993). Generally, low-density sprawl development makes households’ connections weak in 2 directions primary in the close neighborhoods and then to the larger metropolitan community, also urge strongly unsociable values. In the small scale, social linkages with residents in a close neighbor is reduced due to several reasons such as low level of residential density, the heavy dependency on car and lack of accessible local retail outlets. In the larger scale of city, civic linkages with other citizens are also weakened by the forested governmental fragmentation and separated economic resources that avoid commonality of purpose among residents or even make laws for diffusion of accommodation and workplace in an area. As a result, loss of sense of community provide difficulties in generating support for social and local attacks which need actions more than local policies (Burchell et al., 1998; Goetz, 2002).

### ***2.6.3.3 Fosters Spatial Mismatch***

Spatial mismatch has been examined by many researchers such as sociologists Kasarda (1990) and Wilson (1987). According to numerous researches which has been done about this issue, the beginning of the spatial mismatches can be referred to the inconformity of young black works in the USA. In inner-city districts, high level of unemployment is resulting of “spatial mismatch” among places which many new jobs produced and numerous low skilled workers lived. High rates of employers have been moved to places that are far beyond inner-city neighborhoods due to unlimited outward extension of urbanized uses on frontier of metropolitan areas. Hence, workers without jobs do not have chance to be inform about job opportunity in others place in far-out location; meanwhile; unemployed workers nor afford to reach these kinds of jobs if they be informed about them. Consequently, this inconformity both in high level of unemployment in inner-city districts and suburban lack of unskilled worker is based on race as the main causative (Burchell et al., 1998).

### ***2.6.3.4 Fosters Residential Segregation***

Race and income are two factors that contribute to residential segregation under urban sprawl. Inhabitants of each society control land-use planning decisions so, exclusionary zoning restrictions which proposed by far away suburban communities prevent construction of affordable housing for low and middle income households, while there are certainly socially segregated neighborhoods in cities. Residence’s interest is the main factor in making such decision without involving other aspects such as region’s interests or citizens’ enthusiasm in other parts (Freilich & Peshoff, 1997). Inhabitants in a community with crucial economic motivation try to reduce the number of low-cost residential units by maintaining real estate fees as high as

possible and without considering households whose need to access public services will cost the local communities more than paid taxes by them (Fischel, 1985).

Spatial distribution of “gated community” which the most extreme form of urban sprawl represents complete social exclusion of “undesirables” as a consequence of the loss of public space such as streets. In some respects, urban sprawl in the summit processes have created the “gated community” that Le Goix (2005, p.323) expresses them as ‘...a physical and obvious expression of the post-industrial societal changes (fragmentation, individualism, loss of communities), as part of a commoditization of urban public space, and as a penetration of ideologies of fear and security supported by economic and political factors’.

Generally, gated communities are extremely universal; as stated by Blakely and Snyder (1997) there is about 20,000 such communities that include more than three million residential blocks. Besides, the exclusive characters of gated communities develop a permanent isolation pattern for children who live inside of such communities with those maturing outside the gate (Duany et. Al., 2000).

#### ***2.6.3.5 Worsens Inner-City Deterioration***

Decline of the inner city is another costs that urban sprawl as a leader can be blamed (Nuissl & Rink & Steuer, 2005). Mostly deteriorated areas in the city center tend to motivate families and business firms that are economically viable to move elsewhere. Besides, the same conditions also strongly dishearten families and firms that are financially viable from moving into those inner-cities in general and into neighborhoods with high level of poverty in particular. As a result, households and

firms with high level of economic and social viability left settling in such deteriorated communities (Burchell et al., 1998).

According to initial discussion, urban sprawl as a universal phenomenon has occurred in developed or developing countries which have made concerns and debates for scholars and authorities. With respect to the characteristics of urban sprawl, this phenomenon has been the subject of criticism for its negative environmental, economic and social impacts which are come together briefly in Table 1.

## **2.7 Measuring urban sprawl**

Since the aim of this study is to analyze type and costs of urban sprawl, it is essential to review measuring techniques of this phenomenon. Increasing numbers of communities across the nation are discovering a significant linkage between urban sprawl and a full range of related issues such as air contamination, city core poverty and the degradation of urban areas. Governmental authorities are making decision to ameliorate sprawl's costs, while they are looking for meaningful and fundamental information about the measuring characteristics, exact extent and consequences of sprawl (Ewing & Pendall & Chen, 2002). Actually, sprawl has been hypothesized in recent researches and academic works as a multidimensional phenomenon that stands in need of various set of measures for each and every dimension (Torrens & Alberti, 2000; Galster et al., 2001; Ewing et al., 2002).

Scholars have made numerous attempts for measuring urban sprawl; also they have used various scientific methods and approaches. Since urban sprawl has an extremely broad concept, it is difficult to measure, as well as it is essential to choose

the appropriate scientific method for measuring urban sprawl. As a result, for measuring the degree of urban sprawl, there are numerous aspects which have to be considered accurately (Franz & Maier & Schröck, 2006).

Table 1: Negative Impacts of Urban Sprawl Based on Burchell et al., 1998

| <b>Costs of urban sprawl</b>               |  |
|--|--|
| <b>Environmental costs of urban sprawl</b> | Energy Consumption<br>Land Consumption<br>Loss of Agricultural Land<br>Loss of Green Areas<br>Loss of Heritage Sites<br>Air Pollution<br>Water Pollution<br>Biodiversity |
| <b>Economic costs of urban sprawl</b>      | Higher Housing Cost<br>Higher Infrastructure Costs<br>Higher Aggregate Land Costs  |
| <b>Social costs of urban sprawl</b>        | Public Health<br>Weakened Sense of Community<br>Fosters Spatial Mismatch<br>Fosters Residential Segregation<br>Worsens Inner-City Deterioration                          |

With respect to varied scientific researches, there are different however almost common components in measurements divisions of different scientists. Frenkel &

Ashkenazi (2008) divided the measurements into five major groups: “growth rates, density, spatial-geometry, accessibility, and aesthetic measures” (Frenkel & Ashkenazi, 2008).

Hanson and Freihage (2001) apply metrics to define land expansion along six main geographical dimensions: “density, continuity, concentration, centrality, nuclearity; and diversity.” In part 2.3 mentioned the eight major dimensions of urban sprawl which strongly developed by Galster et al. (2001). This sub-section demonstrates how these features that have common dimensions with Hanson and Freihage (2001) divisions, can be appropriately applied for measuring sprawl. The eight conceptually distinct dimensions that also will be used in case study part are described as follows (Galster et al., 2001):

- 1) Density: According to Galster et al. (2001) this is the main measurements of urban sprawl. “Sprawl may be defined as the average number of residential units per square mile of developable land in an urbanized area.” Developable land is devoted to lands without natural landscapes, civic uses, and regulatory restriction.
- 2) Continuity: “May be defined as the degree to which developable land has been developed at urban densities in a continuous and unbroken fashion” (Galster et al., 2001). This dimension shows the degree of leapfrog development. According to Galster et al. (2000), Bodies of water, protected wetlands, natural forests, parks, deep slopes or soils, are not taken into account as interruptions of continuous development patterns.

- 3) Concentration: “May be defined as the degree to which development is located in a small fraction of the total UA rather than well spread out” (Galster et al., 2001). This dimension makes a discriminant between those urban areas where most residential blocks and employment are located in a close proximity at uneven high densities and those where developments are more evenly spread within the urban area (Handy et al., 2002).
- 4) Clustering: “Compactness or clustering may be defined as the degree to which development has been bundled to minimize the amount of land in each square mile of developable land occupied by residential or nonresidential uses” (Galster et al. 2001).
- 5) Centrality: “as the degree to which residential and/or nonresidential development is located close to the central business district (CBD) of an urbanized area” (Galster et al., 2001). Generally, more centrality in an urban area leads to less distance from the CBD. In addition, greater distances from the city center demonstrate an area with greater sprawl (Handy et al., 2002).
- 6) Nuclearity: “Is the extent to which an urban area is characterized by a mononuclear (as contrasted with a polynuclear) pattern of development” (Galster et al., 2001). If CBD of new developments is the only location of mixed use, an area will have a mononuclear structure, on the other hand, if the same activities are spread over several intensely developed places and each include an active mixed uses, it is polynuclear. Besides, it is possible that nuclearity and concentration be linked (Handy et al., 2002).
- 7) Mixed Uses: “As the degree to which two different land uses exist within the same small area and the extent to which this pattern is typical of the entire urbanized area” (Galster et al., 2001). As the variety of uses in a civic society

decreases, travel time and average distance of the inhabitants in the area increases. Besides, if an urbanized area has exemplary characters of single uses, the negative impacts of sprawl increase (Handy et al., 2002).

- 8) Proximity: “May be defined as the degree to which different land uses are close to each other across an urbanized area” (Galster et al., 2001). Proximity is measurable by calculating average distance that persons shall travel from origin to destination. If most people shall travel great distances within an urban area that place has lower proximity among uses. Besides, another substantial feature in the density of connected activities is proximity of similar uses to each other in inner-city area. Moreover, a less important feature of sprawl development that the proximity of dissimilar but supplementary uses such as “housing and employment or consumer goods” (Handy et al., 2002).

Galster et al. (2001) used qualitative and quantitative techniques based on the eight dimensions in his article for measuring urban sprawl. According to the article, for qualitative technique a based map is organized and the eight dimensions are designed on this map based on their definitions. On the other hand in the quantitative technique, he applied their definitions to 13 large urban areas with various economic condition and demographic composition to conclude whether they make sense.

## **2.8 Summary of the chapter**

Although urban planning has a rich history that can be dating back to the previous centuries, however after industrial revolution urban areas has extended further than any other era and only a small percentage of people lived in cities. This process was named *urbanization* that is taking place in all over the world. Unplanned

urbanization led to different types of urban forms, that urban sprawl is a primary form of rapid urban expansion caused many negative social, environmental and economic impacts. As a consequence, characters, driving forces and costs of this universal phenomenon were delineated to know how to measure sprawl and overcome side effects of this phenomenon.

The focus of this chapter is on urban sprawl which plays a crucial role in the current urban development issues. This chapter presented four spatial forms of urban sprawl including leapfrog development, ribbon or strip development, low density development and single use development, as well as explained negative environmental, social and economic costs of urban sprawl. At the end of this part discussed different techniques and categories for measuring urban sprawl; however this thesis will be used Galster et al. (2001) measurement method for analyzing urban sprawl. Thus, in the following part sustainable urban forms that can be used to solve contemporary urban sprawl's issues will be discussed.

## Chapter 3

### SUSTAINABLE FORMS AGAINST URBAN SPRAWL

#### 3.1 Introduction

During the twenty century, the population of human throughout the world has been growth extremely and unprecedented influx of human population to urban area causes urbanization around world. Moreover, this phenomenon in developing countries creates many problems such as “disease, political conflicts, and developed nations have to deal with issues such as “infrastructure deterioration, pollution, and unlimited urban expansion with limited resources” as well (Jaspar, 2008; Mensah & Castro, 2004).

According to notes mentioned above and numerous negative effects of urbanization throughout the world, the need of universal concept of “Sustainability or Sustainable development” is essential. This concept has potential as a solution for the various worldwide, regional and local issues facing humanity these days (Mensah & Castro, 2004). In this regard, many scholars (Dixon & Fallon, 1989; Scoging, 1993; Firor & Jacobsen, 1993; Schwab, 1996) clarified that the term of “sustainability” originally use among scientists studying approaches to make sure about suitable consumption of basic natural resources such as “water, energy and soil”. Thus, it can be mentioned the initial focus of the term “sustainability” is on matters related to the environment (Aguirre, 2002).

Moreover, at the present time the connection between sustainability concept, urban areas and community is one of the most argued subjects and the concentration of concerns on the global environmental plan (Mensah & Castro, 2004). However, the shape of current cities and urban settlements has been perceived as a main cause of environmental issues (Beatley & Manning, 1997; Newman & Kenworthy, 1989). Hence, the “sustainability” concept has resurrected debate through the form of urban settlements (Jabareen, 2006). Surely, this concept has encouraged scholars and experts in different disciplines to search for appropriate support tools for towns and urban settlements to estimate future urbanization trend toward to reach sustainable urban form (Watanabe et al., 2005; Jabareen, 2006). Generally this can be mentioned, “Sustainable development or sustainability” is a holistic approach to increase the quality of human life and dominate on the challenges related to the environmental in communities (Mebratu, 1998; Torjman, 2000).

As consequence, , the purpose of this chapter is clarifying definitions and the goal of sustainability and sustainable development, as well as evaluating sustainable urban forms which proposed by scholars to use for confronting today’s urban development issues.

### **3.2 Sustainability or Sustainable Development**

As mentioned above the sustainability approaches are essential to use in all dimensions of human life to improve the quality of life and confront with the environmental challenges in societies throughout the world. In this regard, the focus of this part is on clarifying definition of sustainability, dimension of sustainability, and sustainable development and urbanization which will be explained in the following.

### **3.2.1 Definitions of Sustainability or Sustainable Development**

Between 1972 and 1992 within various global conferences, the subject of “sustainable development” was preceded (Hurley, 2009; Drexhage & Murphy, 2010). In 1972, the first discussion about sustainability with focus on global environment concern was done in the “United Nations Conference on the Human Environment” in Stockholm (Adams, 1990). In this regard, in 1980 in the “International Union for the Conservation of Nature”, the recommendation of Stockholm conference were more expanded and “World Conservation Strategy” with the title of “Living resource conservation for sustainable development” was published (Grober, 2007; Drexhage & Murphy, 2010).

One of the main commissions that did numerous researches on “sustainable development” and was involved of representatives from both developed and developing nations is “The World Commission on Environment and Development” (WCED). This commission was established in 1983 (Jaspar, 2008; Drexhage & Murphy, 2010). In 1987, this commission published its famous report as the Brundtland report to contribution for understanding of sustainable development and increased universal attention to the concept of sustainability (Bell & Cheung, 2009).

However, the most universally used definition of sustainable development has been published by the Brundtland report as “Development that meets the needs of current generations without compromising the ability of future generations to meet their own needs” (WCED, 1987, p. 45). Besides, this universal report recommended several new approaches to achieve sustainability. The Brundtland’s definition of sustainability consists of two key concepts: (Mebratu, 1998)

- “The concept of “needs,” in particular the essential needs of the world’s poor, to which overriding priority should be given”; and.
- “The idea of limitations imposed by the state of technology and social organization on the environment’s ability to meet present and future needs.”

In way moving toward sustainability the “UN Conference on Environment and Development (UNCED) done in Rio de Janeiro in 1992. This conference known as the “Rio Conference” or the other name of this conference is the “Earth Summit” (Mebratu, 1998). The main purpose of this conference was to pursue a comprehensive plan of activity that would summery the implementation of the pattern of “sustainable development”. The UNCED conference has several significant universal documents involve “Agenda 21, the Rio Declaration, and the United Nation Framework Convention on Climate Change” (Bell & Cheung, 2009).

Furthermore, “Agenda 21” is one of the main and comprehensive documents and plans of action in UNCED which presented a useful and practical approach to exert sustainability strategies at local, national and global level (Blanc et al., 2012; Niwa, 2012). Hence, more than 170 countries signed the “Agenda 21” and accepted sustainability as a universal object (UNSD, 1992).

The “Agenda 21” started its pathetic preamble as follows: (UNSD, 1992) “Humanity stands at a defining moment in history. We are confronted with a perpetuation of disparities between and within nations, a worsening of poverty, hunger, ill health and illiteracy, and the continuing deterioration of the ecosystems on which we depend for our well-being. However, integration of environment and development concerns and greater attention to them will lead to the fulfillment of

basic needs, improved living standards for all, better protected and managed ecosystems and a safer, more prosperous future. No nation can achieve this on its own; but together they can - in a global partnership for sustainable development”.

