Land Use - Cover Change Assessment Framework: Famagusta North Cyprus

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ABSTRACT

In recent studies, assessing the impact caused by human- want on several land cover and land use classes has become important, as the so-called irrelevant changes contribute to the environmental hazards, most especially within the immediate climate condition of that area i.e local climate temperature. Also such influences are observed on the vegetation type and cover and the rate of under-ground disturbances. Accounting for change around urban centers within the suburban communities to identify growth by examining some of the already specified macro indicators on the micro changes have become necessary due to the grass root implications of some social, bio-physical and or economic forces.

The output of the complicated and entangled interactions between bio-physical and socio-economic forces over space and time is **land use**. Placing forward contemporary issues related to land use-cover change, socio-economic (i.e human factor) has been said to contribute greatly to the alterations in the environment, such issues related to land services and land cover changes have considered construction which results to fragmented land. On a global scale, climate change, urbanization, globalization, suburbanization are some of the identified drivers of land use changes. But beyond this, necessity demands that we assess how these macro-scale factors can be examined to some relative degree at the micro-level of Famagusta North Cyprus.

The context of this work brings to the front line the impact of drivers of land use_ cover changes on the distribution of ecological cover and the built environment.

Remote sensing and GIS methods, agent base and meta-analysis were used to describe and explain the relationship between population dynamism, urban growth, economic variance and social needs that has subjected the city of Famagusta to influence changes on her immediate suburban areas. Although the secret behind the choice of polarized urban pattern was not revealed in this research, but the contributing factors encouraging a consistency of change were discussed in detailed. Thus the result shows that within four decades at 4 time-steps observation (1986-2012), population increase relates with the increasing housing demand both (individual and social). This definitely demanded the provision of social amenities such as roads, green space as more building blocks are created within the city. Subsequently, the encroachment of land leads to expansion of territorial boundary as the case is between Famagusta city and Tuzla, the consequence of which is urban_ suburban merging and or in some cases, feature of possible interwoven territory will show up especially along a linear axis. These observations do not take place without the inclusion of a change in land use and land cover.

The research therefore sets up an assessment framework to contribute to the suggestion for the need to implement proper monitoring and planning of a much managed environment by considering factors responsible for the present situation and the distribution of change.

Key words: Land use- cover changes, urban, suburban, population, social amenities.

ÖZ

Arazi kullanım kararları üzerine, mevcut gelişim taleplerinden kaynaklanan süreç ve dinamikler araştırıldığında, son dönemdeki araştırmalar, bu durumun çevresel tehdit ve tehlikeler oluşturrduğuna dikkat çekmektedir. Yerel ölçekteki ani iklim değişilikleri bu etkilerin başında gelmektedir. Bu etkiler, aynı zamanda birki örtüsü ve yeraltı kaynakları üzerindeki olumsuzlukları da içermektedir. Kentsel çevrelerdeki değişimlerle birlikte kırsal etkileşim de farklılaşmakta ve 'çeperdeki' gelişmelerle birlikte bu etkileşim hem kentsel hem de kırsal büyümede belirleyici olmaktadır. Bu bağlamda makro ölçekteki değişimlerle birlikte, mikro ölçekdeki etkileri de gözönünde bulundurularak farklı boyutları(sosyal,bio-fiziksel,ekonomik) ile ele alınmalıdır.

Farklı ölçek ve dinamikler açısından etkileşim arazi ve hizmet alımı konularında yapılaşma ile insan boyutu da devreye girdiğinde fiziksel çevrede önemli değişiklikler meydana getirmektedir.Bu bağlamda bölünmüş arazi ve dağınık arazi kullanım kararları en sıkıntılı olanlardır. Küresel ölçekte, ikli değişiklikleri, kentleşme, küreselleşme, kırsal kentsel arakesitinin genişlemesi bu sıkıntıları yaratan göstergelerdendir. Bu bağlamda, KKTC, Mağusa'nın kentsel gelişim ve arazi kullanım değişiklikleri ele alınarak makro ölçekteki etkilerin mikro ölçeklerdeki yansımaları haritalandırma metodu ile araştırılacaktır. Bu çalışma sonucunda, arazi kullanımındaki değişimin ekolojik ve yapılı çevredeki etkileri üzerinde durulacaktır. Bu anlamda GIS metodu ile, meta-analiz sistemi kullanılarak nüfus dinamikleri, kentsel gelişme, ekonomik çeşitlilik, ve sosyal etkileşim konuları kensel kırsal

arakesitinde (Suburban) iredelenecektir.Süreç içerisindeki bu değişimin tutarlılığı ele alınacaktır.

Araştırma sonuçları açısından son 40 yılı gözönünde bulundurarak dört aşamalı bir değerlendirme yapıp, konut stoğu ve talebi ile arazi kullanım kararlarındaki değişiklikler ortaya konmaktadır.Araştırma, arazi kullanımı ile ilgili bir değerlendirme çerçevesi sunarak, bu değişimin sürdürülebilir bir yapıda olabilmesi için, denetim ve gözetim konularında etkin bir araç olarak kullanılacak bir yaklaşım sunmaktadır.

Anahtar Kelimeler: Arazi-kullanım değişiklikleri, kentsel-kırsal arakesiti, ekoloji

DEDICATION

To him who is able to say a thing and no one can change, creator of heaven and earth, the master planner, my Provider, Sustainer, Healer, King, and Ever-Faithful GOD (Dansaki re o baba!!!). Also to my families now and in future.

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Most importantly, I must say to; my parents, siblings, RCCG Shekinah Parish North Cyprus, Shekinah Glory Choir, House of Testimony fellowship unit, Ayisat Aguome (epo-damola # winks#) Mohammed, it's been God and You all through my stay in Cyprus, May God abundantly reward you, I sincerely Love you.

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INTRODUCTION

1.1 Background Study

The form, physical display and dimension of arrangements of settlements visible or available through records have been used to model ancient roles and value attributes of land shared by a community. This morphology provided depict the lifestyle of the existed, existing and to a high degree lays the foundation and projects the pattern to be exhibited by the future generations (Bibby & Shepherd, 2001). It is made possible that economic, commercial, industrial, political, and territorial domain that can be interpreted from the image of a settlement can be used to infer the population, either present or projected. Usually, the projected standard and pattern of living depends on the current social and economic character displayed by the existing population which further produces the size of the population to be expected in a geographical territory in the nearest years to come. Thus with great magnitude, population growth attached with other factors characterizes the urban, suburban or rural habitats. Therefore, with growing population, slight or major economic shift, particularly when it is on the positive side such as increase in minimum wage, there are tendencies for people to have more need of land, sudden demand for better quality life such as relocation from social houses to individual dwellings that would require gardens, more open space for the family. Thus such need can only be met at the suburban area which compels outward sprawl to these suburbia, and automatically

converts land use classes from one form to the other. With this, it is important to know when an urban area begins to extend her coverage to inconvenience the suburbs in other to properly control the rate of such conversion and bring balance between classes to avoid deficiency of one at the expense of the other. The impact caused by human want between several land cover and land use classes contribute to the environmental hazards, most especially within the immediate climate condition of that area i.e local climate temperature, also such influence is observed on the vegetation type and cover and the rate of under-ground disturbances. Accounting for change around urban centers within the suburbs and communities to identify growth using indicated social forces concerned, remote sensing and GIS methods contributes to the monitoring and planning of a much managed environment by considering factors responsible for the present situation and the distribution of changes. A strictly adhere-to land use plan and management system would help to provide a sustainable land use_ cover within a geographical area. Furthermore, the felt impacts of land use change is dependent on an individual's awareness of that change, and on their beliefs about the causes of these changes, therefore it is important to address the issue of change starting with the indicators and the drivers/ causes of change to verify how this large scale regional change can be described and assessed at the local level.

1.2 Aims/ Objectives

This research aims to provide an assessment method for a descriptive and explanatory analysis of the existing land use/land cover changes (LUCC) occurring in the urban and suburban interfaces. Although, such studies are mostly done on a broader scale, in other to asses this at micro level, Famagusta has been selected for a case study.

1.2.2. Objectives

In fulfilment of the above stated aim, the research will:

1. Ascertain the proximate factors driving land use/cover changes within all scales (i.e macro such as change in government policy – micro such as individual choice of location) based on literatures;
2. Examine the trend and pattern of changes in the study area through image production;
3. Relate some socio-economic drivers to the physical character of land use land cover changes in the study area; and
4. Point out reasons for the need (s) to adopt proper land use planning.

1.2.3 Research questions

1. In which geographical districts areas can distinctive land use changes be identified in North Cyprus? ;
2. What are the proximate factors driving the changes at case study level (Famagusta)? ;
3. What are the exact trends and patterns of changes in the study area; and
4. Is there a need to adopt proper land use planning for land sustainability of the urban area in context of land use /cover?

1.3 Research scope

This study will be building on and adopting knowledge from existing research works on:

- Indicators of land use- land cover changes
- Drivers of land use- land cover changes Land use- land cover change models
- Role of socio-economic drivers on land use/land cover changes
- Effects (positive and/or negative)of land use- land cover changes

Laying more emphasis on the focus given below, the relationship, overlaps and effects of land use change can be derived from these models (see Figure1).