The National Environmental Management Act (NEMA) defined sustainable development as “the integration of social, economic and environmental factors into planning, implementation and decision making so as to ensure that development serves present and future generations” (CDM , 2004). Moreover, the other organization such as Sustainable Seattle daresay that sustainable development is the “long-term, cultural, economic and environmental health and vitality” with emphasis on long-term, "together with the importance of linking our social, financial, and environmental well-being”. Generally, the concept of sustainability is about continuity, balance and equity among economic, social and environment dimensions within societies throughout the world. As final note, sustainability is a dynamic process which changes over time and it is different through geographical locations (Wilbanks, 1994; Gallopín, 2003).

### **3.2.2 Dimensions of Sustainable Development**

As mentioned above, the structure of sustainable development contains of three interlinked pillars characterized by social equity, equal development to respects the environment and economic expansion (WCED, 1987). Thus, sustainable development has three main dimensions include Social, Economic and Environmental which will be explained in the following sections (Figure 5).

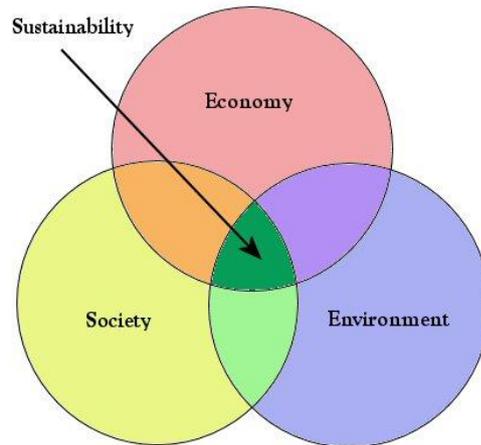


Figure 5: Three pillars of sustainability

### ***3.2.2.1 Social Dimension***

Social dimension cannot be separated from other dimensions of sustainable development. The social dimension is particular, qualitative, and problematic to measure and there is different perceive by various scholars (Lapalme, 2003).

Social sustainability is achievable when several items be considered within a development such as “social justice via equitable resource allocation, eradicates poverty, and provides social services, such as education, health” and others to all residents. Human organizes a main means of development therefor social dimension is based to achieve notion of sustainable development for both current and next generations (ICT, 2003). This achievement is based on essential need for equality of capitals and the entitlement of everybody to an adequate quality of living. Thus, the meet fundamental human requirement is vital and basic objective of sustainability (WCED, 1987).

### ***3.2.2.2 Economic Dimension***

Economic dimension of sustainable development has focus on providing economy comfort and equality for present and next generation with paying more attention to

the existing “natural capital” which means the “natural capitals” such as “plants, soil, animals, fish, and bio-environmental system such as air and water purification” are the bases for the economic system (ICT, 2003).

Moreover, in term of economic aims the economic growth is the foundation of human development and is essential in areas where the elementary requirements are not meet. However, it shall be changed during the time and become less environmentally wrecking. Thus, it is essential to change the present consumption and generation pattern to obtain substantial benefits (Agenda 21, Declaration of the 1992 Rio Conference on Environment and Development, 2010).

### ***3.2.2.3 Environmental Dimension***

An environmentally sustainable system conserves is the best way to eschew extreme use of natural resources. This way is including the protection of biodiversity, achieving atmospheric equilibrium and other systems as noneconomic capitals. In deal with sustainable development issues, ecologists will focus on what is recognized as environment boundaries. Besides, as notion it means that each natural environment classification has definite extent (ICT, 2003). Totally, sustainability means from an environmental point of view is setting limits for “consumption, population growth, pollution and defective ways of production; including wasting waters, cutting the forests or the soil erosion” (ICT, 2003). Accordingly, the key environmental target contains planning a sustainable substructure to support decrease the need of fossil fuels, natural capitals and non-renewable energy source.

Furthermore, sustainable substructure and approaches in term of generating energy, particularly electricity, means providing and using systems that do not depend on

fossil fuels. Since, over many years factories using coal, oil and gas as their main resource of energy which are not sustainable because of the extreme consumption of such resource. Besides, this sustainable substructure shall make sure that water source is safe and stable (Romiguer, 2011). In this regard, “Agenda 21” and “Brundtland Report” generally noted that, from the environmental viewpoint, the aim of sustainable development involve all about resource protection, pollution debarment, conservation the capacity of earth and efficient use of non-renewable resources as possible (Agenda 21, Declaration of the 1992 Rio Conference on Environment and Development, 2010; WCED, 1987).

### **3.2.3 Sustainable Development and Urbanization**

According to information mentioned above, sustainable development is a powerful framework and solution for urban development that increase the quality of life on local and nation levels and can also be a main section of answering to the extensive universal environment crises. Across the world, urban planner and scholars have concentrated on the challenge of designing and planning urban living in approaches that permit a smaller environmental footprint (Heberle, 2008). Hence, during the last decade, numerous of researcher, architects and urban planners discussed about the idea of applying the theory of sustainability to urban and architectural form (Kärrholm, 2008).

However, sustainable urban development has become an extensively accepted and recognized objective for human communities since in several urban settlements throughout the world decadence of social and environmental condition has taken place (Salman & Qureshi, 2009). Generally, means of sustainable urban development is “different things to different people”; meanwhile, there is a universal

agreement that sustainable urban development is a desirable and worthy explains of development that nations should obligate to translate and implement this comprehensive objective into their national and local strategies for achieving sustainability (UN, 2001).

In this regards, Camhis (2006) noted there is a fortified relationship among urbanizations and sustainable development that “promotion to sustainable urbanization” is seen as “a key to global sustainable development”. Besides, due to Kenworthy (2006) research, “making existing cities and new urban development more ecologically based and livable is an urgent priority in the global push for sustainability”.

Accordingly, discussion about sustainability has worldwide dimension and need a mutual integration of universal, nation and local levels. Cities are caused urban focus of sustainability because of extensive consumption of natural resources and production of waste and pollutions. Furthermore, sustainable development within urban areas explains a city potential to achieve a new and different level of “socioeconomic, demographic, environmental and technological performance” which has directly effect on strengthens the bases of the urban structure and system. As final note, sustainable urban development guarantees a long-term strength of the urban system (Nijkamp and Pepping, 1998).

### **3.3 Sustainable Urban Forms**

Nowadays, more than 50% of the world’s populations are living in cities and urban settlements. Hence, reaching and implementing sustainable urban development in urban settlements is vital for universal sustainability. One of the most important

elements that have direct effect on achieving sustainability in urban areas is urban forms; meanwhile, these days relationship among urban form and sustainable development is a common issue that has been extensively argued (Jenks, Burton & Williams, 1998). Besides, there is a comprehensive acceptance about the idea of strong connection between sustainability and the form, size, compactness and land-use of an urban settlement (Williams, Burton & Jenks, 2000).

However, existing evidence upon shows that best current theories and researches through sustainable urban form and development are from developed countries. Thus, finding from this research is not easily to transfer and use to developing countries since the challenges of urbanization within these countries are different. There is a general agreement that for achieving urban sustainability, urban settlements shall to be livable, economically sustainable, socially sustainable and ecologically viable as well as should have official frameworks to distribute social justice, long-term vision and permanent services. Accordingly, one of the main sources of environmental problems in contemporary cities is the form of these cities (Beatley and Manning, 1997; Haughton, 1999; Newman and Kenworthy, 1989).

In numerous research sprawl defined as undesirable form of urban development that has many disadvantages and also has been seen as cause of various problems in urban settlements such as economic, environmental and social problems. Accordingly, many land-use strategies have been generated and provided that involve sprawl and certain options alternative to sprawl (Razin, 1998). However, sprawl urban development has intricate structure and it is different from one country

to another. Hence, in this context different several development strategies against sprawl have been proposed to fight with sprawl.

In this regard, one of the famous countries which trying to produce and provide strategies and alternative development types for fighting the sprawl development is American. Hence, several alternative are proposed in place of sprawl development which four main of them such as Neo-Traditional development (new urbanism, transit-oriented development, urban village), Urban Containment (urban growth boundary, smart growth), Compact City, Eco-City as sustainable urban form will be explained in the following.

### **3.3.1 Neo-traditional Development**

Neo-Traditional development is a movement that historical built environment have encouraged designer, planner and architects to more focus better on urban form based on several of their physical qualities (Nasar, 2003, 58). Besides, the best approach to planning among the Neo-traditional movement is new urbanism (Jabareen, 2006). In the mid-1980's, architects and designers in California and Florida proposed New Urbanism as approach to fighting with sprawl (Besussi, et al., 2010). This model supports design and planning based approaches on traditional urban forms to aid stop suburban sprawl and inner-city decrease and also to build and reconstruct neighborhoods of cities (Jabareen, 2006). Furthermore, other two models of Neo-Traditional movement are Transit Oriented Development and Urban Village which will be explained in this part.

### ***3.3.1.1 New Urbanism***

There is a general believe that new urbanism's residential planning and design characters have potential to satisfy residents, persuade local people walking, support neighborhood relation, and reinforce a sense of community; meanwhile, developing residential density outside the suburban (Leccese & McCormick, 2000). The main aim of new urbanism and neo-traditional residential design and planning strategies include creating urban environment with different types of housing for various range of incomes and family structures, more density and people connection within neighborhood and providing suitable condition to increase people presence by decrees of automobile attendance (Audirac & Shermeyen, 1994; Leccese & McCormick, 2000).

Generally, neo-traditional development confirm concept of sustainable urban form. Hence, in transportation section, this development supports pedestrian orientation and walkable urban settlements. Besides, in density, it encourages greater residential densities than usual suburbs. In mixed land uses, neo-traditional development offers a mix of residential, commercial and public uses. Thus, the perfect model of neo-traditional city would be independent and strongly clustered and walkable. Besides, it have mixed land uses, greater densities, pedestrian friendly environment, different street patterns to let people to move from place to another place by cars and walk, distinguished traditional architectural features with small scale and a variety of building forms and narrow streets, and promote more street life and people connection through such characters as public open spaces and front porches space (Figure 6) (Nasar, 2003; Audirac and Shermeyen, 1994; Fulton, 1992; MacBurnie, 1992; Sutro, 1990).



Figure 6: New urbanism, Seaside, Florida (URL3)

However, new urbanism model is not versus automobiles, but does not accept and emphasis environments with easy car access and easy parking. New urbanism has emphasis on livable, walkable and interesting neighborhoods. In this regards, the congress for new urbanism (CNU) stated: “we believe in choice...people should be able to choose to walk, bike, take transit, use a scooter, ride a motorcycle, or drive a vehicle” (Hikichi, 2003).

In this regards, Beatley (2000) as one of the researchers in urban filed evaluated new urbanism projects and strategies for infrequently connected with decreasing environmental impacts or encouraging environmentally sustainable lifestyle. Hence, in present people need cities and urban settlements where provide a new urbanism that is more environmental in design, planning and function.

### ***3.3.1.2 Transit Oriented Development***

The other kind of development that is based on the neo-traditional development is Transit oriented development (TOD). TOD purposes to design and provide livable communities that are placed on “high quality train systems” (Günay, 2007). In this regards, there are various different definition for TOD that two of them are

mentioned in the following. Boarnet and Crane (1997) explained TOD as developing of residential areas close rail stations. Furthermore, Still (2002) defined TOD as “a mixed-use community that encourages people to live near transit services and to decrease their dependence on driving” (Jabareen, 2006). Accordingly, there is common elements of TOD which shared by different definitions as “incorporates an interconnected street network, often in a grid or modified-grid pattern, mixed housing types, high density, mixed-use development, development that is close to and well served by transit, and development that is conducive to transit riding” (Figure 7) (Transportation Research Board of the National Academy, 2002, p.5-7).



Figure 7: Transit Oriented Development, Jersey City (URL 2)

### ***3.3.1.3 Urban Village***

During 1980s, the urban village as another type of neo-traditional development appeared first in American after that in the United Kingdom (Aldous, 1992). In 1999, Urban Village has been defined by Stole as “a line drawn around a city at a distance sufficient to accommodate expected urban growth” (Günay, 2007). As a fact, the famous notion of sustainability in the 1990s encouraged to the establishment of the aims of the urban village. The several characters of urban village are such as “high density; mixed use; mix of housing tenures, ages, and social groups; high quality;

and being based on walking, and transportation improvements that support walking, use of public transportation, and other transportation demand management (TDM) strategies” Particularly inside urban cores and urban villages (Figure 8) (Aldous, 1992).



Figure 8: Bordesley Urban Village (URL 2)

In 1997, Douglas Kelbaugh recommended urban villages and zoning restructurings are effective strategies for present cities and suburbs. In this context, he explained that “Seattle’s urban villages make sense” for the following reasons:

they are an effective way for the city to take its fair share of regional growth; they are economical since they use existing institutions; and they are walkable, The layout of the street system is in a grid pattern or modified grid pattern, emphasizing interconnected streets and the ability to reach local destinations without crossing major streets or primary arterials, neighborly, transit-friendly, they are mixed housing a range of types, sizes and prices in closer proximity, and sustainable, offering a lively and rich environment. (p. 121-127).

### **3.3.2 Urban Containment**

Two models of urban containment are urban growth boundary and Smart growth which will be explained in the following.

### ***3.3.2.1 Urban Growth Boundary***

Urban growth boundaries (UGB) is one of the antidote to sprawl development (EC, 2011).The urban growth boundary creates a separation among urbanized and rural lands. Besides, this kind of development has focus on promote the well-organized of public facilities and preserve farm lands and jungles outside the boundaries. Thus, in UGB urban development beyond the boundary is forbidden. In this regards, several jurisdictions and executive agencies provide the terms “urban limit line” (ULL), to use of blue line or green line as real physical border to separate rural and urban areas. Additionally, the concept of urban growth boundaries has been used for first time in United States that is valuable to debate “Portland’s urban growth boundary” development (Figure 9). Hence, in the 1970s urban growth boundary has been implemented in Portland which brought out several positive characters for this city such as growing density inside the UGB, encourage an suitable mix of actions that let walking as an attractive alternative in cores of cities, decreased use of automobiles and support other forms of public transportation, pedestrian friendly environments (Jabareen, 2006; Johnson, 2001; Hirt, 2007).

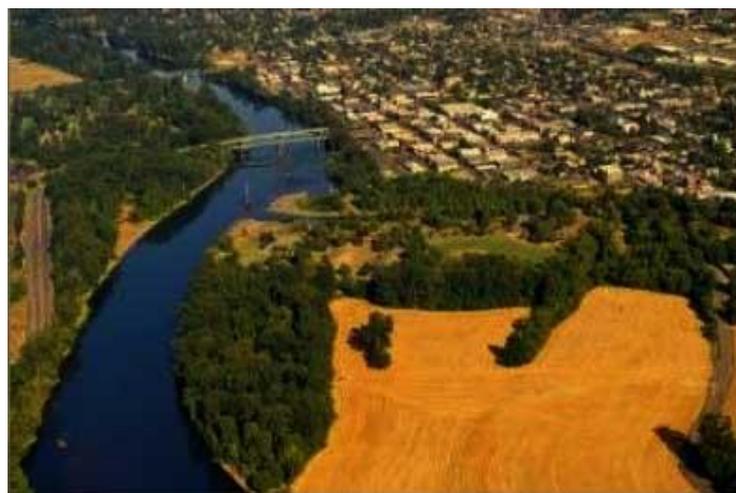


Figure 9: Urban Growth Boundary, Portland (URL 2)

### 3.3.2.2 *Smart Growth*

Another model of urban containment is smart growth which is based on reconstruction land-use to create them further sensitive to solve issues of lack of “housing diversity, traffic congestion and ecological confusion” (Günay, 2007). In this context, Talen (2003) defined smart growth as “a movement focused on promoting urban development that is compact, higher density than urban sprawl, diverse and walkable as opposed to a car-dependent and land-consumptive...one” (Figure 10). Furthermore, The American Planning Association explains smart growth as “planning, designing, developing and renovating, promoting location sense, preserving natural and cultural resources and delivering development advantages and disadvantages fairly” (SGN, 2002).

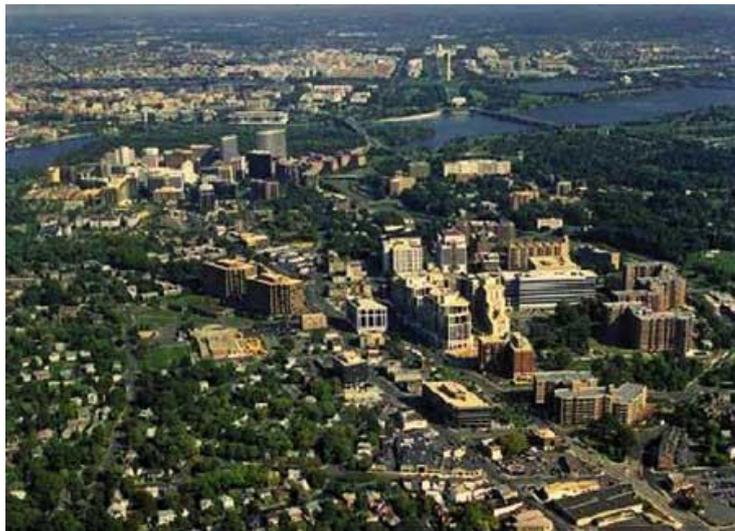


Figure 10: Smart Growth, Arlington County, Virginia (URL 3)

Many of researchers and scholars in reaction to urban sprawl have analyzed a set of offers to decline sprawl as characteristics of smart growth which mentioned in the following: (Dempsey, 2010)

- 1) “Mixed land uses;

- 2) Take advantage of compact building design;
- 3) create a range of housing opportunities and choices;
- 4) Create walk able neighborhoods;
- 5) Foster distinctive, attractive communities with a strong sense of place;
- 6) Preserve open space, farmland, natural beauty, and critical environmental areas;
- 7) Strengthen and direct development towards existing communities;
- 8) Provide a variety of transportation choices;
- 9) Make development decisions predictable, fair and cost effective;
- 10) Encourage community and stakeholder collaboration in development decisions”.

Accordingly, smart growth is including “housing diversity, single-family and multi-family housing in multi model location in good access for walking, cycling and public transit systems with Smart Street which designed for everyone” (Downs, 2005; Litman, 2012).

### **3.3.3 Compact City**

Before promoting the sustainable development concepts and agenda, the notion of a “radiant city” was proposed by Le Corbusier’s as answer to the issues of Victorian city (Figure 11). This idea allowed creation of tower blocks to lodgment high-population densities inside wide-open spaces. In the following of this idea, Dantzing and Saaty in 1973 proposed the idea of compact city. The vision of this idea was for enhancing the quality of urban life without the expense for the future generation. The concept of compact city is an idea that is in compatible with present principles of sustainability.

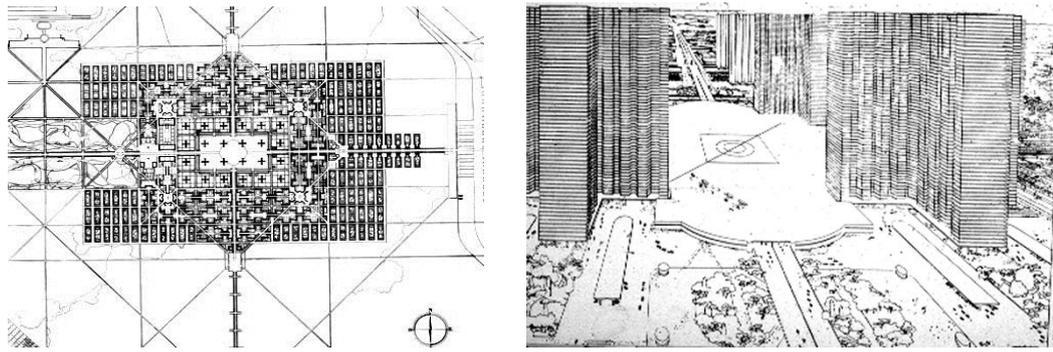


Figure 11: La Ville Radieuse (URL 2)

Generally, it can be mentioned the concept and idea of compact city involves numerous strategies and approaches that goal to create and provide compactness and density as solution to avoid many issues of the modernist cities design and planning (Laghai, 2010). Besides, the compact development has potential to implement on different scales. Furthermore, compact development recommends density of the built areas and increase of the activities, effective land planning, mixed land-use, and appropriate transportation systems (Breheny & Gent & Lock, 1993; Leccese and McCormick, 2000).

Additionally, Commission of European Communities in 1990 advocates intensely the “compact city” as an approach that makes urban environment more ecologically sustainable and develops quality of urban life (Laghai, 2010). Hence, compact city is a high-compactness, mixed-use city with narrow streets and well defined borders (Figure 12) (Jenks & Burton & Williams, 1996; Williams, Burton, and Jenks, 2000).



Figure 12: Mixed of Functions, Gothenburg (URL 3)

Moreover, this mixed-use provides various choices of public transportation systems and the opportunity to walk between the functions (Figure 13) (Laghai, 2010).



Figure 13: Different Types of Transportation in Amsterdam as a Model of Compact City (URL 4)

The compact city model was supported for many reasons such as: (Williams, Burton, and Jenks, 2000)

- Capable for more sustainable systems of transport;
- Sustainable use of land;
- In social terms is associated with social diversity, social cohesion, and cultural expansion;
- Ecologically viable because substructure, such as ways and street lighting, can be provided cost-effectively per public capita;

- Population densities which have directly effect on support local services and businesses.

### 3.3.4 The Eco-City

The eco-city is a model of development that encompasses an extensive range of urban environmental suggestions to achieve urban sustainability. This model encourages the environmental agenda and highlights ecological management through a set of official and policy tools. Besides, the specific notions of the eco-city are “greening and passive solar design”. Furthermore, eco-city in terms of compactness and other notions is imagined as a “formless” city (Figure 14).



Figure 14: Eco City, Freiburg, Germany (URL 2)

However, the main features of eco-city are summarized in the following: (Jabareen, 2006)

This model is combined of

- Compact;
- Pedestrian-oriented;
- Public transport-oriented;
- Mixed-use neighborhoods.

An eco-city should be an attractive place to live and work through composition of attractively and nicely designed public spaces and mixing green areas and subjects of cultural heritage to provide different surroundings (Mayerhofer & Skala, 2005). Besides, sustainable and suitable infrastructure contributes to the well-being, welfare and safety of residents and their identification with the eco-city (Jabareen, 2006; Mayerhofer & Skala, 2005).

Generally, urban form includes a number of physical characters and non-physical features involving “size, shape, scale, density, land uses, building types, urban block layout and distribution of green space”. Besides, in this part five comprehensive and inter-related fundamental elements include “density, accessibility and transport infrastructure, housing/ building type, land use and layout” as make up urban form have been classified. However, these fundamental elements of urban form have direct influence on sustainability and human manner (Dempsey et al., 2010). The following table shows summarize of characteristics of different sustainable urban forms versus urban sprawl which explained above (Table 2).

Table 2: Characteristic of Sustainable Urban Forms against Urban Sprawl

| <b>Sustainable urban form against urban sprawl</b> | <b>Density</b> | <b>Land use</b> | <b>Layout</b>   | <b>Accessibility &amp; transportation infrastructure</b> | <b>Building / housing type</b>             |
|--|----------------|-----------------|---|--|--|
| <b>New Urbanism</b>                                | High densities | Mixed land use  | Grid street layout  | Low car dependency & medium public transport             | Small scale and diversity of building type |
| <b>Transit Oriented Development</b>                | High density   | Mixed use       | Interconnected street network, often in a grid or modified-grid pattern | Medium car dependency & rich public transportation       | Mixed housing type                         |
| <b>Urban Growth Boundary</b>                       | High density   | Mixed use       |   | Medium car dependency                                    |  |
| <b>Urban Village</b>                               | High density   | Mixed use       | grid pattern or modified grid pattern                                   | Medium public transportation                             | Mixed housing type                         |
| <b>Smart Growth</b>                                | High density   | Mixed use       | Smart street or complete street   | Medium car dependent & low public transportation         | Diverse housing type                       |
| <b>Compact City</b>                                | Higher density | Mixed use       | narrow streets in an organic form                                       | No car dependency & rich public transportation           | Compact building typologies                |
| <b>Eco-City</b>                                    | High density   | Mixed use       |   | public transport   |  |

### 3.4 Summary of Chapter

The twentieth century saw extraordinary population growth rate as *urbanization*. This phenomenon generated issues for developed or developing countries according to their condition. Under such a circumstance, sustainability has become a global concept to solve problems which caused by urbanization such as urban sprawl. Many caused problems by urban sprawl in the today's cities will be solved by a sustainable urban form.

The focus of this chapter is sustainable urban forms against urban sprawl that act as a comprehensive solution for contemporary city problems. Thus, this chapter

discussed and reviewed sustainable urban forms against urban sprawl including neo-traditional development (new urbanism, transit-oriented development, urban village), urban containment (urban growth boundary, smart growth), compact city and eco-city to suggest one form which can find a solution for current environmental problems. In the next part, Kyrenia urban sprawl will be analyzed to understand type and costs of urban sprawl based on those 8 dimensions.

## **Chapter 4**

# **ANALYSIS OF COSTS AND TYPE OF URBAN SPRAWL IN KYRENIA**

### **4.1 Methodology of the Analysis**

As have been mentioned in the previous chapters, urban sprawl is a universal issue throughout the world. Hence, there have been done countless researches which debated on this phenomenon, its costs and impacts. Thus, several methods for measuring sprawl have been proposed. One of the famous methods for measuring sprawl is proposed by Galster et al. in 2001, which the case study of this research will be analyzed based on qualitative technique. Galster et al. (2001) in their research which published under the title of “Wrestling Sprawl to the Ground: Defining and Measuring Elusive Concept” offered eight conceptually distinct dimension of land use which is explained section 2.7. As mentioned earlier, this study uses Galster et al. (2001) method and technique to investigate characteristics of urban sprawl.

For this study, Kyrenia coastal line is selected as a case study due to more urban sprawl development, vacant land and touristic attraction. At the start point of the research project, map of the study area was prepared based on Google map layout as a source. Then, with respect to the village’s borders, the study area is divided in to 6 regions (Catalkoy, Arapkoy, Teknecik, Karaagac, Esentepe, Bahceli) and for more accurate and precise analyze on new developments along coastline, a grid was drawn on the map. The grids have been distributed in to 1 square mile which each of them

divided to 4 quarter square mile as sub-division. In the prepared graphic maps, the grey color is undevelopable lands and the vacant lands are shown as white parcels, also each dot is representing 2 housing units. This legible graphic maps representation of quantitative data which can help any researcher for clearly visualizing each dimension and characters of urban sprawl. Besides, in order to collect data, the qualitative method that includes visual observation technique, helped the author of this research to record the physical condition of case study area. By taking photograph on site and using documentary sources such as 2007 Kyrenia Notice plan (figure 16) helped the author to understand function of lands across study area.

## 4.2 General Information about Kyrenia and Case Study Area

### 4.2.1 Location

Girne which is the most picturesque town in Mediterranean is located on the northern part of Cyprus (Figure 15).

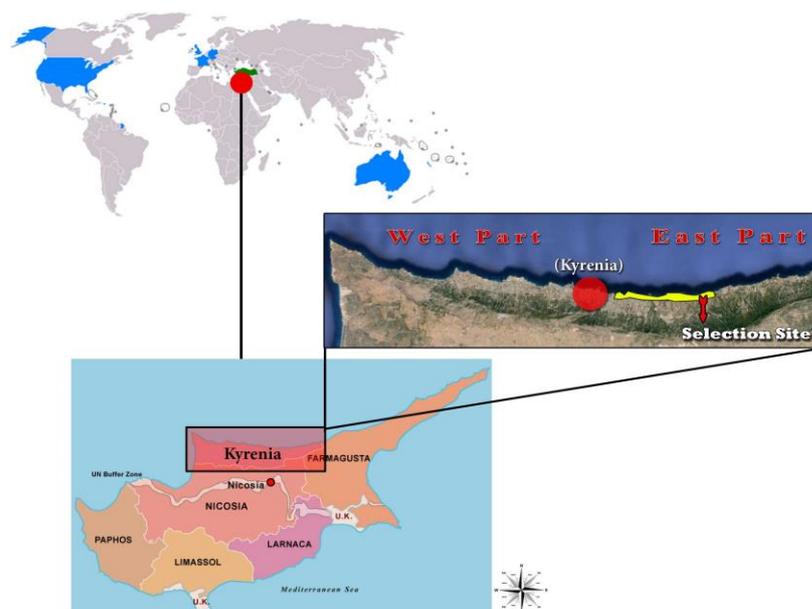


Figure 15: Location of Case Study

## GİRNE 2.BÖLGE

Karşıyaka, Lapta, Alsancak, Malatya, İncesu, Yeşiltepe, İlgaz, Karaoğlanoğlu, Edremit, Karaman, Zeytinlik, Girne, Doğanlı, Karakum, Ozanköy, Beylerbeyi, Çatalköy, Arapköy, Beşparmak, Karaağaç, Esentepe, Bahçeli

# KAPSAMLI EMİRNAMESİ

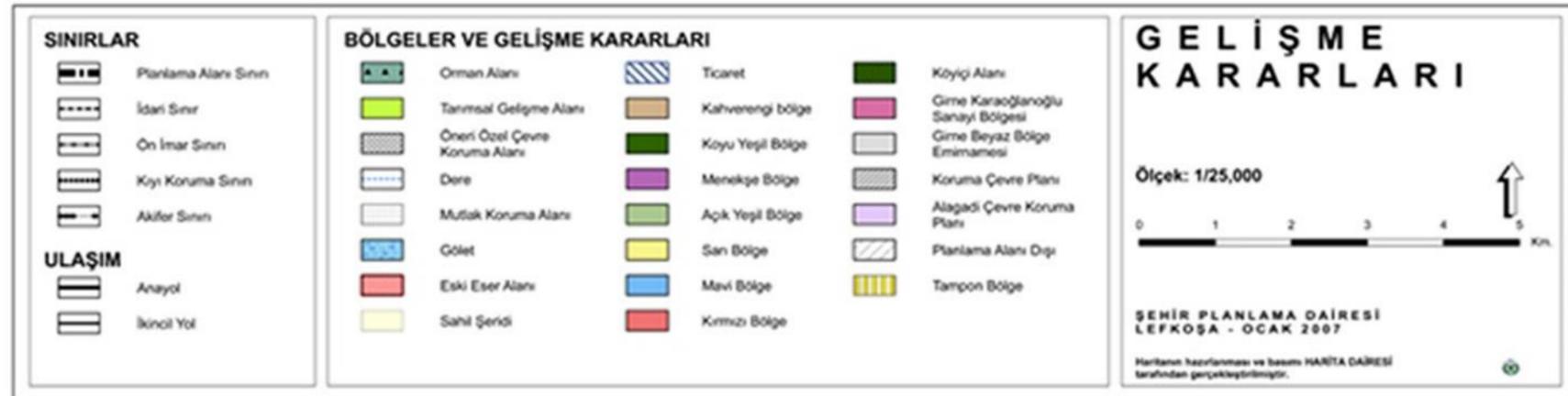
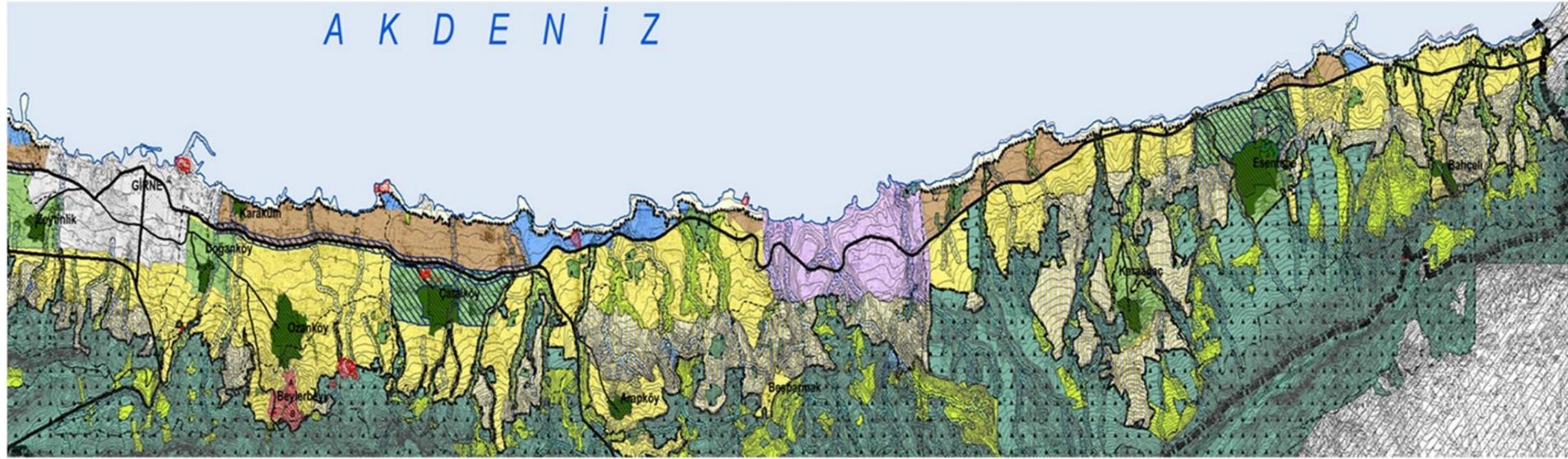


Figure 16: 2007 Kyrenia Notice (Source: Town Planning Department)

Kyrenia is the capital city of tourism in the northern part of island, due to its location and climate. One side of Kyrenia is surrounded by the high ranges of mountains and the other side has a crystal-clear Mediterranean Sea coast.