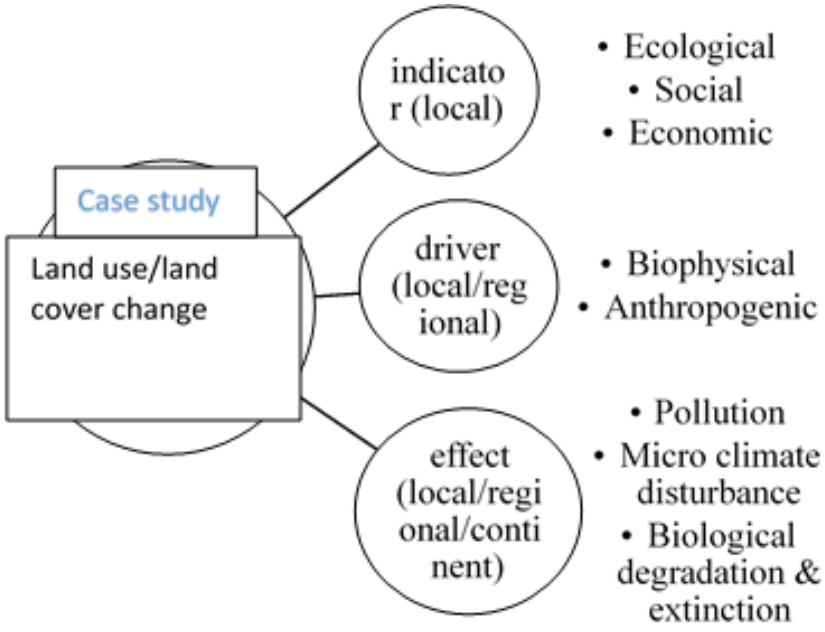

Figure 1: Case study - cause and effect relational scope of research.

- Findings on scope, role and importance as well as scale of land use oriented studies.

Therefore, for the purpose of integrating this research into an applicable frame work, the simulation incorporating at case-study scale will present the following (see table 1):

Table 1: Research output framework simulation

Spatial scale for results: District, Municipality, Regional, national, European	District, Municipality, Regional
DPSIR framework: Driver, Pressure, State, Impact, Response	Driver, State, Impact and Response of land use change
Land use issues covered: Housing, Population growth, Agriculture, Natural Area (such as wetland), Water, Tourism/recreation	All
Output indicators: Socio-economic & environmental external constraints; Land Use structure; RUR Metabolism; ECO-system integrity; Ecosystem Services; Socio-economic assessment Criteria; Decisions	Socio-economic & environmental external constraints; Socio-economic assessment Criteria
Output Drivers/ Actors: Residents, planners, policy makers, entrepreneur and service suppliers.	All
Knowledge type: Narrative storylines; Response functions; GIS-base maps; Tables or charts.	All

Adopted from Kroll, F. et al., 2009.

1.4 Significance of Study

Studies on land use _ cover changes have become relevant in the global society due to the occurrence of several depletion taking over the world, alongside the target to have better management scheme for earth resources, land cover and land use were considered necessary for monitoring. Therefore, this research is set to put forward the distribution of land use- cover within the case study area, and also put up some reasons related to the observation to draw attentions of planners, institutions on the

need for land use planning. The study further provide a futuristic likely occurrence which will be useful to interested researchers in this field.

1.5 Structure of the Thesis

This study has been considered under five chapters. Chapter 1 consist of the research background which relates the problem of research with the aim or purpose, objectives to aid the successful achievement and the mind troubling question that should be answered in this study. It also included the scope where issues related to land use_ cover changes are covered in this study, significance of the study, definition of terms and as well the structure of the thesis.

In the proceeding chapter 2, a wide coverage of contemporary land use_ cover change related issue were discussed, all extracted from works of interested researchers in environmental concern. Therefore, both bio-physical and human factors of land use_ cover change were detailed put into consideration. This span from indicators of changes to drivers of change. An explanation of the various roles of these indicators and drivers which are inclusively; Ecological, Social and Economic while the drivers are bio-physical and anthropogenic.

The next chapter comprise of the method adopted for the research. As a case study research, it applied qualitative research techniques, dwelling on secondary data. It covered the introduction to some of the several land use_ cover change models adopted in 21th century studies, considering this quick review in tabular form, provide the data type and source with the geo-referencing property and software utilized in the research. Sample frame, size and procedure, method of data analysis and limitation to the study.

Chapter 4 described the applicability of the macro-scale drivers and indicators within the micro-scale study. In assessing the role of socio-economic drivers on land use-cover change, the chapter covered the relativity of population growth, increasing housing demand, institutional decision and economic condition of the study area. To proof the outcome of the socio-economic influence, remote sensing with Geographic Information System were combined to produce the pictorial distribution of land use_ cover within four time-steps. And on a conclusion, a projection was made to estimate the future occurrence and the expected distribution as a result of the present observation.

And finally, chapter 5 pointed to some ways of addressing problems discussed above and listed alternative methods of approaching some of the issue causing land use_ cover change.

1.6 Limitation(s) in the Study

Land or property discussion are generally referred to as case sensitive issue, therefore few people seems to be interested in what happens to their environmental land, talk less of what their neighbor, an institution or government decisively embark on with the land. This thus goes a long way in the attitude contributed towards availability of relevant data.

While on the other hand, the difficulty in getting programs that can aid projecting land use in the study area is discouraging and simply shows the general negligence towards issues related with land use and land cover changes.

Also, the need to decide which definition of land use is best adopted in this research out of the many definitions existing probes some challenges to the study.

Chapter 2

LITERATURE SURVEY

2.1 Contemporary Social Urban and Suburban Land Use/Land Cover Relation

Individual opportunities with these urban vary according to social class, race, gender, ethnicity, age, and family status, among other factors. The spatial arrangement of home subject to economic, or the distance taken to school, shopping or market place, the numerous leisure points where we socially reconnect to friends are all related to spatial or locational philosophy usually discussed as a social variables, in traditional subject matter of sociology and urban studies (Gottdiener & Hutchison, 2011). Thus, social scientists define urban areas as a specific type of settlement that contains a large population, much diversity of land-use and a dense, built-up area. Their focus is on actors, in particular their socioeconomic and socio-demographic features, their specific attitudes concerning housing environment and their interactions within institutions and governance structures (Storper and Manville, 2006).

These settlement spaces commands special cultural meanings and value from the people living within them. Discovering how these settlement spaces have come to be, the role that economic, political, and social institutions play in creating and changing these spaces, and the processes by which these spaces are given meaning by local inhabitants are all part of the socio-spatial perspective of the new urban sociology.

The built-up region contains a mix of cities, suburbs, vacant space, industrial parks, intensely farmed agricultural land, shopping malls, and recreational areas—all of which are interconnected and bridged by communication and commuter networks including highways, rail, telecommunications, and satellite or cellular-based links (Gottdiener & Hutchison, 2011).

The platform for all of these activities is **"Land"**. Land has always played a vital role in human life, its importance ranges from the provision of food, shelter, leisure, to the global dependency of all living form on land. Land have been a necessity both in the rural and urban arrears, to the poor as well as to the rich, to man and woman, both young and old, alien and citizen, all look up to land as the means of sustenance. Not even the modern world of technology can deny the importance of land, no wonder every disciplines of life carves out their best interpretation of land based on the diversify obligations man expects from land. For these reasons, man put land to duty and thus the resultant effects cannot be quantified. The consequence of man's motives and expectations from land has brought the long history of land use change noted by lay and scientific interest. This worrisome interest has grown so much that ancient writers, philosophers, scientist and lay people have documented records of this unwanted change caused as a result of the significant adverse impact man remits to land as his gratitude for provisions (Briassoulis 2000).

Land and Land Resources: Refer to a delimitate expanse of the earth's terrestrial surface, covering all attributes of the biosphere right away, on-top and underneath above or below this sphere, not excluding the immediate bio-physical and physical environs, the lithosphere, hydrosphere, the accumulated and associated layers of

groundwater and geohydrological reserve, the biotic populations, man's living approach and visible results of past and present choices (FAO/UNEP, 1997).

Dr. Alfred Marshall (as cited in agriinfo 2011), defined land to go beyond the mere word, but whole of the materials and forces which nature gives freely for man's benefit in form of land, water, in air and light and heat. Land makes up all nature, biotic and abiotic. It includes all natural resources that human derives free from air, water and land. Truth speaking, the terms 'land' generalizes all that nature has created on the earth, above the earth and below the earth's surface (Agriinfo 2011 retrieved on 19/03). Land can be divided into two interlinked concepts:

Land Cover: refers to the bio-physical coverage of land (for example, crops, grass, broad- leaved forest, or built-up area);

Land Use: indicates the socioeconomic use of land (for example, agriculture, forestry, recreation or residential use). Data derived for land cover and land use forms the basis for spatial and territorial analyses which are increasingly important for:

- The planning and management of agricultural, forest, wetland, water and urban areas;
- Nature, biodiversity and soil protection and;
- Prevention and mitigation of natural hazards and climate change (Eurostat, 2009).

Land use: Land use is described by the arrangements, action and contribution people undertake in a certain land cover type to make, divert or retain it" (FAO/UNEP,

1999) (*Adopted during the course of development of the Land Cover Classification System*, LCCS). In application, a more comprising definition of the term is preferred, as -Land use actually includes near-surface water. Any given area of land is usually used to satisfy multiple objectives or purposes" (FAO/UNEP, 1999).