#### **4.2.2 History**

It is believed that the origin of Kyrenia's settlements can be dating back to 1000 BC by Greeks that made it a prosperous town (URL 5). Throughout the history, Girne has faced numerous and varied cultures like "Roman, Byzantine, Lusignan, Venetian, Ottoman and British" that have affected urban expansion or architectural characteristics of the city (Castelli, 1974). Girne had been known as one of the city kingdoms of Cyprus within Ancient times. Throughout the Persian period, a Cypriot style with particular emphasis on sculpture developed. During Roman times, the port continued to be especially important (URL 6). According to the researches, Harbour's site has been carefully selected and built within this period. In Byzantine era, trade and agriculture are factors that had affected the city development (Oktaç, 2005). In this time; castle plays a pivotal role in the defense of the Girne from the sea side attacks throughout 5-7 centuries (URL 7). Kyrenia castle played a crucial role in Lusignan period as well. The Lusignans extended the castle, by building a wall and towers all around the town, and enlarged the fortifications to the harbor (Figure 17-18) (URL 8). The castle began to change slightly its appearance throughout Venetian period. Venetians extended the castle and entirely rebuilt the three out of four corner towers, and made higher the wall which was on the west side of the castle. The Ottomans were in the power in Cyprus for 500 years. The castle played the role of military in Ottoman period. In British era, the city started to enlarge and people made program for mending the harbor.



Since this day the urban development of Kyrenia has been affected by publishing, “Old Municipality Zone Notice”. Before, the city expanded without any planning and protection of the historical value of the city. So, existence of many unplanned construction without traditional value is the result. With implementation of this Notice the city development was in control for a short time. Based on this Notice, great traditional and old-fashioned values of the city are carefully protected and the urban planning started to entirely depend on regulated and designed projects (Oktay, 2005).

#### **4.2.3 Laws and Regulations**

Based on studies, in Northern Cyprus, Kyrenia has been known as conservation zones under the New Town Planning Law (1989) and Antiquities (1994) Laws (Oktay, 2005).

There is one prepared conservation plan in North Cyprus which is developed for Girne exclusively. The conservation plan for Kyrenia under the title of “Environmental Conservation Plan Notice” (1993) was prepared by “Town Planning Department” in association with the Municipality of Kyrenia. Beside, another regulation with the name of “Streets and Building Regulations Law” (CAP, 96) is implemented. Prior to the “Environmental Conservation Plan Notice”, there was an “Old Municipality Zone Notice” (1992) with the aim of controlling new development in the city and proposing some affected restrictions about environmental protection, illegal constructions, and shop fronts. Also, “Environmental Conservation Plan” plans to provide sustainable urban development in “Old Municipality Zone Notice” and includes all borders which were defined in 1974 by Girne Municipality. It has capacity to cover large area such as villages

around Kyrenia. Besides, the “Environmental Conservation Plan” (1993) defined the city into 8 regions (Figure 19) (Oktay, 2005).

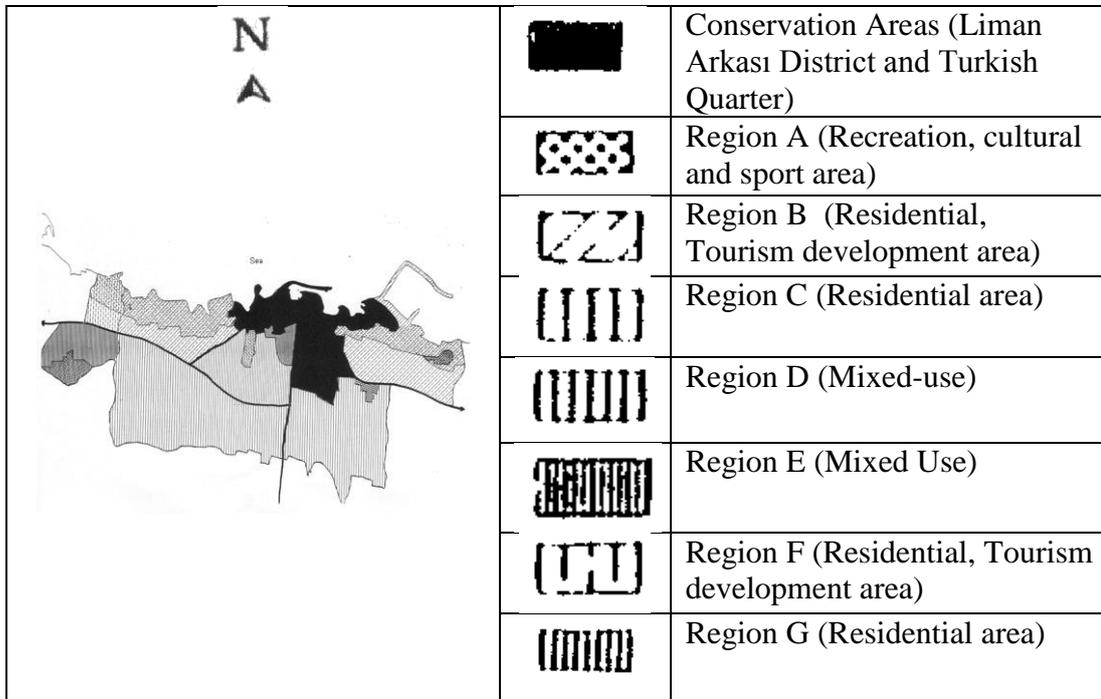


Figure 19: Eight Regions in Kyrenia According to Environmental Conservation Plan

In 2003 and 2005 numerous revisions have been done on the “Environmental Conservation Plan Notice” (1993) (Oktay, 2005). Cyprus interior planning executed new laws under the title of “2007 Girne 2.Region comprehensive plan” for North Cyprus in order to achieve one of its aims which was to prepare and implement the master plan for management of urban settlements, however actually this mission has never succeeded for the city of Kyrenia (Doratli & Hoskara, 2007).

Besides, between 2010 and 2011, authorities did three revisions on the previous ones of Kyrenia Notice plan to make better choices with respect to new changes.

#### **4.2.4 Factors Accelerating Urban Sprawl in Kyrenia**

Legal and administrative framework plays a crucial role in the physical expansion of settlements. "streets and buildings regulations (Cap.96)" is one of the main accelerating factors of urban sprawl in Kyrenia which proposed any piece of land with access to a main road is eligible for development. Also, Town Planning Department in 1993 prepared the first Environmental Conservation Plan Notice with the aim of controlling land use and urban growth by municipality of the town. Although many other Notices has been prepared up to 2011, however all of the regulations could not successfully coop with urban sprawl development in Kyrenia. Besides, in 2002, united nation prepared Annan Plan which suggested restructuring the Republic of Cyprus as a "United Republic of Cyprus", that would be a federation of two states. After having a referenda process in 2004 haphazard physical development due to the construction boom started to be seen especially along the shoreline of the city. Urban sprawl in Kyrenia is not matched by environmental advances; it carries out environmental effects and leads to degradation of resources instead, due to lack of management and planning strategies in the city (Doratli & Hoskara, 2007).

#### **4.3 Selection of Case Study**

New development in Kyrenia city has been expanded in two directions, East and West along coastal line (Figure 20). This research has the focus on the Eastern part due to possible reasons for selection of this area which categorized in three parts in the following:

1. Physical geographic condition of Eastern area is one the main reasons because there is more vacant land for future expectation and development of

residential and nonresidential uses along coastline and mountain area within this part.

2. Due to touristic attraction of area, high percentage of people have tendency to spend time there, so more land can be supplied for future likelihood expansion.
3. Having more sprawl like development in comparing to the western part.

With respect to 2007 Kyrenia Notice (see Figure 15), administrative authorities used 6 colors to determine various functions and rules in the study area which is collected in Table 3. Consequently, this area has many potential for future outward expansion and has capacity to attract local people and tourist.

Table 3: Land Use Policy Based on 2007 Kyrenia Notice

| <b>Color</b>  | <b>Land use policy</b>   |
|---|--|
| <b>Yellow (Bahceli &amp; Karaagac)</b>  | Mining, Industrial and storage utilities, Entertainment functions such as: disco- casino, Apart hotel, Retail, Traditional hostel                                    |
| <b>Brown(Catalkoy &amp; Arapkoy &amp; Esentepe &amp; Karaagac &amp; Teknecik)</b> | Residential use, Retail, Public facilities such as: hotel-club-bar-holiday villages- mixed touristic accommodation, Traditional use, Social service, Public services |
| <b>Blue( Arapkoy)</b>   | Holiday villages, Hotel and apart hotel, mixed touristic accommodation   |
| <b>Purple ( Teknecik)</b>   | Environmental protection   |
| <b>Dark( village's center)green</b>   | Should be compatible in terms of scale, material, height, etc. With Kyrenia city center  |
| <b>Light green</b>  | Agricultural development areas   |

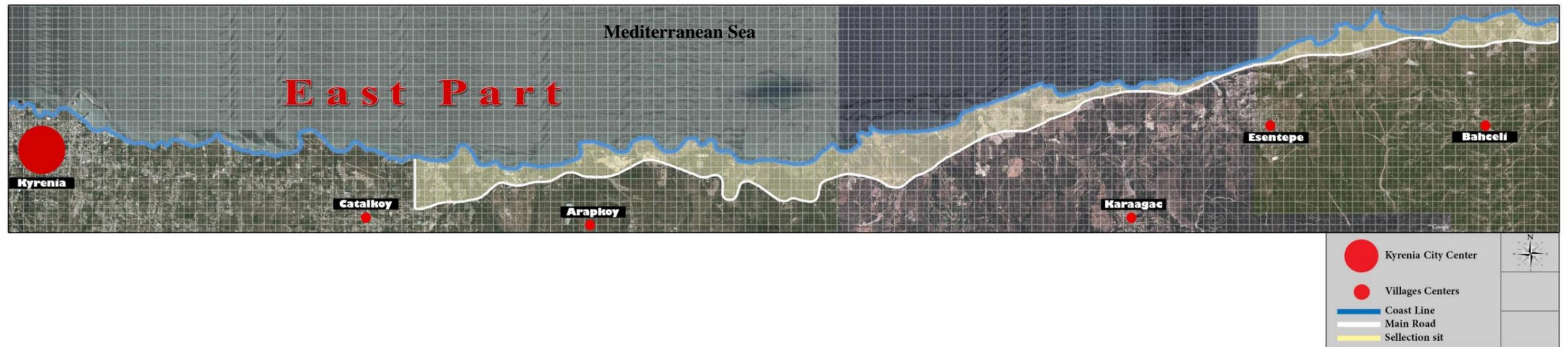


Figure 20: Selection of Case Study

Selected study area comprised of 5 villages which briefly would be explained in the following part.

*-Çatalköy Village*

Çatalköy is located east of Kyrenia city center on the low lying mountain, which has 10 km distance. Origin of Çatalköy can be dating back to the Neolithic period, that had the first migrators from Anatolia who had made homes there from 7000/6500BC (Figure 21) (URL9).



Figure 21: Catalkoy Village (URL 10)

Based on observation, some facilities such as shops and restaurants, a casino and accommodation are provided. Catalkoy as a traditional Cypriot village is a favorite place for tourists from UK due to its magnificent Mediterranean and mountain views (URL11).

*-Arapkoy Village*

Arapkoy a small Cypriot village is located near to Catatalkoy village. The village which is just minutes far from Girne, is sited on the on the low mountains and valleys that run up to the five finger mountain range on the north Cyprus. This region

has a breathtaking view of northern Cyprus mountain views; also this small rural style village has a few shops and services (Figure 22) (URL 12).



Figure 22: Arapkoy Village (URL 2)

*-Karaagac Village*

Karaagac is east of Kyrenia, spreads from the coast directly in to low lying mountain. This village is 20 minutes to the east of Arapkoy village and has a short distance away from Esentepe village (Figure 23).

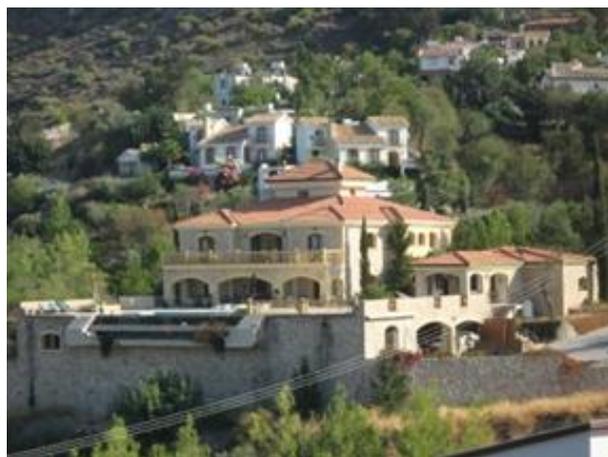


Figure 23: Karaagac Village (URL 2)

### *-Esentepe Village*

The first settlements of Esentepe were originally set up by Greek soldiers of Ancient times. The village is located on the foothills of five finger mountains, due to its placement; this traditional Cypriot village has always been well-known for its wild apricots (URL13). Esentepe village has public facilities such as shops, restaurants, a post office, primary and secondary school also a police station (Figure 24).

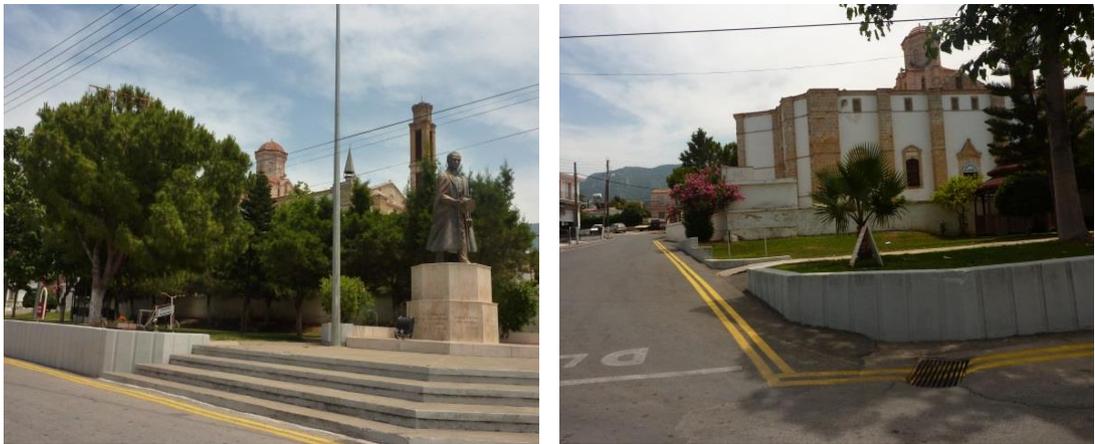


Figure 24: Esentepe village (Source: author)

### *-Bahceli Village*

Bahceli village is only minutes' drive away from Golf Course at Esentepe. The village has a number of simple amenities including grocery shops and restaurants that make a friendly area for visitors. The village's inhabitants were included Romaian immigrants or Turks; also the main economy of village is based on livestock and farming and agriculture (Figure 25) (URL 14).



Figure 25: Bahceli Village (URL 2)

#### **4.4 Analysis of Urban Sprawl on Eastern Part of Kyrenia**

Based on the 8 dimensions of sprawl and their definitions which mentioned in the methodology part (4.1); as density, continuity, clustering, continuity, concentration, centrality, nuclearity, mixed use and proximity are analyzed by author and their results can be seen in the following part.

##### **4.4.1 Density Analysis**

During the recent years, along coastal line within territory of **Catalkoy** village, numerous touristic residential units and villas in format of residential settlements have been constructed (Figure 26). According to the analysis (Figure 24), the total land area of Catalkoy is approximately 83km<sup>2</sup>. The development pattern of these residential settlements is approximately 69 % (37km<sup>2</sup>) in the border of this village which illustrates high density pattern (Figure 27).



Figure 26: New Developments along Coastal Line of Kyrenia (Source: author)

Since, various factors such as location of Catalkoy village in short distance from Kyrenia city center and existence of close neighborhood with number of bars, restaurants and a casino have encouraged people to live in this area which increased density of residential units and villas.

According to the density analysis (see Figure 27), the total land area of Arapkoy is approximately 171km<sup>2</sup>. Regarding to the analysis, the density of new residential development within territory of **Arapkoy** village is approximately 28% (11km<sup>2</sup>) of total land area of Arapkoy shows low density development. This is because of the following reasons (Figure 28):

- 1- Location of village which is on the plateau of mountain and far away from coastal line.
- 2- Existence of high level of undevelopable land (approximately 40%) in the close neighborhood.

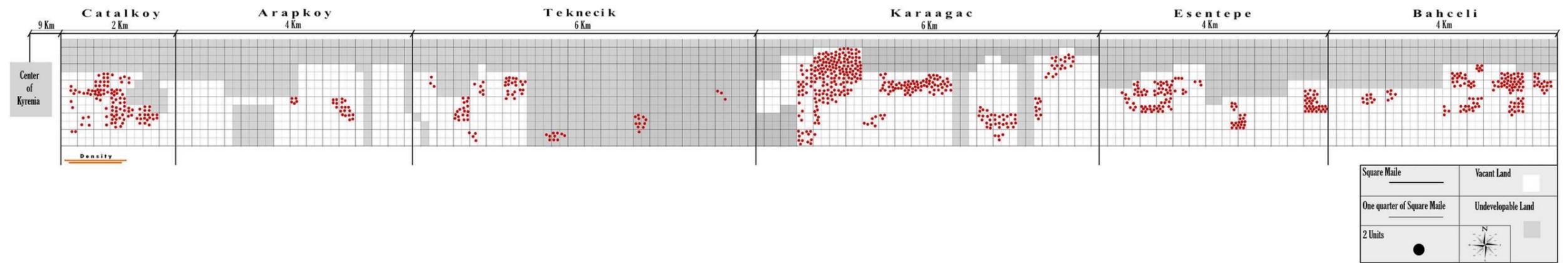


Figure 27: Density Analysis



Figure 28: New Development along Coastal Line, Arapkoy, Kyrenia

(Source: author)

Besides, there is no specific village along distance between Arapkoy and Karaagac villages; therefore, due to placement of Teknecik power station, this part named as **Teknecik** area. With respect to density graph (see Figure 27), total land area is 254 km<sup>2</sup> that density of new developments along shoreline in this area is approximately 28% (36 km<sup>2</sup>). This number shows low density pattern of new villas. On the beginning of this part low density villas and residential complexes have been spread on the land. According to “2007 Girne 2.Region comprehensive plan”, existence of high percentage of undevelopable land (86%) such as power station on the right and protected and forest area on the left of this part have resulted in low development density. Moreover, new developments have occurred on the outskirts of Kyrenia city center and expanded far beyond any village where residence cannot supply their daily needs.

Next area is related to **Karaagac** village that according to density analysis (see Figure 27) new constructed villas and residence complexes have been located near to shoreline are in high density pattern with covering approximately 59% of total land

area (62 km<sup>2</sup>) of Karagaac village. In this area, landscape is adjacent to costal line and has the same level with sea. Moreover, with regard to “2007 Girne 2.Region Comprehensive Plan” this area is devoted to touristic complexes and villas with facilities which are needed for an adequate touristic life such as clean water, small parks and gathering areas, a playground and a supermarket.

In continuous, new built residential complexes near **Esentepe** village which is one of the oldest and biggest villages with infrastructures such as municipality, police station, school (Figure 29) also, low level of undevelopable land in the neighborhood have motivated private building constructed to have plan for future developments (Figure 30).



Figure 29: Esentepe Village (Source: author)

According to density analysis (see Figure 27) Esentepe has approximately 189 km<sup>2</sup> and the new built residential villas and units in this area are covered approximately 13% of total land area (36 km<sup>2</sup>) that illustrates low density pattern.



Figure 30: New Developments on the Mountains, Esentepe (Source: author)

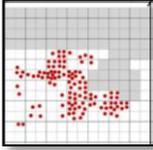
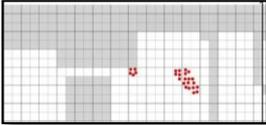
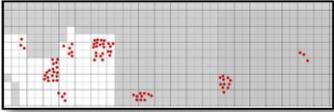
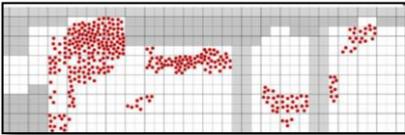
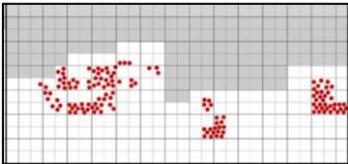
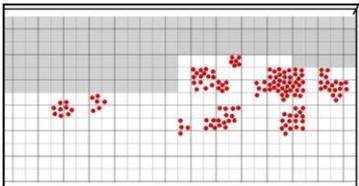
According to density analysis (see Figure 27), the final point of study area is **Bahceli** village with approximately 62 km<sup>2</sup>, which new residential buildings and villas (Figure 31) have been developed in low density pattern with approximately 15% of total land area although, have a close neighborhood to sea, Bahceli village and also just a 10 minutes' walk from turtle beach.



Figure 31: New Developments along Coastal Line, Bahceli (Source: author)

Table 4 shows the density of case study area along the eastern coast line of Kyrenia.

Table 4: Density Analysis Results.

| Graphical map   | Density area      | Low | High |
|---|-------------------|-----|------|
|    | Catalkoy village  |     | ●    |
|    | Arapkoy village   | ●   |      |
|    | Teknecik area     | ●   |      |
|   | Karaagac village  |     | ●    |
|  | Essentepe village | ●   |      |
|  | Bahceli village   | ●   |      |

#### 4.4.2 Continuity Analysis

The start point of study area is **Catalkoy** village which new constructed units within area related to this village follow a high continuous building line around a street block (Figure 33). According to “2007 Girne 2.Region Comprehensive Plan”, there is no limitation for land as undevelopable land in this area. Also, land’s slope among this part is approximately in same level in comparative with other parts.

Thus, these two reasons have made new developers to build continuous blocks. Besides, new development of **Arapkoy** is notably influenced by two factors which have resulted in low continuity of block expansion involve existence of undevelopable land such as military land on the right has created a gap in the site (Figure 33); meanwhile, according to “2007 Girne 2.Region Comprehensive Plan” authorities proposed the following functions such as hotels, apart-hotels, mixed touristic accommodation and resorts, however these functions have not built yet. In the **Teknecik** area, built blocks do not follow continuity in this part (Figure 33) due to high level of undevelopable land under the title of environmental protection plan which has been implemented in comparative to other parts of costal line.

Furthermore, new built units within territory of **Karaagac** are spread continuously on the west side (Figure 33) of area and discontinuously on the East. According to “2007 Girne 2.Region Comprehensive Plan”, different functions proposed for this area. Units on the West side which follow continuous building line around a street are comprised of different functions such as residential, commercial use, although authorities have made limitation for east part with priority of non-residential use at first and then residential use which led to low continuity (Figure 32).



Figure 32: High Continuity of West Side of Karaagac Village (Source: author)

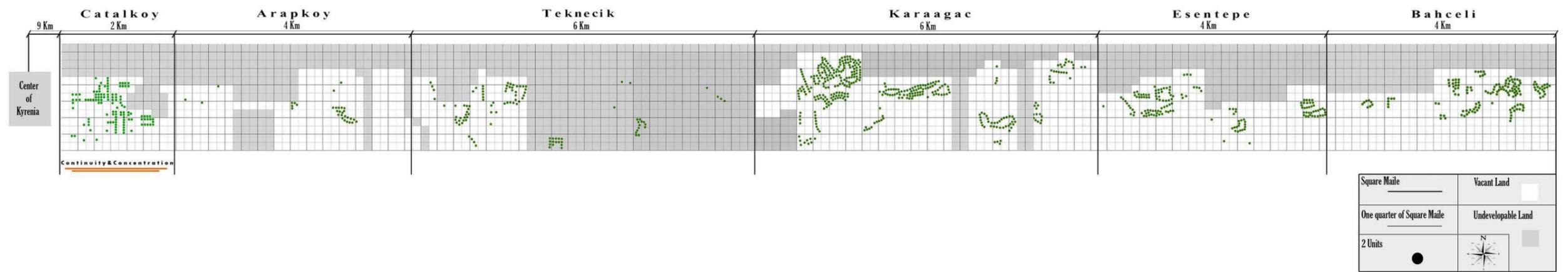


Figure 33: Continuity & Concentration Analysis

In territory of **Esentepe** village, new residential developments are not organized to follow a continuous street line (see Figure 33). In “2007 Girne 2.Region Comprehensive Plan” has mentioned to build different kinds of uses including residential and non-residential functions; however most of the proposals have not built yet. Thus, this event caused low continuity in urban pattern. There is also limitation for some parts of land division due to undevelopable lands. These two reasons resulted discontinuity and fragmentation of blocks in this part.

As last area, in **Bahceli** territory, blocks are built in a low continuity pattern (see Figure 33). Existence of undevelopable land (approximately 30%) and high land’s slope in comparative to other parts has led to low continuity of building (Figure 34).



Figure 34: Low Continuity of New Complexes in Bahceli (Source: author)

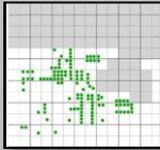
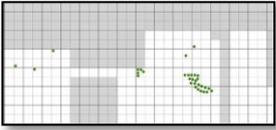
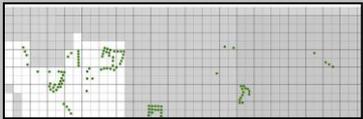
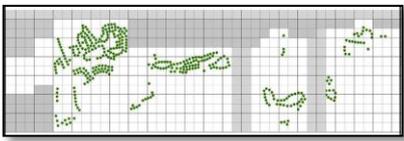
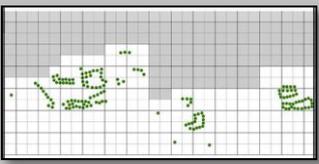
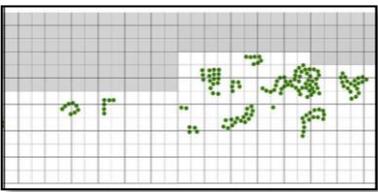
Table 5 shoes the overall results of continuity analysis in the case study.

#### **4.4.3 Concentration**

New urban settlements along coastal line which are belonged to the **Catalkoy** village are not concentrated in a small portion of land area. Deconcentration of urban

functions in combination with dispersed urban settlements causes more urban sprawl (see Figure 33).

Table 5: Continuity Analysis Results

| Graphic map   | Continuity Analysis | Low continuity | High continuity |
|---|---------------------|----------------|-----------------|
|    | Catalkoy Village    |                | ●               |
|    | Arapkoy Village     | ●              |                 |
|   | Teknecik Area       | ●              |                 |
|  | Karagaac village    | ●              |                 |
|  | Esentepe village    | ●              |                 |
|  | Bahceli village     | ●              |                 |

New low-density residential housings in outlying of **Arapkoy** village are concentrated in a small land due to land use limitation such as “2007 Girne 2.Region Comprehensive Plan” and undevelopable land in the surroundings (see Figure 33).

New low-density developments in **Teknecik** part are distributed disproportionately which indicates deconcentration. Low density development and deconcentration demonstrate the highest degree of sprawl (see Figure 33).

New housing units in **Karaagac** village are spread disproportionately evenly at high densities which causes consuming of more lands and more sprawl.

Distribution of new residential units in a close neighborhood to traditional Cypriot village of **Esentepe** indicates deconcentration. Share of spatial neighborhood that is occupied by housing units along coastal line reveal disproportional distribution. Deconcentration is one of the evidence of urban sprawl (see Figure 33).

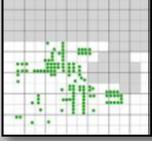
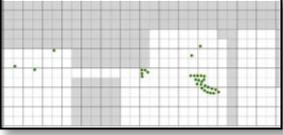
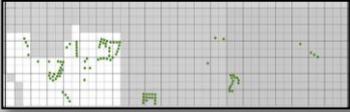
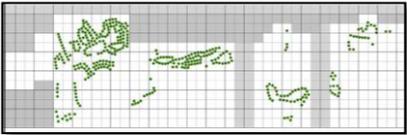
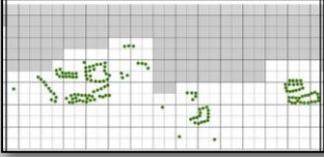
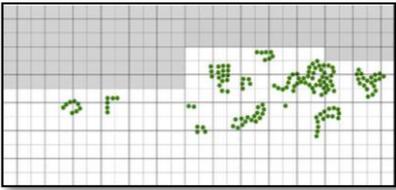
Last but not least, new high density developments in **Bahcelli** village are dispersed disproportionately within the urban area. So, deconcentrated new development causes more sprawl.

Table 6 represents the overall results of concentration analysis in the case study area.

#### **4.4.4 Clustering**

As mentioned in the previous chapter clustering also is one of the main dimensions of sprawl analysis. Hence, clustering is analyzed in throughout the study area (Figure 36). Based on graphical map, residential blocks within **Catalkoy** village territory are designed as cluster units (Figure 36).

Table 6: Concentration Analysis Results

| Graphic map   | Concentration analysis | Concentrated | Deconcentrated |
|---|------------------------|--------------|----------------|
|    | Catalkoy village       |              | ●              |
|    | Arapkoy village        |              | ●              |
|    | Teknecik area          |              | ●              |
|   | Karagaac village       |              | ●              |
|  | Esentepe village       |              | ●              |
|  | Bahceli village        |              | ●              |

The main reason in formation of residential blocks as clustered is efficiency use of land and forest preservation (Figure 35).