Land hold variety of meaning to different people, so much that categorizing the meaning of land would bear an endless list and in same likeness is the attribute we individually place on land, and thus the definition of land knows no bound. A classical and neoclassical economist would see land as the "original and indestructible power of the soil (en.wikipedia.org/wiki/land_ economics), a geologist would refer to land based on its accumulated stratified or sediment mineral components, irrespective of the diversity of meaning, "land (Briassoulis 2000) is the avenue to source and resource the whole life necessity of man. Doubts arises if there is going to be change to the meaning of land in urban context due to the functional characteristics attributed to land by urban designers. Here land is adopted in similar view as the platform for all human conduct and all resources necessary for such conducts (Briassoulis 2000). The various conducts carried out on, from and with land, all denotes the function which land serves, and the act of putting land to role in an area, for a purpose or the other is generally referred to as land use.

Land use involves the management and alteration of raw environment or wilderness into modified environment such as settlement and semi-natural habitats such as arable fields, pasture and managed woods by man (en.wikipedia.org/wiki/Land_use. Retrieved on 18/03/2014). Veldkamp and Fresco (1996a) notes, land use "is determined by the interaction in space and time of biophysical factors (constraints)

such as soils, climate, topography, etc., and human factors like population, technology, economic conditions, etc." (Agarwal et al., 2002).

The degree to which land is used depends on need and its availability in the geographical location (extent of land area), also the extent of change changes that has or may occur varies with time and location, this also known as "land use change". As many would say "change is inevitable", none the less, timely and proper identification of the factors responsible can reduce the risk of an inevitable adversary.

Land Use/ Land Cover Change (LUCC): This is the conversion or modification of land from one form and service to another and also, it is the extension or reduction in the topographical character or situation of an ecosystem. Mostly, a land cover change is an attribute of bio-physical influence but likewise carries traces of human (anthropogenic) factors within. (LUCAS 2009, retrieved from http://epp.eurostat.ec.europa.eu/portal/page/portal/lucas/data on 18/03/2014).

A change either caused by bio-physical and or social factor has a cycle that in no way omits human activities. Most predominant is the increase in population which has greatly modified the earth. The problem with population has always had associates of positive and negative impact. On the higher side is the adverse effects which when based on the scientific study of determinants and impacts of land use changes is not confined to the global scale only (Briassoulis 2000).

Studies on land use/ land cover changes have span through the global scale to the local scale, researchers have explicitly outline the hierarchical concerns of interest in

LUCC. In the following order, Agarwa et al., 2002 considers the scope of concerns from global – continent – region – location and finally to the site in the context of scale (see Figure 2).

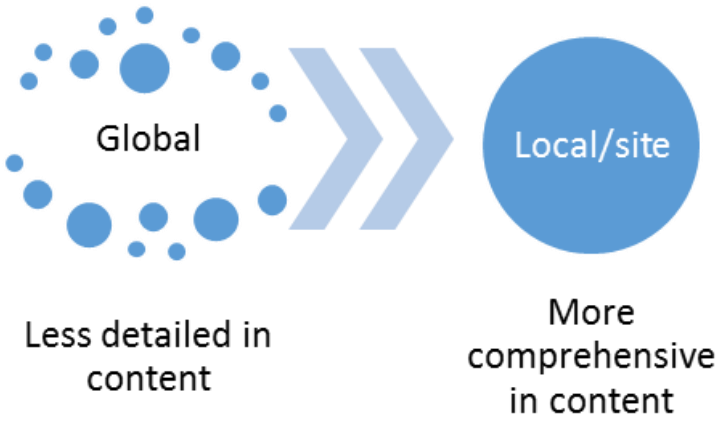

Figure 2: Land use study scale, Agarwal, et al., 2002

Though scale fraught with confusion in meaning. Relative to a geographer, a large-scale map of a neighborhood (in 1:10000) shows detailed content, and a small-scale map is such as a world map (1:12,000,000) which show little information on the area of coverage. This is in comparison to some other social sciences. The scale also determine the model which will be considered for land use/ land cover analysis (Agarwal, et al., 2002).

Beyond the spatial and temporal scale to deal with or analysis issues related to land use changes, others scales such as administrational, functional and perceptually defined scales. "Land use/cover changes could be examined on the administrative platform, i.e from local, considering national and giving a thought to the global changes, through social and political tools. On the other hand, a beckon on the roles of industrial system, and other urban field of interest are other tools to guide the

scope of research on the impact of production, service-based sectors on land use/ cover changes. The scope of limit of research is usually based on individual motives and instinct, reflecting the aspiration and culturally diverse traditions (Briassoulis2000).

2.2 Land Use - Cover Relation Regarding to Case Assessment Approach

Contemporary socio-economic issues related to land services and land cover changes have considered construction which results to fragmented land (Lin and Ho, 2003; Long and Li, 2005), the adoption of some new market principles which has resulted to internal restructuring of agricultural land use (Heilig, 1999; Li and Yeh, 2004). The sporadic industrial development and urban growth resulting from some economic reforms. Likewise, population increase have greatly affected land-use change through the increase of built-up areas and peri-urban encroachment (Wu et al., 2004). Based upon distinctive physical, functional characteristics, type, rate, formal and informal urban development trends, the land (described in the context of FAO/UNEP, 1997) has been changed and modified, some in ways that could have been alternatively avoided.

2.2.1 Indicator Applicability. An Assessment Method to Explain and Display Land Use- Cover Changes (LUCC)

"The built environment of human settlements is continually changing and being changed. Sometimes these changes occur rapidly and at other times, the physical pattern of place seems so static. Although, they never really are static; the natural and artificial environment of cities, suburbs and villages are always changing either due to human intervention or natural process of terrestrial environment. These processes

include the steady erosion, oxidation, bleaching resulting from the effect of sun, water, wind, and also from the growth of organism and plant.

These causes disaster for man due to the poor ability to manage the effects. Other changes occur due to human invaded activities, purposefully changing the existing pattern because there are possibilities of meeting needs. Further environmental changes are response to these human induced changes (Jon Lang 1994). Either anthropogenic (human) or bio-physically driven, a theoretical approach, that recognizes knowledge gaps and omissions even though it might not be possible to achieve a comprehensive account in a later stage depending on data availability or indicator applicability is needed to explain and display land use/land cover changes (LUCC).

This brings us to the background idea of Indicators, Driver, Pressure, and State, Impact and Response applicable to the present study scale (Kroll, et al., 2009). The understanding of Land use/ land cover is a series of complex processes among which includes land use indicators, land use drivers, land use models, land use impacts, e.t.c (Kroll et al., 2009, Veldkamp & Lambin 2001, MacLeod & Moller 2006). Land use/land cover change is a branch of these complexity, observable with several indicators at different social and spatial scales (Valbuena 2010). A list of which cannot be exhausted when considering the impact of land use change on the indicators. Kroll et al 2009 suggested a compilation of key indicators as; **Ecological indicators**: Biodiversity potential, Carbon storage, Potential Evapotranspiration, Food provision, Energy provision, Water provision, Recreation, Climate regulation. **Social indicators**: Population density, Settlement population density, Household size, Housing area per person, Mean age, Quality of life, regarding: Air quality,

Access to public green space, Availability and access to public transport, Availability of shopping facilities, Noise pollution, Area safety and security, House or flat suitability, Waste collection. **Economic Indicators**: Unemployment rate, Commuting distance, GDP, External costs, green space, Costs carbon stock, Costs air pollution". The process and patterns of urban, suburban and rural forms depends on these alarming factors. To understand the cause-effect and feedback relationship of land-use change at the local case-study level, it is appropriate to discuss some of the indicators of land use/land cover which based on various research concerns are quantifiable as dependent or independent variables. Indicators are parameters that describe situations or circumstances that cannot be ascertained directly. They are used to monitor system performance (Banzhaf et al., 2013, Pissourios 2013).

2.2.1.1 Ecological Indicators

Most bio-physical functions performed by the ecosystem are generally characterize with the ecological indicator of LUCC. Ecosystem services (see table 2) are goods and services directly or indirectly (McBratney et al., 2013) developed at the interface of society and nature, (Kroll et al 2009) providing support and information necessary for environmental management and biodiversity conservation strategies Martı´n-Lo´ pez 2012) due to its traditional and modern benefits of nature to households, communities, and economies" (Daily 1997), temporally and spatially adjusting its boundaries to accommodate human theoretical and empirical experiments.

Within the numerous scope of roles possessed by the ecosystem, the feedback relationships that have been observed gives the worrying concern on the adverse impact man consciously and unconsciously produce.

Table 2: Uncovered Ecosystem Functions to man, some of which are measurable for environmental impacts

Regulating Services	Cultural Services	Supporting services	Provisioning Services
Benefits obtained from regulation of ecosystem processes	Non-material benefits obtained from ecosystems	Fundamental necessities to support life	Goods produced or provided by ecosystems
Air Quality Regulation Climate Regulation Erosion regulation Nutrient regulation Water purification Disease regulation	Spiritual and Religious Values Knowledge Systems Educational Values Inspiration Aesthetic Values	Habitat and gene pool Biogeochemical cycling, biodiversity	Food - Crops - Livestock - Capture Fisheries - Aquaculture - Wild Foods

Pest regulation Pollination Natural Hazard regulation	Social Relations Sense of Place Recreation and Ecotourism		Fiber - Timber - Cotton, hemp, silk - Wood Fuel Energy

(Martı´n-Lo´ pez 2012, Kroll.et al., 2009, Bryan 2013, McBratney et al., 2014).