Figure 35: New Clustered Villas in Catalkoy (Source: author)

The **Teknecik** electrical power area is analyzed as low density development due to high percentage of undevelopable land which led these units tightly bunch to each other for preserving green areas (Figure 36).

In territory of **Karaagac** village, new built blocks which characterized as high density (59%) in section 4.4.1 and therefore they tightly bunched to each other to minimize development impacts (Figure 36). Clustered developments of blocks in this part has effects on, preserve forest, efficiency of use land, and provide enough space for filling living accommodations such as playground, market, small open spaces and parks (Figure 37).

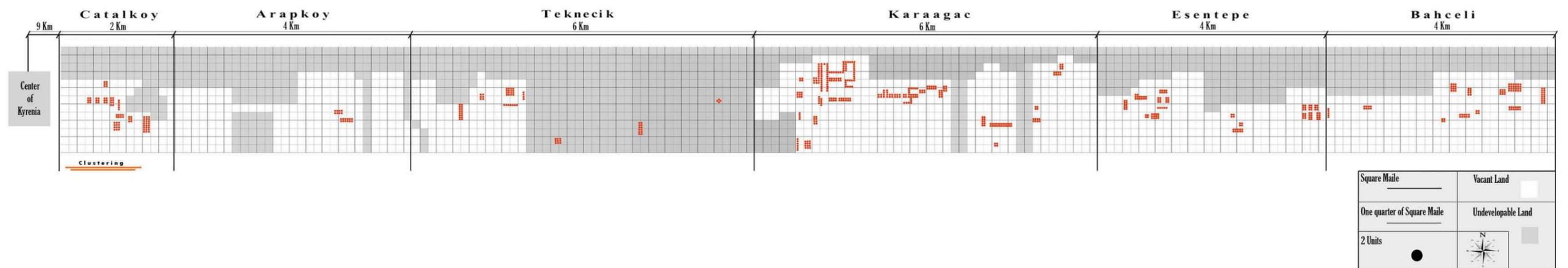


Figure 36: Clustering Analysis



Figure 37: Clustered Housing Units in Karaagac (Source: author)

New residential developments in **Esentepe** village are in low density pattern (13%) which this kind of developments is constructed in a way to minimize consumption of land. These bunched complexes are defined in a way to preserve green areas and create public spaces for residence (see Figure 36).

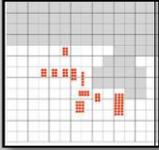
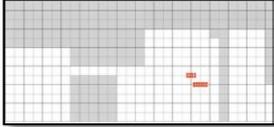
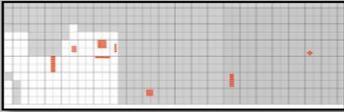
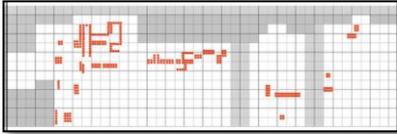
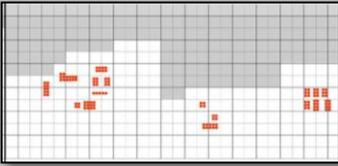
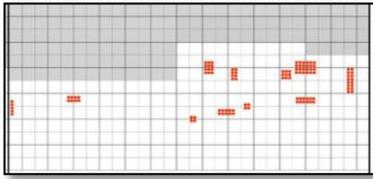
Similarity in **Bahceli** village, new residential buildings (Figure 38) are designed to place tightly bunched to each other for having more public spaces and accommodations for residence and using efficiency of land (see Figure 36).



Figure 38: Clustered complexes in Bahceli (Source: author)

Table 7 presents the whole evaluation of the clustering in the case study areas.

Table 7: Clustering Analysis Results

| Graphic map   | Clustering       | Clustered | Unclustered |
|---|------------------|-----------|-------------|
|    | Catalkoy village | ●         |             |
|    | Arapkoy village  | ●         |             |
|    | Teknecik area    | ●         |             |
|   | Karaagac village | ●         |             |
|  | Esentepe village | ●         |             |
|  | Bahceli village  | ●         |             |

#### 4.4.5 Centrality

Based on the graphical map, the new high density constructed complexes with 83km<sup>2</sup> total land area in **Arapkoy** village are developed on the outskirts of Kyrenia city center as a mixed of uses led to decentralization of new developments along coastline (Figure 39).

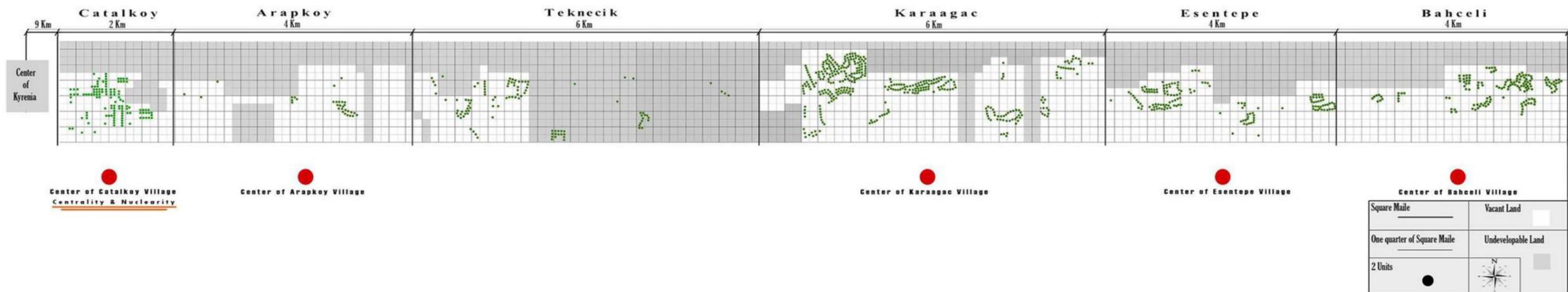


Figure 39: Centrality & Nuclearity Analysis

The new constructed houses in **Arapkoy** village, which developed far away from Kyrenia city center as an illustration of compact urban form, represent decentralization pattern along coastline which is one of the characteristics of urban sprawl (see Figure 39).

According to the graphical map, the new low density houses and residential complexes in **Teknecik** area are developed near to the Arapkoy village which is far from center of mixed uses (Kyrenia), indicates of decentralization and more sprawl in the area (see Figure 39).

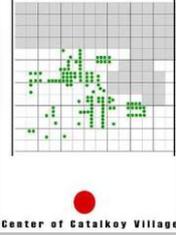
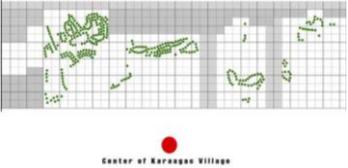
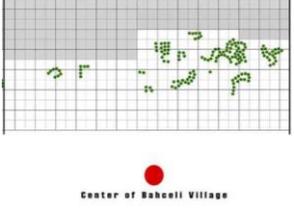
The new high density constructions in **Karaagac** village are organized in a way to be far from center of compact development (Kyrenia) which led to decentralization and leapfrog development in this part (see Figure 39).

As can be seen in the graphical map, the new low continuity and deconcentrated houses and residential complexes in Cypriot village of **Esentepe** are developed on the outskirts of Kyrenia as a center of mixed uses which indicates decentralization and more sprawl pattern in the area (see Figure 39).

The new low density residential complexes in the **Bahceli** village which has the farther distance with center of mixed uses (Kyrenia), indicates decentralization and leapfrog development in the area (see Figure 39).

Table 8 presents the whole evaluation of the centrality in the case study areas.

Table 8: Centrality Analysis Results

| Graphical map   | Centrality                  | Centralization | Decentralization |
|---|-----------------------------|----------------|------------------|
|    | <b>Catalkoy<br/>village</b> |                | ●                |
|    | <b>Arapkoy<br/>Village</b>  |                | ●                |
|   | <b>Teknecik<br/>area</b>    |                | ●                |
|  | <b>Karaagac<br/>Village</b> |                | ●                |
|  | <b>Esentepe<br/>Village</b> |                | ●                |
|  | <b>Bahceli<br/>Village</b>  |                | ●                |

#### 4.4.6 Nuclearity

Based on the graphical map, the new high density, deconcentrated developments in **Catalkoy** village, which are far from Kyrenia city center, has new sub-center in

close neighborhood of city as village, led to polynuclear development pattern in this area (see Figure 39).

The new low density constructions in **Arapkoy** village are developed on the outskirts of Kyrenia city center as an illustration of compact urban form has a new sub-center as village which led to polynuclear development pattern as one of the urban sprawl characteristics (see Figure 39).

According to the graphical map, the new constructed low density complexes in **Teknecik** area which are far from Kyrenia city center has a new sub-center as village which indicates polynuclear pattern and more sprawl in this area (see Figure 39).

As can be seen in the graphical map, the new high density, deconcentrated villas in **Karaagac** village are organized and developed on the outskirts of center of mixed uses (Kyrenia), has new sub-center as village which led to polynuclear development pattern along coastline (see Figure 39).

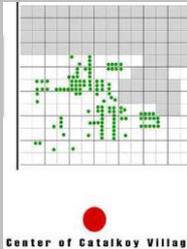
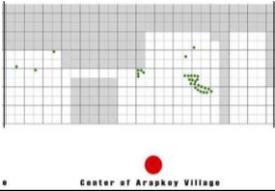
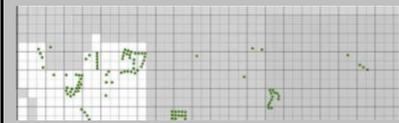
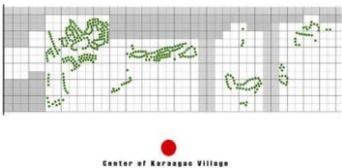
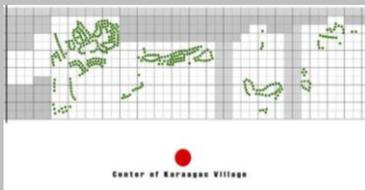
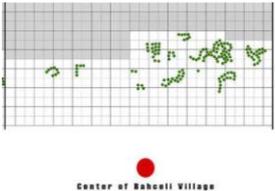
With respect to the graphical map, the new low density development in old Cypriot village of **Esentepe** are developed far from Kyrenia as a center of mixed uses, has new sub-center as village which indicates polynuclear development pattern and one of the urban sprawl characteristics in this area (see Figure 39).

The new low density constructed residential complexes in **Bahceli** village are spread on the outskirts of center of mixed uses and compact form (Kyrenia) has new sub-center as village which represents polynuclear pattern in this area can be led to create

problems such as increasing land values and decentralized urban development that are features of urban sprawl (see Figure 39).

Table 9 shows the nuclearity of case study area along the eastern coast line of Kyrenia.

Table 9: Nuclearity Analysis Results

| Graphical map   | nuclearity       | Monoclear | Polynuclear |
|---|------------------|-----------|-------------|
|    | Catalkoy Village |           | ●           |
|  | Arapkoy Village  |           | ●           |
|  | Tekecik Area     |           | ●           |
|  | Karaagac Village |           | ●           |
|  | Esentepe Village |           | ●           |
|  | Bahceli Village  |           | ●           |

#### **4.4.7 Mixed Use**

Based on the graphical map, the new high density houses and residential complexes in **Catalkoy** village are planned to symbolize private villas without any other functional divisions of land. There is just one building as non- residential uses in this area which indicates single use development and one of the most important characteristics of urban sprawl (Figure 40).

New housing developments along coastline of Kyrenia in **Arapkoy** village are planned to be far from Kyrenia city center as an illustration of mixed uses and included residential zone. So, single use pattern of development in this area shows the main characteristic of urban sprawl (Figure 40).

Based on the graphical map, new residential developments in **Teknecik** area which are developed far from center of mixed uses have no functional sub division of land. The new low density houses are included Residential Zone which indicate single use development and more sprawl in this area (Figure 40).

The new high density development in **Karaagac** village are developed on the outskirts of Kyrenia city center as an illustration of compact urban form, are designed in a way which indicates single use development along coastline (Figure 40).

Based on graphical map, the new constructed buildings in old Cypriot village of **Esentepe** are planned and proposed without any functional sub divisions of land which represent Residential Zone. So, single use constructed villas in this area represent more sprawl (see Figure 40).

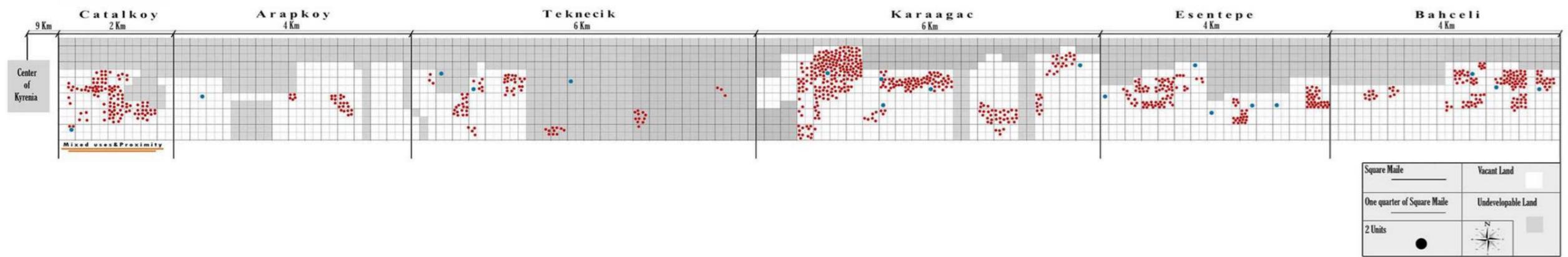
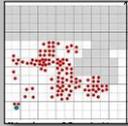
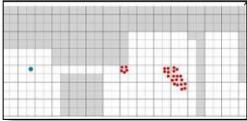
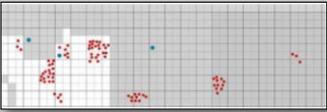
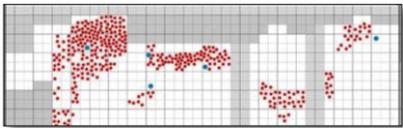
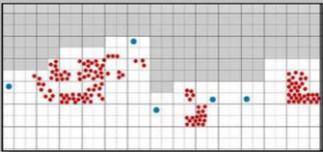
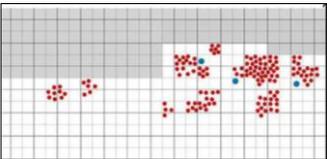


Figure 40: Mixed Use and Proximity Analysis

According to graphical map, the new low density constructed houses along coastline in **Bahceli** village are planned to symbolize private villas. So, the new houses which are developed far from center of mixed uses (Kyrenia) represent single use development and more sprawl in this area (see Figure 40).

Table 10 represents the mixed use of case study area along the eastern coast line of Kyrenia.

Table 10: Mixed Use Analysis Results

| Graphical map   | Mixed Use        | Mixed Use | Single Use |
|---|------------------|-----------|------------|
|   | Catalkoy Village |           | ●          |
|  | Arapkoy Village  |           | ●          |
|  | Teknecik Area    |           | ●          |
|  | Karaagac Village |           | ●          |
|  | Esentepe Village |           | ●          |
|  | Bahceli Village  |           | ●          |

#### **4.4.8 Proximity**

Based on graphical map, the new single use development along coastline in **Catalkoy** village are developed in way to have distance with workplaces (city center of Kyrenia) which result in lower proximity and more sprawl (see Figure 40).

The new low density, single use, deconcentration developments in **Arapkoy** village are designed and organized in a way to be far from center of mixed uses (Kyrenia) where retails, businesses and offices are located. This shows Lower proximity which is another characteristic of urban sprawl (see Figure 40).

According to the graphical map, the new low density developments in **Teknecik** area are located far from city center of Kyrenai as an illustration of compact urban form so, residents have to cover a distance from their accommodation to their workplace which represent low proximity along coastline (see Figure 40).

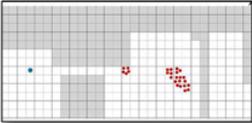
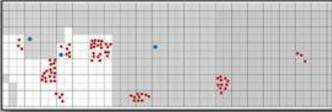
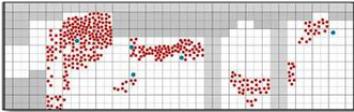
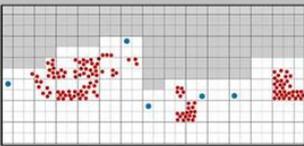
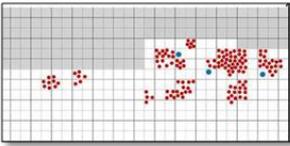
The new high density, deconcentration, single use complexes in **Karaagac** village are developed on the outskirts of Kyrenia city center where retails stores, offices and businesses are located. As a result a greater distance has to be covered by residences which represent low proximity and more sprawl in this area (see Figure 40).

With respect to the graphical map, the new constructions in **Esentepe** village are developed and designed to be removed from Kyrenia city center where offices, retails stores and businesses are located which led to travelling greater distance between workplaces and accommodation conclude to lower proximity in this area (see Figure 40).

As can be seen in the graphical map, new low density complexes in **Bahceli** village are developed in a greater distance with Kyrenia city center as an illustration of compact urban form so, inhabitants have to cover a greater distance between workplaces (Kyrenia) and accommodation which represent lower proximity in this area (see Figure 40).

Table 11 identifies the proximity of case study area along the eastern coast line of Kyrenia.

Table 11: Proximity Analysis Results

| Graphical map   | proximity        | High Proximity | Low Proximity |
|---|------------------|----------------|---------------|
|   | Catalkoy Village |                | ●             |
|  | Arapkoy Village  |                | ●             |
|  | Teknecik Area    |                | ●             |
|  | Karaagac Village |                | ●             |
|  | Esentepe Village |                | ●             |
|  | Bahceli Village  |                | ●             |

## 4.5 Urban Sprawl Characteristics in each Village

Up to now we looked through the general urban sprawl characteristics along the coast line of the city. Now, the village based urban sprawl characteristics are given (Table 12-17).

Table 12: Urban Sprawl Analysis in Catalkoy village

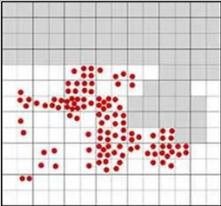
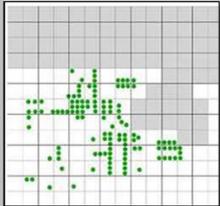
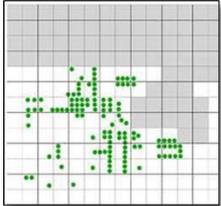
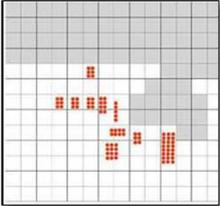
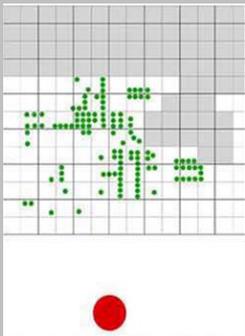
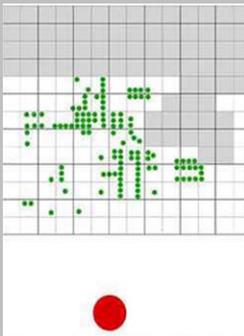
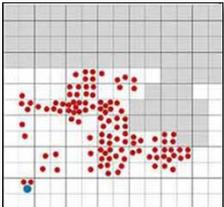
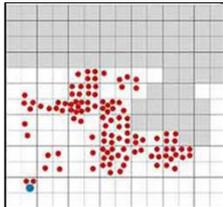
| Catalkoy Village  |   |
|---|---|
|  <p>High Density</p>   |  <p>High Continuity</p>                                 |
|  <p>Deconcentrated</p>                                     |  <p>Clustered</p>                                     |
|  <p>Center of Catalkoy Village</p> <p>Decentralization</p> |  <p>Center of Catalkoy Village</p> <p>Polynuclear</p> |
|  <p>Single Use</p>   |  <p>Low Proximity</p>                                 |