2.2.1.1.1 Biodiversity Potential

Biodiversity covers the diversity of genes, kindred and ecosystems that makes up life on earth. There is concurrently a loss of biodiversity, with fundamental consequences for the physical environment and for human well-being. The reason for this loss is attached to the constant changes in natural habitats, which all boils down to the intension to increase agricultural productive systems, building of road, dams and houses and others, mining, excessive lumbering, draining of oceans, rivers, lakes and soil resources, pollution and aggravating global climate change. (Retrieved 2/4/2014 from http://www.eea.europa.eu/themes/biodiversity/intro). Due to the alarming decline in ecosystem services i.e. the services supplied naturally: climate regulation, water and air, soil fertility, and the production of food, fuel, fiber and medicines, many researchers have diverted their attention to the impact of land use changes on the ecosystem. Majority of the studies theoretically relate man to the depreciating potentials of all biological components (other than man) in a top-down approach of cause- effect relationships.

Soil as a physical component of this biodiversity has had a severe change in composites, either from high chemical and physical properties to low or vice versa. Soil with a high property composition is referred to as “High Soil Combined” (Geist & Lambin 2004), a major determinant of land degradation (Vu et al., 2013). European Environmental Agency reported the role of man in shaping the natural environment from the time of the discovery of agriculture and animal husbandry over 5 000 years ago. The agrarian and industrial revolutions led to striking and increasing changes in land use, intensification of agriculture, urbanization and land abandonment. This in exchange has given way to the extinction of many practices

(e.g. traditional agricultural methods) that were helpful in maintaining biodiversity-rich landscape. But the truth is, this phenomenon is not particular to Europe alone as studies in New Zealand's species-rich lowland ecosystems have reportedly been dramatically modified by several significant changes in land use since the arrival of humans (MfE, 1997; Norton and Miller, 2000), cited by MacLeod & Moller 2006 who explained their research outcome in New Zealand as indicator of an overarching, strong and steady trend for agricultural intensification and to a lesser extent diversification with the increasing stocking rate and yield of fewer animal and plant species and the increasing inputs like fertilizers, pesticides, among others. Not only do man risk losing his biodiversity potentials but also incurring diseases from the practice of "monoculture" which is a platform for wide and quick spread of diseases in animals and to man (EEA 2011).

The need to preserve and protect endangered species in our environment also suddenly became urgent and alarming responsibility government and non - governmental agencies had to confront due to the severe loss of both plant and animal species. Impacts of habitat loss or degradation may be severe for species with small or isolated populations, for example, the Gunnison sage-grouse and other sage-brush were enlisted endangered species in Idaho, Nevada, Oregon, and Wyoming, southwestern Colorado and southeastern Utah. The observed impact of fire (natural and prescribed) has been attributed to human alteration and fragmentation of sagebrush landscapes (Braun, 1995, Connelly et al., 2004, Schroeder et al., 2004), which was barely known prior Euro-American settlement. Change in land-use, presence of invasive species (Baker 2006, cited by Bryan 2013) has proposed

Gunnison sage-grouse an endangered species under U.S. Endangered Species Act in 2013 (U.S. Fish and Wildlife Service, 2013).

2.2.1.1.2 Carbon Storage

A period of expansion or contraction in the industrial era has a way of influencing land use changes and in return creates an impact on the indicator. Over the last few decades traditional land use activities, such as farming, have, on the whole, become more intensive. Vast areas of Europe have also been transformed into urban zones or industrial zones and on the other hand could be cut up by an increasingly dense transport network (European Union, 2013). A change in settlement pattern around such a place, resulting to urban shrinkage (Haase et al., 2012), a fall of in market economy or the dissolution of certain union (policy maker) could cause abandonment of land for so long as to become carbon fill or dump. Schiermeier 2013 emphasis the effect of this abandoned 31 million hectares of land in western Russia and Ukraine to have accumulated carbon estimated to total of over 400 millions of tonnes. Now the question is should such a land be preserved for such use or be converted to a crop land?

For as much as a carbon fill could provide environmental advantages, it also has the potential of prohibiting neighborhood livelihood and depopulation (Haase et al., 2012). The significantly higher organic carbon density in urban soils is due to a misbalance carbon stock and cycling in soils, plants and the atmosphere and both urban and peri-urban have been recorded as source of nitrogen and phosphorus, an unpleasant environmental observation. Some more concerns have arisen with the poor uptake of phosphorus and nitrate by plant, with excess fertilizers added to soil

(Pouyat et al., 2002, Kroll et al., 2009). Now the question is should peri-urban/ rural hinterland of cities be nitrogen or phosphorus sinks or sources?

2.2.1.1.3 Potential Evapotranspiration, and Food Provision

They are both affected by the ability of a plant. The property components of a soil directly determine the nutrient composition available to a plant, which relates how much of water required for food processing and vapor releasing capacity of plant. Meaning there will be more loss of water through evaporation than transpiration (Allen 1998). Though the deficit of water through soil surface (evaporation) is largely dependent on soil type. Factors such as high saline soil, infertile land, and inadequate use of fertilizers, hard and impenetrable soil layer, uncontrolled diseases and pests and improper soil management may hinder crop development and decrease evapotranspiration (FAO (1998).). Thus it is important to recognize the riparian vegetation that are capable providing ground cover which helps to reduce the amount of direct soil surface water loss (evaporation), conserving ground surface moisture provided beneath its canopy and by evapotranspiration, creates interface for regulating water surface temperature (Hlúbiková et al., 2014).

Of all agro-ecosystems services which includes a range of provisioning (e.g., food, fresh water, and bioenergy e.t.c), ***food provision*** has the longest history that can be directly related to human motive for land use change and the one-to-many, many-to-one, many-to-many feedback that has be received (Bryan, 2013). The conversion of many eco-system from its natural state (forest, wetland) restricted or not, to crop land is based on the ability of services that can be provided. The 2030 projection of intensification in crop production in the form of yield increases (67%) and cropping intensity (12%) with cropland expansion of 20% is expected in the developing

countries (FAO 2003a). The direct influence of this projection is an increasing consumption rate estimated to increase by 1.4%, an impact which reflects on land use/land cover.

2.2.1.1.4 Energy Provision and Water Provision

Biofuel, solar, hydroelectric energy, fresh water, desalted water, and others are embedded in ecosystem. Water scarcity is one of the most important issues emerging today. Ensuring there is sufficient fresh water to satisfy the competing needs of urban, rural, and agricultural communities is already a significant issue in many parts of the world. It is estimated that nearly one-third of the global population live in regions characterized by severe and chronic water shortages. Moreover, it is projected that nearly two-thirds of the population will be impacted by water shortages by 2050 due to population growth, increased energy needs and changing dietary preferences (Alfieri et al., 2013). The economic, social and cultural services derived through the exiting forest, solar, water and other relatively available bio energy have been over exploited and utilized in such a way that the relationship between urban pattern and energy consumption have been expressed with such a huge correspondence. The major concern is that, human negligence to recreation of renewable energy and resources and conservation of non-renewable ones in the ecosystems may have passed biotic and/or abiotic thresholds (Ferreira et al., 2013). Incessant water pollution have decreased the possibilities of a clean beach, consumable fresh water (springs), fishing lakes in our communities (Nakaya, 2006). Energy extraction has been a major back bone to most environmental issues experienced today. The commercial energy consumption rate in developing countries is a major contributor to degradation of the local environment. Such fuel as coal, oil, biomass account for 38-23% of the total energy consumed by developing countries.

Fuel wood and charcoal consumption in Brazil, India, and Africa might not be a single most important factor of forest depletion but contributes largely to soil erosion, forest degradation, and deforestation in the highly populated areas of these regions (Ravindranath & Hall 1995). Increasing change in biomass harvest appropriation northern and southern regions in Italy by around 26% due to agricultural intensification, despite shrinking croplands is an indicator of LUCC (Niedertscheider &Erb 2014).

2.2.1.1.5 Recreation

The inspirational, recreational, relaxation and spiritual social services provided by ecosystem has been a rooted link to cultural lives of human existence. Culture as it is, has played a role in where, what, how food, clothing and shelter directly comes from the bounties of nature. An observer once put in writing, Tokyo's experience to the loss of connection to nature in summarizing what nature was previously understood as, "where children's playgrounds were brooks and fields, where nature, untouched and untainted by human hands, played an integral part in our lives" (Yukio Aoshima 1995-1999) cited by Inoguchi et al., 1999. Majority of recreation areas have been shaped and reshaped to suit aesthetic experiences and not to express the wonderful work of nature, so to this end, ecotourism has taken the fold of touching the untouched with the so-to-say "eco-loving". Thus questions are should "eco-tourism" not be concerned with re-building what has been touched and not touching what is yet tainted?. Many at times, human re-creativity seldom recognized the role of private gardens and backyards, although they play an important role in the preservation, connection and heterogeneity of biodiversity and ecosystem services both in urban and suburban enclaves. The arising need to identify and characterize the green infrastructure within the municipality, to approach the citizens to the green

areas, stimulating the fruition of parks and woods, lakes and wetlands with meadows has become a concern in the education sector for people to value and preserve what they can enjoy (Ferreira et al., 2013).

2.2.1.1.6 Climate Regulation

The more global issue did not originate at that so-called global scale, but can be traced to the way we manage ecosystem services related to microclimatic conditions, air quality, noise pollution, water and nutrient fluxes (Ferreira et al., 2013) from local scale which has brought about dealing with climate change and its cohorts such as ozone depletion, global warming, acid rain and the responding "green agenda" world-wide clamor (Inoguchi et al., 1999). The saying "nothing goes for nothing" simply depicts the responses we get from the environment for our actions. So far, land use change has not only had implications for international trade, wildlife conservations, culture loss, but has heightened the need for more global climate change policy issues. Today many regulating agencies exist with the aim of combating the issue related to climate change (Lubowski et al., 2008).