Table 13: Urban Sprawl Analysis in Arapkoy Village

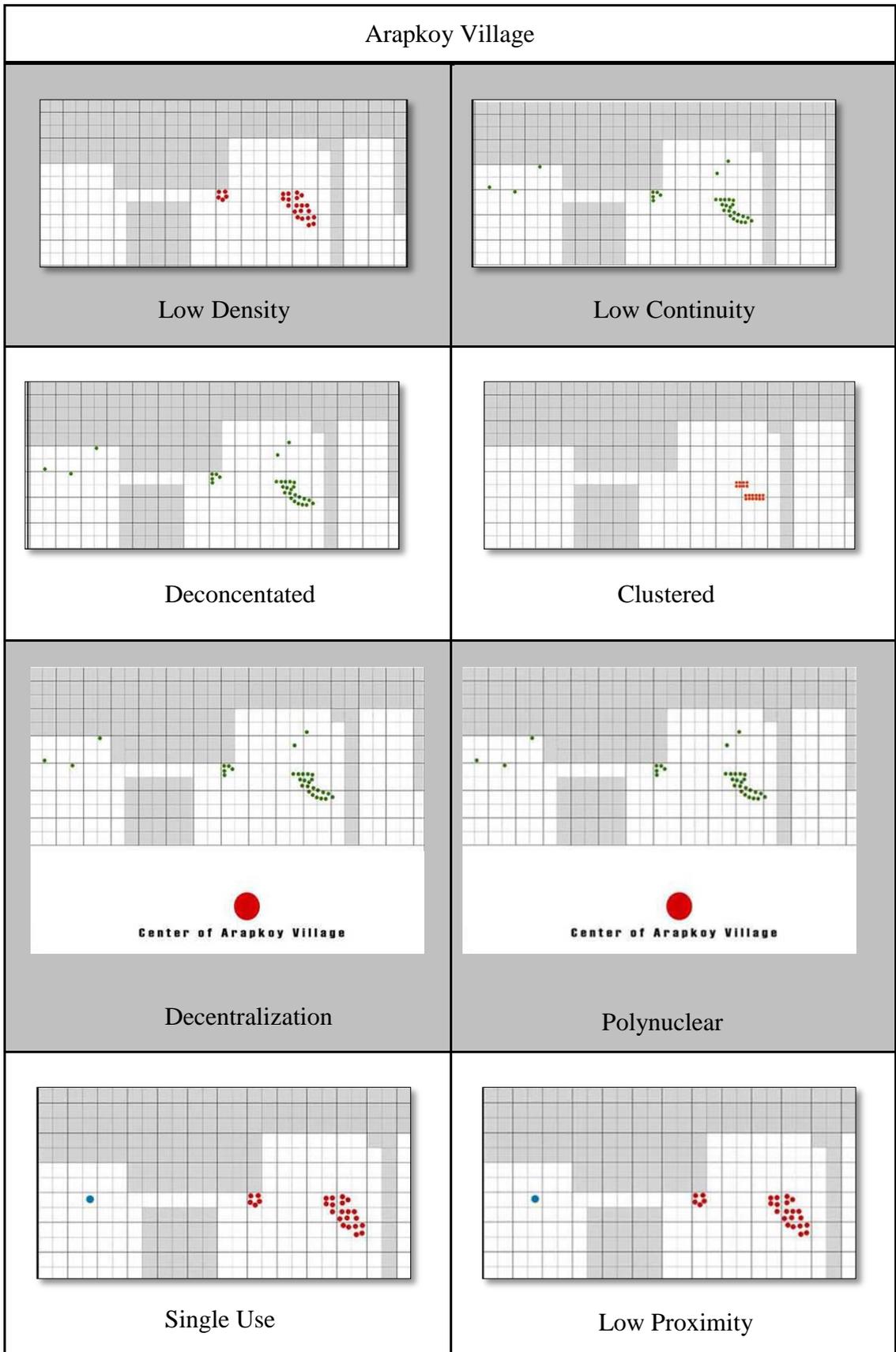


Table 14: Urban Sprawl Analysis in Tekneçik Area

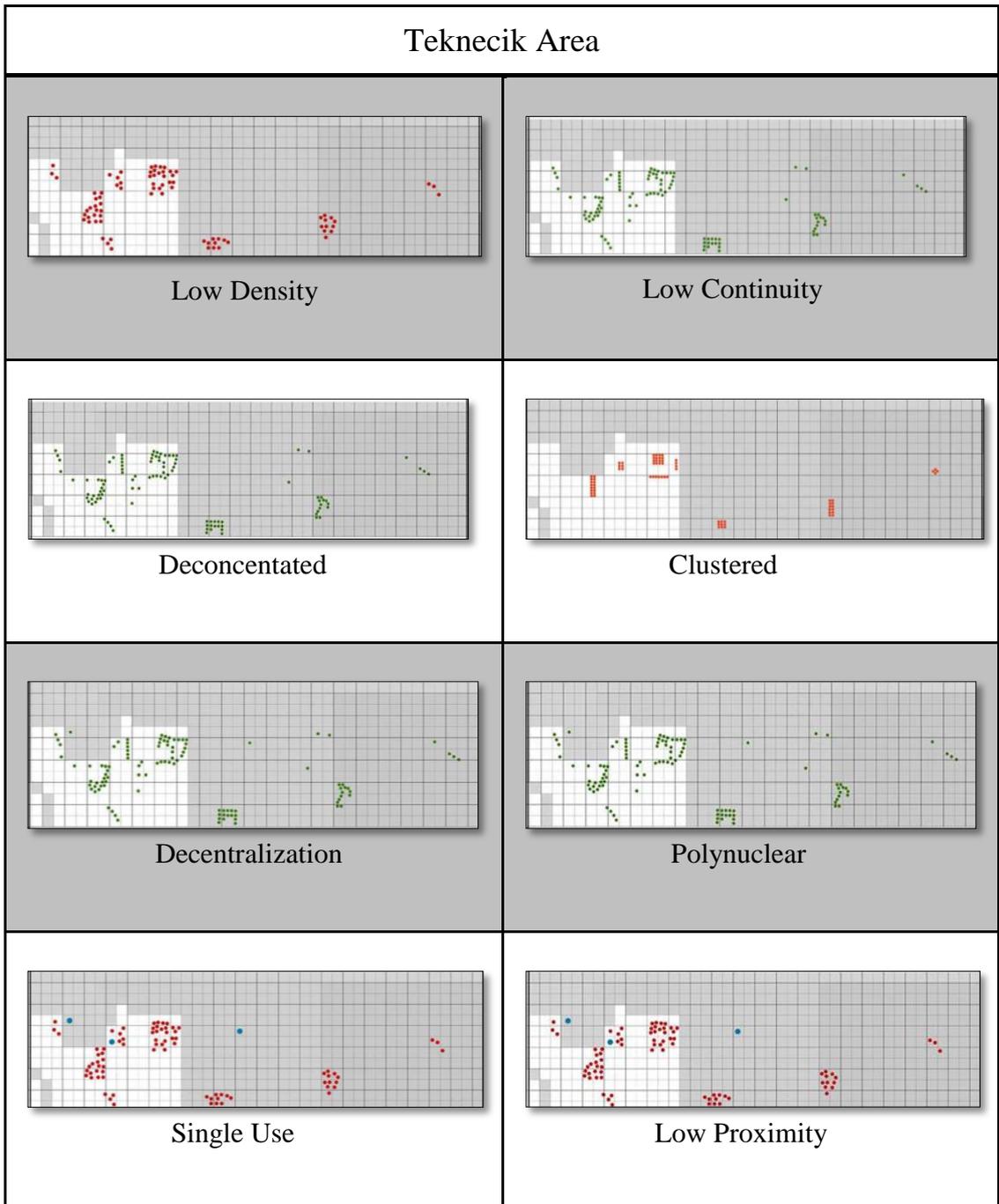


Table 15: Urban Sprawl Analysis in Karaagac Village

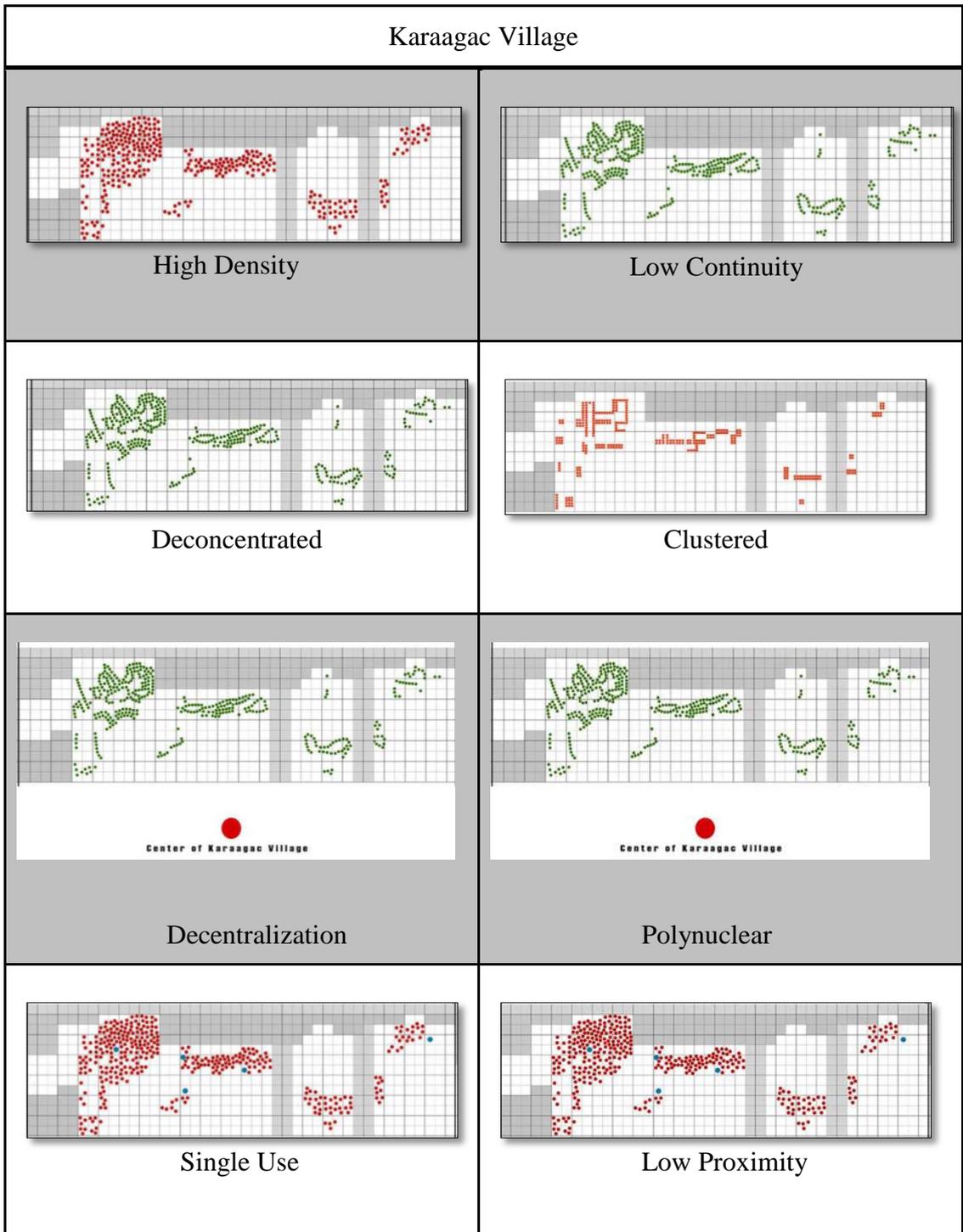


Table 16: Urban Sprawl Analysis in Esentepe Village

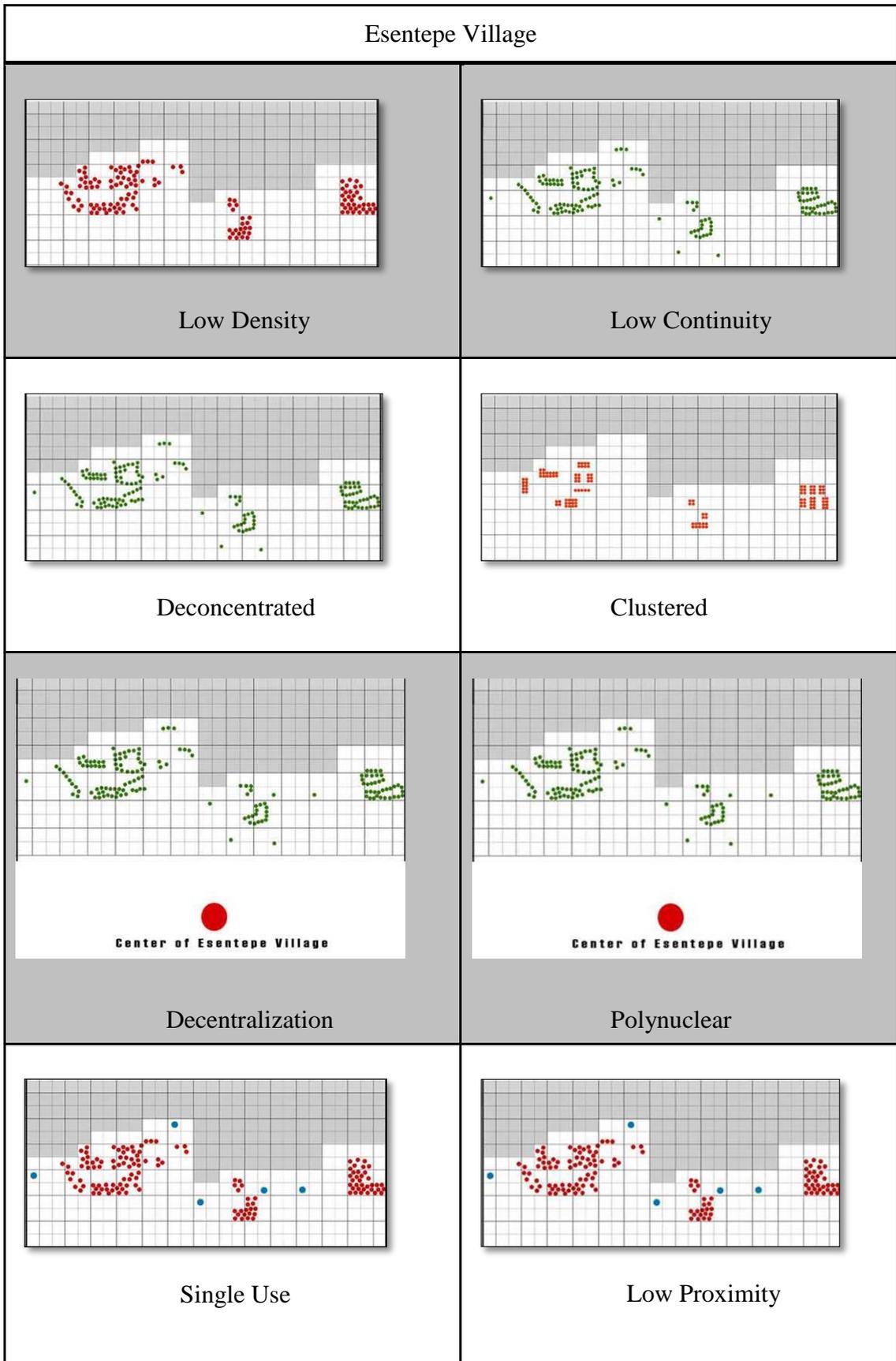
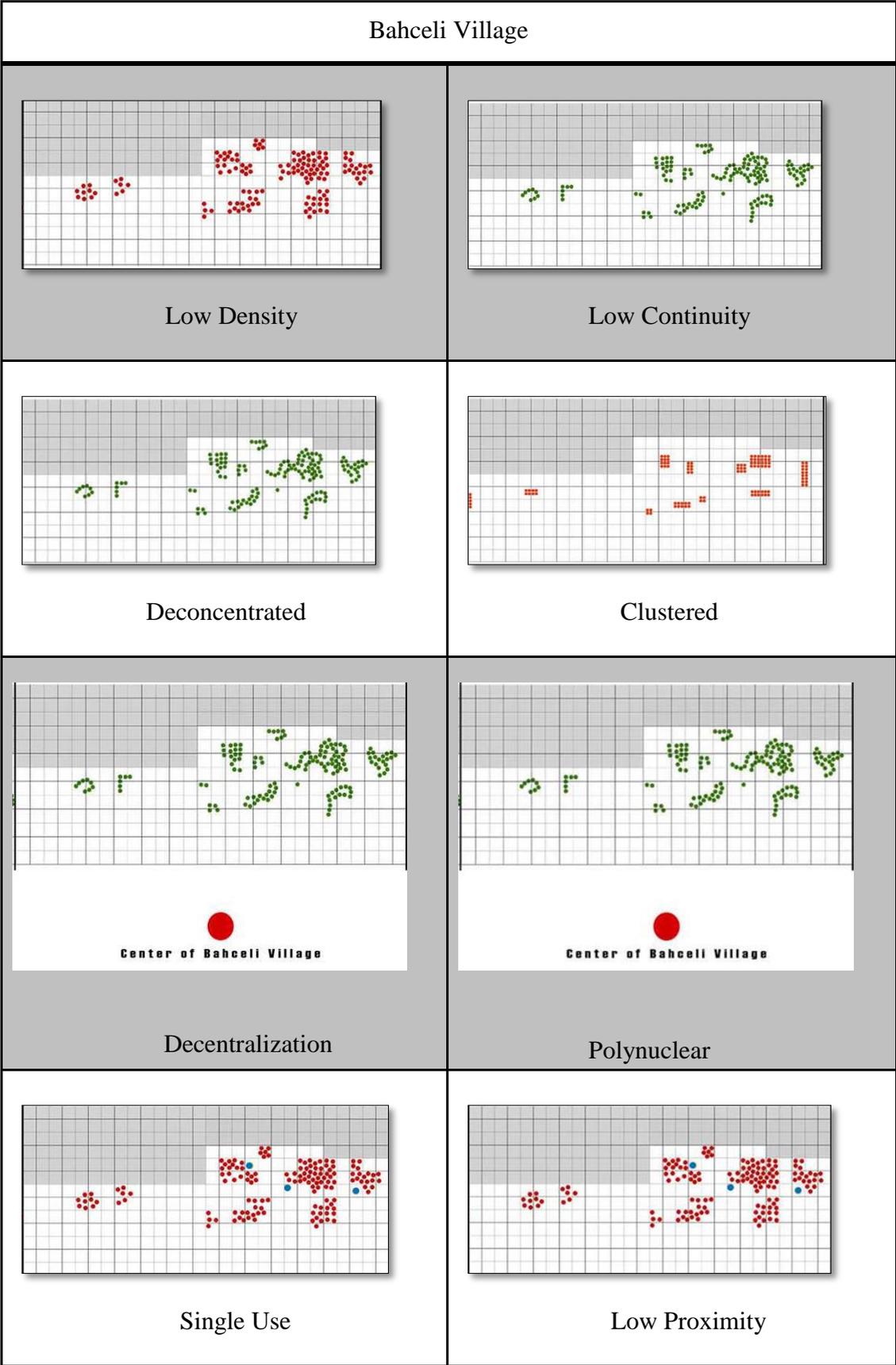


Table 17: Urban Sprawl Analysis in Bahceli Village



Based on all the analysis, new developments in Arapkoy, Esentepe, Bahceli village and Teknecik area have more sprawl form than Catalkoy and Karaagac village. New single use developments in Arapkoy village are organized in a more sprawl pattern due to the existence of high level of undevelopable land (approximately 40%). High percentage of undevelopable land (approximately 86%) in the Teknecik area due to the existence of Teknecik power station in a close neighborhood led to sprawl pattern of new developments. New developments along coastline in Esentepe village are organized in a way which indicates more sprawl due to more the narrowed land along coastline in comparing to the other areas. New spread villas in Bahceli village are organized in a low continuity pattern with more sprawl form due to the less difference slope of land in comparing to the other parts of the case study.

#### **4.6 Summary of Chapter**

This chapter evaluated and examined all dimensions of urban sprawl on the eastern coastal line of Kyrenia based on extensive data about city by using qualitative method. In this respect eight dimensions of urban sprawl including density, continuity, concentration, clustering, nuclearity, centrality, mixed use and proximity along the eastern shoreline of Kyrenia have been analyzed. These qualitative results which are based on those eight measurements indicate the leapfrog development of urban sprawl. As a result of such sprawl the costs are determined as higher energy and land consumption, loss of green areas and loss of agricultural lands in Kyrenia. According to this chapter, the whole process of analyses will be concluded in the next part.

## **Chapter 5**

### **CONCLUSION**

#### **5.1 Introduction**

Urban sprawl is the primary urban form which caused by human population explosion under the title of urbanization. This universal phenomenon is the main source of many environmental, social and economic problems which are against sustainability. Accordingly, the focus of this thesis has been evaluating types and costs of urban sprawl on the cities structure. The problem area and field study of this research has been chosen as eastern part of coastal line of Kyrenia city in the North Cyprus. Therefore, the main aim of this study has been defined as analyzing variety and costs of urban sprawl on Kyrenia city in terms of physical environment.

The coastal line of Kyrenia in North Cyprus is an attractive place with luxury villas and housing complexes which act as second homes for visitors. These residential units in this touristic pole are developed and expanded in the urban sprawl form, thus it is essential to look to the future of city's image. Accordingly, it is fundamental to suggest a sustainable urban form which can overcome future likelihood environmental problems.

In line with the main aim, this research in the second chapter has provided a broad review of the urban sprawl. Hence varied definitions of this phenomenon have been given to find a clear, beneficial and measureable definition. "Urban sprawl is a

certain form of urban development that described by low-density, leapfrog, commercial strip expansion and discontinuity” definition is given as the most known one in the section 2.2. Besides, the main characteristics of urban sprawl have been explained. In the continuous, in order to understand the nature and growth of this uncontrolled and unplanned growth, different types of urban sprawl have been identified including leapfrog development, ribbon or strip sprawl, low density continuous sprawl and single use development. Since urban sprawl focuses on the expansions of land and changes in land uses, a wide range of driving forces of urban sprawl have been mentioned in a summary including urban expansion and population growth, consumer demand, employment, economic development, and technology, infrastructure and transportation, poor planning and management and lack of affordable housing. According to these forces, urban sprawl has gone under the countless criticism for its negative impacts. Therefore, different kinds of negative environmental (energy consumption, land consumption, loss of agricultural lands, loss of green areas, loss of heritage sites, air and water pollution, biodiversity), economic (higher housing cost, higher infrastructure costs, higher aggregate land costs) and social (public health, weakened sense of community, fosters spatial mismatch, fosters residential segregation, worsens inner-city deterioration) impacts of urban sprawl have been reviewed. Since the main aim of this study is to analyze type and costs of urban sprawl in the last part different measuring techniques of this universal phenomenon have been reviewed which this study used Galster et al. (2001) technique.

According to many negative impacts that caused by urban sprawl, the emergence of sustainability and sustainable development as a potential solution for the many

international problems is essential. Therefore, this study in the third chapter reviewed definitions and dimensions of sustainability and sustainable development. Since urbanization and consequently urban sprawl caused many global environmental crises for cities the definition and aim of sustainable urban development has been clarified in the next part. According to the previous knowledge urban sprawl considered as an undesirable form of expansion that some alternative proposals under the title of sustainable urban forms are produced to replace sprawl development. Four main urban form categories such as neo-traditional development (new urbanism, transit-oriented development, urban village), urban containment (urban growth boundary, smart growth), compact city, eco-city have been reviewed.

Based on literature review and the main aim, the fourth chapter has analyzed urban sprawl in the east side of coastal line of Kyrenia in North Cyprus. As before mentioned, Galster et al. (2001) technique is used to measure 8 dimensions of urban sprawl in Kyrenia in chapter four.

In the following sections the research findings and suggestion will be given.

## **5.2 Research Findings and Recommendation**

As has been mentioned earlier, urban sprawl would have negative effects on the future of Kyrenia, so it is essential to review and conclude all analysis findings again and based on these research findings it can be argued that, a sustainable urban form with the aim of decreasing future negative environmental impact and controlling urban sprawl in Kyrenia is needed.

*Density Analysis:* Based on graphical map, density of each village along coastal line have been analyzed that four of these villages have low density and two of them have high density development. As a conclusion, new residential complexes are in a low density pattern which is the main characteristic of urban sprawl.

*Continuity Analysis:* According to the graphical map, new developments in the all villages except Catalkoy are designed and organized to follow a low continuity pattern. As a result, non-residential and residential complexes in the whole area are spatially in a low continuity pattern due to lack of proper master plan and failure the framework of cap.96.

*Clustering Analysis:* Based on analysis which has been done in the previous chapter, all the new developments are tightly bunched to each other in the all 6 villages, due to efficiency use of land, facilities or preference of land owners.

*Concentration Analysis:* Based on the results of analysis, new urban settlements along coastal line in the most villages except Arapkoy are spread disproportionately which indicates deconcentration. Existence of deconcentration presents another evidence of sprawl in the case study.

*Centrality Analysis:* Based on the analysis, the new constructed houses along shore line which developed on the outskirts of city center of Kyrenia as an illustration of compact urban form is the evidence of decentralization and more sprawl.

*Nuclearity Analysis:* With respect to the analysis, new housing complexes along coastal line are developed in a polynuclear pattern which is another character of urban sprawl.

*Mixed use Analysis:* As has been mentioned in the analysis, all new housing along shore line in Kyrenia are planned to be a single use housing, also these new developments are on the outskirts of Kyrenia as the center of different land uses. Therefore, this commercial strip development is another character of urban sprawl.

*Proximity Analysis:* According to the analysis, new developments along coastal line of Kyrenia are designed in a way to have greater distance between workplaces (Kyrenia city center) and accommodations which lead to lower proximity and more urban sprawl.

Based on the results of the analysis leapfrog urban sprawl in Kyrenia can be characterized as low-density, , commercial strip development, discontinuity, low level of proximity and polynuclearity. Based on these characteristics, many negative environmental impacts such as high level of land and energy consumption, loss of agricultural land, loss of green areas and air pollution are the likelihood future problems which will be seen in the Kyrenia.

Accordingly, to prevent these future negative impacts, it is essential to suggest another urban form which is more sustainable. Based on section 3.3 of the thesis, smart growth as one of the sustainable urban form can be a solution for further development along coastal line of Kyrenia in the future.

Smart growth focuses on the reconstruction of land-use to create them further sensitive to solve issues such as lack of “housing diversity, traffic congestion and ecological confusion” (Günay, 2007). In this context, Talen (2003) defined smart growth as “a movement focused on promoting urban development that is compact, higher density than urban sprawl, diverse and walkable as opposed to a car-dependent and land-consumptive...one”. Accordingly, smart growth is including “housing diversity, single-family and multi-family housing in multi model location in good access for walking, cycling and public transit systems with Smart Street which designed for everyone” (Downs, 2005; Litman, 2012).

### **5.3 Agenda for Future Development**

It is deeply felt hope that this research provides the baseline information of urban sprawl and brings attention of city planners for future likelihood problems of Kyrenia city which is associated with inappropriate urban development. Unfortunately, has to be said that, due to time limitation some parts including socio economic impact of urban sprawl in Kyrenia could not analyzed and is missed. Further research can be focused on these dimensions in order to see whole impacts/costs of urban sprawl. By completing this thesis, it is hope that this study could be useful and beneficial not only for the researchers and individuals but also could help professional city planners and municipality for future regulations and proposals.

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