2.2.1.2 Social Indicators

They can otherwise be referred to as the push-pull signals of land use/land cover changes. Social indicator of LUCC are closely relate to the human/individual position on land use functions and/ or type which are known as "residential choices" at local case-study level (Kroll et al., 2009).

2.2.1.2.1 Settlement Population Density

Population density is the total number of people living in an area per km^2. Migration as a single determinant of a country's population is a common trend of sub-urbanization and urbanization in most countries. This factor has increased the

number of informal constructions both in the cities and periurban. Houses illegally built (gejekondu) as commonly referred to by some eastern European countries are the problems having to deal with at inter and intra boundaries by master planners (Ferreir & Condessa, 2012). Population density in some places have hit the highest record during the early 1990s (545 persons/km2) in the Western World (Shoshany &Goldshleger, 2002), and by now many more would be taking the new lead role. When considering a review of Malthusian's work on population theory, the criticisms among many others of his assertion that "food production could not keep up with population growth" (Malthus1798), we can only imagine the insight of knowledge from which such words came and the complexity of our actions on this simple truth. Both the socialist and capitalist discuss on human needs in the trans-discipline of urban design and economics have considered the different relationships that exist between population growth and economic development regarding different social development stages, i.e social class of an individual or economic condition of a nation (Weeks 1996). The increasing number of occupants or the change from a single flat occupancy to multi-flat occupancy is in itself an indicator of land use functional change (Kroll et al., 2009). Housing increase and population density surrounding protected areas is a major predictor of local species extinctions, particularly of ungulates and carnivores, and extinction risk for these animals inside the protected areas was greater closer to the border with the human settlements (Estes et al., 2012).

2.2.1.2.2 Household Size, Housing Area per Person, Mean Age

Issues on urban shrinkages has put forward some beyond significant to problematic relation of land use changes to structuring and reshaping of house hold sizes, mean age of a particular neighborhood, age composition and wellbeing in a locality as well

as gender versus labor structure relative dependency of a region (ÇAĞTAY 1995, Haase et al., 20012, Xu 2013,). The disparity or compactness of developed area measurable as land consumption ratio – high ratio=high density zoning=more densely developed area, while low ratio=low density zoning= more disperse development indicates how much land is consumed per residents, thus direct relation to land cover changes is measureable (Jantz & Manuel, 2013).

2.2.1.2.3 Quality of Life

Sense of community, Sense of safety, Happiness, Relationship with family, Social cohesion, Hobbies and club membership, Air quality, Access to public green space, Availability and access to public transport, Availability of shopping facilities, Noise pollution, Area safety and security, House or flat suitability, Waste collection, Life expectancy, Crime rate, GDP (Gross Domestic Product), Poverty rate, School attendance constitutes both objective and subjective measuring indicators for quality of life (Kroll et al 2009, Petrosillo et al., 2013). These generally referred to as "environmental amenities" decreases with urbanization processes, land use type and functions and other identified or yet identified factors. With rapid urban expansion and loss of open space, attractive local landscapes, increasing social housing and various private developments at the periurbans (Banzhaf et al., 2013), dis-amenities such as water, air and noise pollution has continue to gain importance in empirical research on location decisions and on political agendas on "quality of life" since the 1990s (Waltert & Schläpfer, 2010). The increasing urban heating, GHG and CO2 emissions (Viegas et al., 2013) and the unresolved problem of how to measure and determine local climate change on air quality and other environmental issues are all indicators on existing qualities of life. Also with the densely populated spirit associated with suburbanization and urbanization, food, water and social security is

creating circumstances for recognition in most Asian and African countries causing global dilemma (Lele et al., 2013). Some of which are attended to but majority of which has gained immunity against local combating capacity and demands urgent attention.

Distances to major centers alone may not be sufficient to explain density patterns of urban land use but a combination of access to public green spaces, either from the view point of its capacity to serve preventive measure for flood-hazard or as a quality of life indicator for residents in a developed urban and suburban area gives a measureable indication of land use/land cover impact (Lu & Guldmann, 2012, Banzhaf et al., 2013). The public green spaces which could also include natural wetlands are increasingly been lost to such factors as urban sprawl (Steiner &Butler, 2007, Hasse & Lathrop, 2013).

2.2.1.2.4 Value and Attitude

Recent studies have included works on structure of the values assigned to peri-urban agricultural landscapes by residents as an indicator of land use changes both at the urban and periurban scales. Attitudes towards residential development approaches were also related significantly to assigned but not underlying values. Peri-urban agricultural landscapes are perceived as multifunctional systems by the urban public and are valued for a range of functions not typically included in land use policies. Thus analysis of "trade-offs" are possible as urban growth begins to incorporates values such as scenic amenity, landscape heritage and outdoor recreation in planning for future land uses (Ives & Kendal, 2013, Bryan2013, Klapwijk et al., 2014). Observed increasing new land values, changing access to resources in peri-urban,

coupled with the increasing habitat value is becoming of concern at the local/municipality level (Becker, 2012, Benini et al., 2010)

2.2.1.3 Economic Indicators

The most visible, widely felt and with long overdue history of land use/ land cover (change) to man is the economic impacts. Let me digress a bit with brief talk on two well-known pioneers of land use change (George Perkins Marsh in the U.S.A. and J.H. von Thunen in Germany) based upon Land as the first life support system accessed by man (Briassoulis, 2000). They have both approached mans impact from double E's perspectives (Environmental and Economical).

Marsh focuses on land as a central platform where man's actions are staged and the point for the transformation and modification to meet certain need and uses, which produces some degrees and gravity of unintended impacts. A widely cited reference by many conservationist, Von Thunen's problem of the best alternate allocation of spatial layout for the various crops and other land uses around a central market place as composed the two streams from which other theories and model developed, is another scenario for land use/ cover change upon man's decision (Briassoulis; 2000, Korcelli; 2008).

Considering both the utilitarian and managerial perspectives, "Optimization" has been the emphasis from which man has decided the choice synergize or trade-off within and between ecosystem services. The one-to-many, many-to-one, and many-to-many feedback on our choice of ecology and or economy are great economic indicators of land use change in our locality (Briassoulis, 2000; Bryan, 2013).

The concept of ecosystem services has been a valuable tool for economic analysis owing to a basic truth that all economic products result from the transformation of raw materials provided by nature. The thin line between the additional benefit, monetary valuation and disaster thresholds vicinity lies the trouble (Farley, 2012). Economic indicators such as Unemployment rate, Commuting distance, GDP, External costs, Green space, Costs carbon stock, Costs air pollution, are hardly experience and or threated alone without the inclusion of the social indicator, thus a socio-economic observation are induce by such factors as human immigration and the introduction of plants, animals, capital, technology, land use policy and knowledge systems that leads to a fast transition from a low- to a high-intensity agricultural system (Fetzel et al., 2014). Starting with the increasing transfer of land from non-market customary tenure systems to market-based, formal land tenure regimes on the edges of cities changes just for residents to secure livelihoods and the vice change on commodity market (Becker, 2012), the growth of a market also greatly influences the intensification and expansion of production employing irrigation mechanism to places that are ill-fertile (Parcerisas et al., 2012) to improve the Gross Domestic Product from a community for her country (Su et al., 2014), motivated using several incentives (Bryan, 2013). Also, the increasing settlement growth and commuting rate between a community and its neighboring places as indicated in several studies demonstrate the change in economic structure, from agricultural – industrial, trade and/or service sectors provides evidence of non-agricultural alternatives to livelihoods (Hietel et al., 2005, Su et al., 2014).

2.2.2 Drivers of Land Use Change

With demographic population growth and consumption patterns takes another turn, more land are on demand for accommodations and agricultural production. Many

factors have forced out the veto power of man and nature to be exercised in a continuous fight for all means of livelihood, yet sustaining ecosystem services and biodiversity must top-list the priority in all check and balance agenda (Nelson et al., 2010).

Both the natural and human factors have duly had their share of blames in the imposition of changes- biophysical-to- man, man – to – biophysical. On a global scale, climate change, urbanization, globalization, suburbanization are some of the identified drivers of land use changes. But beyond this, more appropriately to deal with the issues of identifying drivers of land use/ cover change is to figure it out at the combination of scales. Meaning, putting together the accumulation of boundary, use or role and its view toward a situation to derive factors responsible within individual and or combined scale in favor of the measure, assessment, and evaluation of the impact of land use changes (Briassoulis, 2000). Taking into account the exogenous and endogenous factors visible at regional and local scale is important in analysis that contributes to proper land use and management. It can be said that while exogenous/external drivers at local scale are related to the biophysical and socioeconomic context as thus includes climate, the market, access to technology and policies.

Endogenous/Internal drivers include those personal, socio-economic and biophysical factors inherent to the farmer and to the farming system such as existence of a successor, type of farm, amount of land and environmental constraints and possibilities (Valbuena et al., 2010).

Poverty, poor agricultural technologies and population growth were viewed as the main causes of deforested cities in the 1960s down unto 1980s (Meyfroidt et al., 2013). Elevation, population growth and economic development (Dewan &Yamaguchi, 2009), federal farm policies, demographic, technology and market-related (Lubowski et al., 2008, Braimoh, 2009, Estes et al., 2012) among others are variable factors identified with land use/cover changes. All of which belongs to a class of economic, cultural, climatic or institutional drivers (Robson & Berkes, 2011). In some of the most recent studies, sustainability can be drawn out as a driving force to land use/ land cover change (Cabanillas et al., 2013, Bernard et al., 2014). More than a few to be mentioned, biophysical and human drivers varies in scale and context.

2.2.2.1 Biophysical Drivers

Places have been influenced by the type and condition of soil, climate, and topography, as well the report remitted by existing users or those found in historical archives.

2.2.2.1.1 Land Suitability for Crops

The parent material and holding capacity of soil automatically decides what type of crop is most suitable to be cultivated in a community. Therefore, there are different ecological zones in a region, and to a high extent, the expectations of the famers varies based on this factor. A changing soil property and low holding capacity of an area that solely depends on natural soil fertility can drive the probable change in decision of either to extend or permanently shift from the place of cultivation (Braimoh, 2009). So also, suitability of the land for specific purposes, which may affect the probability distribution of a production decision could be based on soil quality (Valbuena et al., 2010). To a degree, the existence of a suitable land brings

about the intensification and specialization of crop, which in most cases constitutes increasing homogenous cropping (Bittnera & Sofer, 2013). Besides cropping system being decided by land suitability, alluvial floodplain forests, fertile wetlands and indigenous grasslands are now largely replaced by agricultural landscapes pre-dominantly pastures (MacLeod & Moller, 2006).

2.2.2.1.2 Temperature/Precipitation

Annual, seasonal, and monthly trends in precipitation, mean temperature, maximum temperature, minimum temperature, and temperature range (Martinez et al., 2012) are valuable to the context of evapotranspiration, which is so typified of agricultural land use change. Incremental shortage of water and the low (relative and absolute) humidity drives crop output to decrease qualitatively and quantitatively, thus causes external reaction from the market system, and the decision dilemma faced by the farmer. Although it is always unclear which of the climatic changes drives change on crop production and the decision of land use change (Waha & Rolinski, 2013). Yet, local research has shown that elevated temperature affects the performance and grain quality characteristics more significant than changes in rainfall. Most grains experiences decreases in weight and in some grains, total nutritional value (carbohydraes, starch, fructose and raffinose, become lower). At the same time, the concentration of lipids and aluminum in crude fiber reduces (Högy et al., 2012). And as a result of biophysical boundary conditions, primarily water scarcity, overuse of resources and climate change possess greater threat to ecosystem function in dry-lands than in non-dry-land systems (Millenium Ecosystem Assessment, 2005a). Desertification syndrome of adverse temperature/precipitation on land has been considered in researches beyond geographical and climatic boundaries, as the impact is not limited by scale (Dawelbait& Morari, 2012). Most effective alternate measure

to aid production in the dry-lands has been the adopted irrigation method, helping to reduce surface temperature and increase regional and local atmospheric moisture. This brings a modified regional circulation pattern and changes in micro and mesoscale precipitation, contributing to agricultural land use changes (Douglas et al., 2009). Analysis of anthropogenic forcing redistribution of the repartition of land precipitation, shows decrease in the extent of arid area (area with precipitation range between 50 and 300 mm/yr), and increase in the extent of area with a precipitation range between 450 and 900 mm/yr (Alkama, 2014).

2.2.2.1.3 Effects of Past Land Use

Historical trends in plant phenology (environment-mediated chronology of periodic life-history events (phenophases)) to help assess the effect of climate change on the processes and location of ecology and the modified decision of duration and location of certain plant species. Such incidences as must have been experienced in the past may explain both biophysical degradation and improvement of land, mainly for crops through the records on the lengthening spring and autumn duration especially in the mid-higher latitudes (Buyantuyev et al., 2012). In addition, the long known structure of an existing biofilm and the existence of riparian buffer in certain localities determines a possibility of land use change (Hlúbiková et al., 2013).

So also, impact of insect pest pressure, weeds, winter chill fulfillment, springtime freeze risk, pollination, heat stress, and disease (Winkler et al., 2014), contributes to the driving changes in land use. Pest outbreaks which occurs more frequently, particularly during extended periods of drought, followed by heavy rainfall has increase the importance of predicting changes in geographical distribution and population dynamics of insect pests. Similarly, this indicates the role of climate

change to increase more land use change through pest invasion. Increasing CO_2 and temperature concentration renders components of pest management such as host-plant resistance, bio-pesticides, natural enemies, and synthetic chemicals less effective (Harle et al., 2007; Caffarra et al., 2012; Hari &Prabhakar, 2014).

2.2.2.2 Human Drivers

The pace, magnitude and spatial reach of human alterations of the Earth's land surfaces are unprecedented. Human purpose or intent applied to these attributes are among the most important and significant drivers of land use change (Lambin et al., 2001). A variety of which includes Population size and density, Technology level, Level of affluence, Political Structures (through command and control, or fiscal mechanisms), Economic conditions, Attitudes and values, generally referred to as "**SOCIO-ECONOMIC DRIVERS**" (Agarwal et al., 2002, Tavares et al., 2012). These social drivers modify land use change into three different types: special objectives oriented type, social-political intervention type, and normal urban growth type (Xiao et al., 2006).

2.2.2.2.1 Population Size and Density

Population, which directly influences the consumption of goods, is one of the most important drivers of global environmental change. Demographic change usually have significant impact on urban growth and land consumption. While some countries experiences "double-decline" i.e decreasing population and household population, others show a decreasing population but increasing household. This contributes to the living arrangement and the type of housing in an area which affects land consumption (Haase et al., 2013). Demographic trends, including an ageing population and the growth of smaller and single person households, are adding to the demands for new housing and to the pressures for suburbanization in rural areas (as

well as for improvements to the quality of the environment and everyday life in inner city areas Lloyd-Jones, 2004). The direct influence of population size and density on urban development is evidenced in the increasing sealed surfaces, urban sprawl, traffic congestion and residential segregation (Haase et al., 2012). Through some indirect causes, population accumulation has been driven by lack of access to land and natural resources, declining soil productivity, and high population pressure in origin locality. Towards the destination, pull factors drawing people into new areas can be availability of natural resources, including land, employment, and access to markets and social services, and reunification with family (Estes et al., 2012). The result of such indirect action is urban, suburban or even rural encroachment. Land expansion has been largely driven by elevation, population growth and economic development. Rapid urban expansion through infilling of low-lying areas and clearing of vegetation resulted in a wide range of environmental impacts (such as decrease in area of water bodies, cultivated land, vegetation and wetlands), including habitat quality (Bahrain, 2003; Dewan &Yamaguchi 2009). This (rural-urban) movement necessarily might not have negative impact on biodiversity as such a demographic change could encourage heterogeneous species on abandoned forest plants (Robson &Berkes, 2011).

2.2.2.2.2 Technology Level

Adequacy or inadequacy of information derived through technology can contribute to the decision on land use changes (Schiermeier, 2013). Therefore, decision as to improve quality of life base on the "World Bank" standard of indicating a country's technology adequacy [telephone lines (per 100 people), internet users (per 100 people), mobile cellular subscriptions (per 100 people), secure internet servers (per 1 million people) Milenkovic et al., 2014] become obligation to be met. Thus, the need

to evacuate a crop land are sometimes made necessary for such development purpose and the conversion from crop land to wood land or forest is observed.

2.2.2.2.3 Level of Affluence

Another contributing drivers of change in the typology of land use and degree of consumption is associated with the right to property adopted in a country. To a very significant rate, forceful evictions have become a serious problem with an increasing number of families being deprived of their land, homes and livelihoods. This indirect driver of land use has been a major issue in the developing countries (Rudi et al., 2014).

2.2.2.2.4 Political Structures

Likewise referred to as *institutions,* include local and regional governments, agricultural associations and the market. These institutions can react to market changes and to changes at landscape and regional level by setting legislation or providing incentives (e.g. policies to protect cultural landscapes Valbuena et al., 2010), through which command and control, or fiscal mechanisms such as devaluation, trade liberalization, credit subsidies, infrastructure development, and land tenure and distribution (Braimoh, 2009) are applied, given that agricultural systems are embedded in wide social institutional networks that influence their way of operating (Bernard et al 2014). The restriction and preservation policy of institutions collectively contributes to reasons for land use/cover change.

2.2.2.2.5 Economic Conditions

More than any, the economic condition of a country is a major force of change. The question of how economic activities affect environment has become popular among scholars by 1960s, though the catastrophes caused by man on the environment has

not been a news, relating to historical account of China's massive deforestation for rice terrace by 800 B.C (Aşıcı, 2013). The influence of industrial revolution and the clash with population growth on land use transition and conversion brought need for several economic developments, resulting to increasing income. This increase in household income was extended to the rural areas through decentralization developmental strategies as Local and Community Driven Development (LCDD) (Daniel, 2014).

Growing prosperity and wealth and increasing demands for an improved quality of life are reflected in the increasing consumption of land and space, demand for privacy and better living conditions and access to green space (Lloyd-Jones, 2004). Increasing personal possession of land has exacerbated the limitation to natural reserves and other ecological amenities. Recently, the constraints of accessibility to land and resources has been solved through touristic advantage given to such resources as forest, wetland, manageable as recreational facilities for economic benefits. This has aided the adoption and transformation of natural amenity to enhance quality of life (Chi & Marcouiller, 2013). The aim of boosting economy cannot be overestimated as a force for change in land use, such cases as seen in the developing countries, a case study of south-south Nigeria where oil discovery has converted agricultural land to waste land and the rivers to inconsumable. The willingness to surrender this gift of nature (land) for the sole sake of its net return has been empirically proven in many cases (Lubowski et al., 2008).

Land intensification and irrigation has been enhanced to meet up and improve the standard of living of the rising population. Such has contributed to land use change in

Ghana where fiscal and commercial policies were enforced to intensify agricultural produce. The macroeconomic policies induce changes in market conditions and prices which in turn influence farmers' choice of agricultural technologies and factor proportions. Economic incentive adds considerably to decision of land use change. Such benefits as market price both on input and output, land compensation are all drivers of land use change (Braimoh, 2009).

2.2.2.2.6 Attitudes and Values

Entrepreneur who have decided to neglect his/her land due to loss-making and low returns, (2) dissatisfied neighbors affected by farming operations and retaliates through silent or active conflict, (3) change in consumer choice due to dissatisfaction and (4) strict regulators who without linearity regulates farm activities, have greatly drive a change in the local land consumption (Bernard et. al., 2014). Such sentimental reaction induces land sales and contributes to land use/cover changes. None the less, values attributed to a locality by government greatly contributes to land use change. A practical example is the discovery of ground resources such as gold, petroleum, bitumen etc, the change in the value of land brings a change in land use. Aesthetic innovation is another reason for land use change, which is yet to be widely explored in the research filed.

Summary

Within the macro-scale, the varying rapid changes which at other times seems so static, though aren't have some factors responsible for their physical appearance. To understand the complex relationship between the users of this environment and the physical characteristic, some indicators and drivers such as explained above on global scale are put together to simplify this complexity. In assessing the factors responsible for the changes taking place at a micro-scale, few but relevant of these

factors are combined to examine the influence of anthropogenic factors on land use-cover changes, this is supported by derived spatial-temporal images. Some researchers work on the different methods of assessing this as shown as a meta-analysis below gives an overview of the concerns and methods of dealing with these concerns through several mirrors.

The output of the complicated entangled interactions between bio-physical and socio-economic forces over space and time is **land use**. Managing this difficulty for practical purposes, probably for policy making, land management for sustainable land use and others will be unachievable without some break down analysis of the complicated relationships at least to a manageable and understandable dimension. Which bring the necessity for symbolic and conceptual models (Braissoulis, 2000). This section creates a meta-analysis of summarized models and scenarios (see Chapter 2, Table 3) adopted in some 21st century research in mimicry of Agarwal 2002's and Braissoulis 2000's empirical review and assessment of land use/ land cover models and theories which were observed to comprise mainly of models adopted in the 19th and 20th century for the purpose of an adequate meta- analysis.

Table 3: Meta-analysis of some adopted land use/cover assessment models/methods.

Model Name/ Citation	**Model Type/ modules**	**Model Scale (time-step/duration/extent)**	**What It Explains / Dependent Variable**	**Other Variables**	**Strengths**	**Weakness**
Multi-agent Systems (MAS)Arend Ligtenberg et al 2004	spatial simulation scenario base		conceptual approach to include multi-actor decision making within spatial planning process	agents representing organizations and interest groups, beliefs and preferences of actors, location of and relation between spatial objects	Revealed the need for further research on the representation of spatial objects and reasoning, learning and communication about allocation problems	It was too narrow in scope for attribute and value driver/ of land use. Neglecting importance of land ownership and right of actors on location pattern
econometric model (Lubowski 2008)	Micro-economic module of land use and land quality	1982 and 1997 /regional scale	Measures the impact of factors affecting land-use choices when multiple land-use options are economically and politically viable.	Crops, pasture, forest, urban, range, and a federally financed use, the Conservation Reserve Program (CRP) dependent on net returns	First evidence of the relative historical importance of markets and federal farm policies affecting land-use changes nationally	No explicitly feedback model Land use data limitation to USDA National Resources Inventory (NRI).

Agent-based modelling (ABM) (Valbuena et al 2010)	agent-based approach	regional scale	Capture feedback frame work of decision-making process	Farm cessation, farm expansion and farm diversification.	Ability to combine different concepts including agent typologies, farm trajectories and probabilistic decision-making processes, into one analysis of LUCC	Problem with the validation of the model. Respondent's secretiveness to disclose data on ability and willingness.
Regional growth model Waltert& Schläpfer 2010	migration and regional economic models, and hedonic pricing models	regional and local	Assesses the importance of landscape amenity in economic development.	Population equilibrium and disequilibrium. Employment and Income. Rents, and Wages (fiscal and economic opportunity)	Combination of multi-studies (migration, economic growth and housing price) to provide evidence for amenity impacts in the study regions.	In most cases, research on this topic usually attributes negative finger to landscape amenity's substantial public spending in local economic development. Lack of simplified empirical support to measure the role of landscape amenity as a development tool.
Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST) model (Nelson et al 2010)	LULC conversion scenarios, Agricultural Outlook trade model, Cellular modeling technique	Global – national - regional and grid-cell level	Predicts net change in urban and cropland area based on urban population expansion and land suitability	Land slope population density Arable land Protected land Irrigated land, Land management Soil condition Temperate climate condition	Relatively simple and transparent method for creating spatially-explicit differences and projections at different complex levels	The model lacks ability to explain "if or not" land use pattern is compatible with projected demands.

Model Name/ Citation	**Model Type/ modules**	**Model Scale (time-step/duration/extent)**	**What It Explains / Dependent Variable**	**Other Variables**	**Strengths**	**Weakness**
GIS model (Xiao 2006)	GIS, Remote sensing techniques	Grid cell 1 km×1 km, city scale	Detect and categorize spatio-temporal patterns of land use type, size	population, traffic conditions, industrialization, and policy	Work better with time steps and duration, extent and resolutions	A proper categorization is dependent of real site observation
Market-based incentive Bryan 2013	Conceptual representation of market – based policy	Multi-scale	Synthesis complex linkage of incentives, land use and ecosystem services. Quantifying and understanding linkages	Agriculture, forestry, carbon planting, land sparing, direct payments/ rewards, tax incentives, cap and trade markets, voluntary markets, auctions, and certification programs	Applicable to non-linear variables. Produces feedback effect of incentives on land use and land use on ecosystem services	Limited research with the application of this method

Model Name/ Citation	**Model Type/ modules**	**Model Scale (time-step/duration/extent)**	**What It Explains / Dependent Variable**	**Other Variables**	**Strengths**	**Weakness**
Land use model (Long 2007), Qian 2010	Remote sensing	pixel-to-pixel, regional scale	Spatially-explicit Land use change detection	Industrialization, urbanization, population growth and economic reforms	Combine spatial, temporal and human-decision making complexity	
I-distance method (Milenkovic 2014)	statistical I-distance method	Regional scale	synthesizing socio-economic development indicator	Economic, Social, ICT, Health variables	Accommodates many variables to synthesis a single indicator	It could be problematic drawing limitations for the number of variable to include due to its flexibility.
Political Economy Model (MOSLEY 2013)	Political-economic model, econometric	Multi-scale	Aid effectiveness in economic growth through institutional structure.	Donor social capital index Tax diversification government expenditure World Bank/IMF disbursements Tax/GDP ratio Budget surplus/deficit	Ability to identify indicator for country's transform into a developmental state. Provides two-way interaction	Requires wider range of experiment to effectively adapt it at varying scales.

				Openness to trade Social efficiency wage Secondary school enrollments Population size		
human appropriation of net primary production (HANPP) framework Niedertscheider & Erb 2014	Land transition module : HANPP ratio, HANPP efficiency, HANPP trajectories	Regional-national scale/1934 and 2007 (120yrs)	Sum of productivity losses due to land use and land cover change. Identifies strong drivers of land system change that can potentially overrule the harsh differences in biophysical and socio-economic framework conditions between the two regions.	New energy forms, population surges, and technological progress	Quantifies biomass harvest, potential productivity of ecosystem and current productivity induced by land use processes. Use of land trajectory methods to falsify unavailable data where necessary. Provide the knowledge base for more sustainable land use in future	Open to high degree of error margin just as identified in CORINE 2006's work Allows for oversimplified hypotheses

Decision-focused framework model Kroll et al 2009	DPSIR approach	Regional and scenario application	Environmental social and economic indicators of land use/cover changes	Ecology, economic, social indicators, ecosystem services, ecosystem integrity	Variety of indicators provides strong relevance of the approach in the real life scenarios.	Many crucial indicators are still in development and yet to be experimented. Uncertainty of the result and usefulness of proposed scenarios
Model Name/ Citation	**Model Type/ modules**	**Model Scale (time-step/duration/extent)**	**What It Explains / Dependent Variable**	**Other Variables**	**Strengths**	**Weakness**
Meta-Analysis model (Seto et al 2011)	remotely sensed scenarios	Global (covering 326 studies), 1970-2000	Analysis effect of urban land conversion and expansion	Annual growth in GDP, population growth, loss of farmland, local climate, fragments habitats, and threats on biodiversity	Great potential for forecast of land use/land cover scenarios.	Difficulty of observation at global scale due to regional variable differences
Bio-Sight framework for models (Wu &Li 2013)	Integrated approach, Bio-economic modules	micro-level and spatially-explicit	policy analysis for sustainable agriculture, food, water, land, energy, and the environment	Farming practices, agro-ecological methods, commercial agriculture, biotechnology.	Provides approaches for sustainability	Science base and therefore might be difficult to apply effectively at local level

Land Transformation Model (LTM) (Pijanowski et al 2002)	(GIS) with artificial neural networks (ANNs)	Local	Forecast land use changes using Grand Traverse Bay Watershed	roads, highways, residential streets, rivers, Great Lakes coastlines, recreational facilities, inland lakes, agricultural density, and quality of views	predictive ability of the model scale-metric identifies responsible variables at each scale	

Chapter 3

METHODOLOGY

3.1 Introduction

As one of the motive for adopting an overview of existing models, the review enlist some models using key focus as social and economic variables, indicators, drivers of land use/land cover that have been adopted in other researches. Most important in this brief 21st century's models overview, are the list of models, many of which were not identified with Agarwal 2002's review and assessment of land use/cover models, a classification which dates in the 1990s. Also this method took a step ahead in dimension of arraying land use studies (Wu & Li 2013) by combining several dimensions within a single frame work of methodology, considering the ability of each model and the limitations of the researchers. Hence, with a quantifiable knowledge of some of this models, methods and frameworks, either enlisted here or not that has been adopted by previous researchers, this study has come to the conclusion of the choice of an alternative method for this research, based on the level of understanding and skill of the researcher.

3.2 Data Types and Source

For the study, Landsat satellite images of Famagusta were acquired for four Eras; 1986, 1986, 1996, 2006 and 2012. All images (1986, 1996, 2006 and 2012) were obtained from USGS global visualization viewer (www.glovis.usgs.gov) an Earth

Science Data Interface., at Landsat 4 MS for 1986 and 1996 but Landsat ETM for 2006 and 2012 collection source on 30m resolution (see Table 3).

It is also necessary to point out that the case study was carved out from the entire North Cyprus boundary, using the administrative map sourced from the municipality (Famagusta). Google earth images of the city was used to extract the road system. These were brought to Universal Transverse Mercator projection in zone 36.

Table 4: Data Source

S/N	DATA TYPE	DATE OF PRODUCTIO	SCALE	SOURCE
1.	Landsat image	October, 2012	30m ™	www.glovis.usgs.go
2.	Landsat image	August, 2006	30m ™	www.glovis.usgs.go
3.	Landsat image	September, 199	30m ™	www.glovis.usgs.go
4.	Landsat image	April, 1986	30m ™	www.glovis.usgs.go
5	Administrative Map Famagusta (Gazimağusa).	2013	1:8000 (view scale)	Famagusta Municipality

Developed by author

3.3 Data collection technique for case study

Notwithstanding the variety of methods that could be applied to this study, Agent Base Model (ABM), Remote sensing and Geographic Information System (GIS) and thorough collection of some relevant secondary data gracefully aided the completion of the study in this region, reasoning from two basic point of views:

1. The time-step and duration under consideration.
2. The need to dig into the historical achieve in identifying the role of driving forces (Population dynamics, Housing, institutional decision and economic) in the observed land use changes.

Within the sphere of this study, an indispensable description of land use change from one type to the other within a temporal and spatial limit will be reviewed, as well giving detailed changes in value and quantitative characteristics of the land cover changes. This section of the study makes use of remote sensing software known with Geographic Information System (GIS) capacity. The basic premise of these procedures is that changes in LULC result in differences in the pixel reflectance values between the dates of interest. However, while these techniques are effective for locating change, they cannot identify the nature of change. This is considered as the basis for further inquisitive search of "why" such a change occurs and thus bring us to the explanatory analysis of factor responsible and consequences of the observed changes at this lower spatial level of analysis.

The advance in technology has made data assessment and collection a great comfort, in terms of availability and reliability, thus adoption of such techniques as remote sensing and GIS is no news any longer, most importantly in studies that requires both temporal and spatial assessment, comparison or and analysis. In such studies, a fore understanding of remotely sensed data is required to comprehend the differences in the appearance of land use and the changes are then identifiable with GIS. Adopting the use of remote sensing for classification consistency and accuracy, with GIS tools inclusively to acquire, analyze and manipulate data related to both urban and sub-

urban environment, aerial photographs imageries with other satellite images has been accepted to be the most economically rational technique of dealing with spatial and temporal differences, changes and observations related to land cover mapping throughout the world (Trisurat et al., 2000).

Spectral bands of Landsat images scenes from 1986, 1996, 2006, &2012 were collected to detect these environmental changes using multi- temporal satellite data. The digital image-processing software Idrisi and ArcGIS 10 were used to process, analysis and integrate spatial data to reach the pre-set objectives of the study. The three case study within the region were dealt with separately base on administrative boundaries. The subroutine embraced for research work here which forms the basis for producing statistical prove of land use dynamics and the subsequently expected change in future takes the following steps (see figure 3, cartographic map).

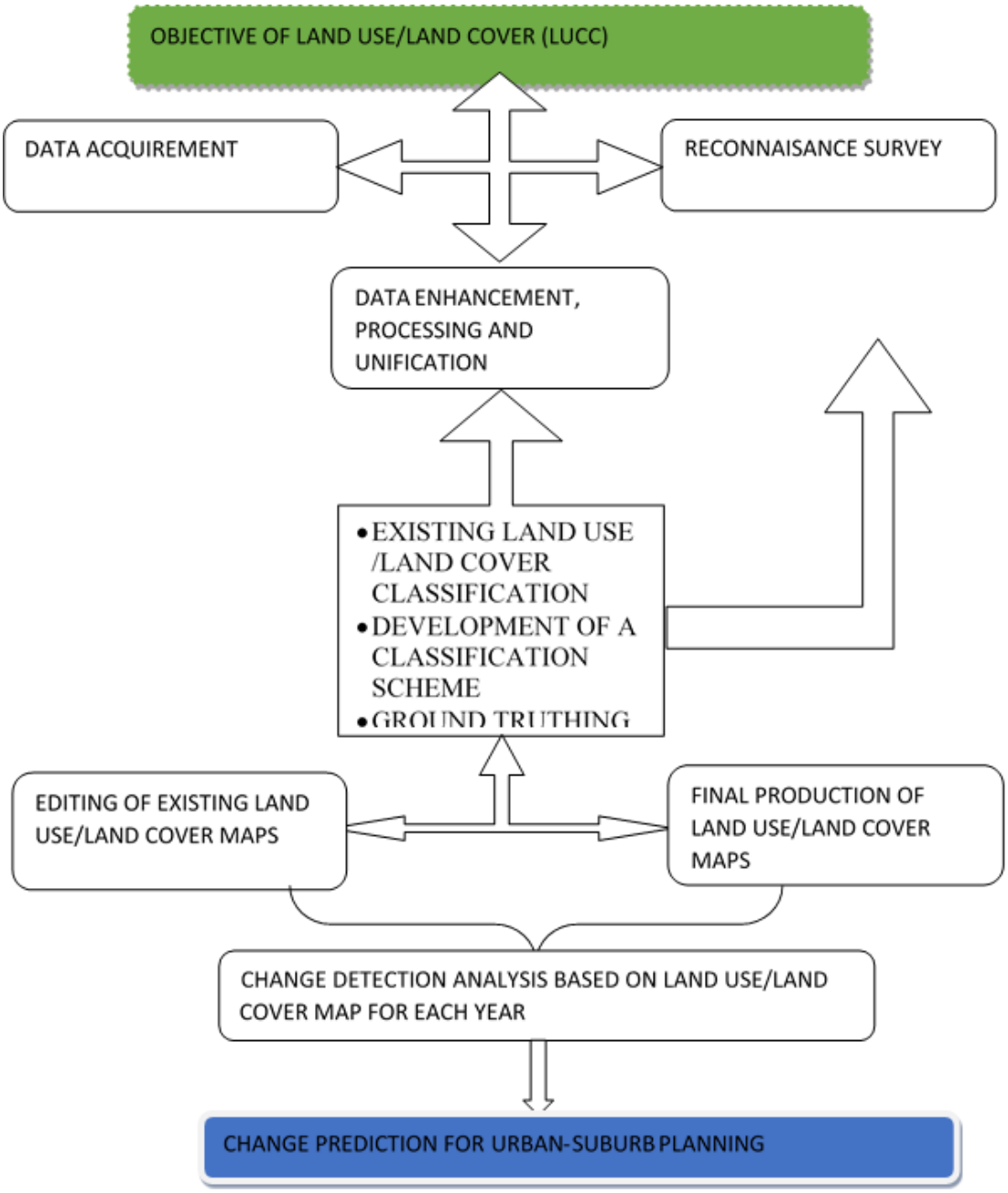

Figure 3: Cartographic Model. Developed by author

3.3.1 Geo-referencing Properties of the Images

The images derived from both sources (GLCF and municipality) were geo-referenced on Google earth with the following properties; Data type: rgb8; File type: binary; Scene information: ID: LC81760352013295LGN01; CC: 0% Date: April 1986, August 1996, Sept 2006 and Oct 2012; Quality: 9 Product: OLI_TIRS_L1T; Path and Row: 175, 35; Referencing system: utm-36; Reference units: m.

3.3.2 Software applied

Basically, 3 software were used for this project viz;

(a) ArcView 10 – this helped in displaying, processing and in the proceeding enhancement of image. Utilized in carving out Yenibogazici, Tuzla and Karakol districts from the whole Northern Cyprus imagery using both the Google and administrative map.

(b) ArcGIS – It was used to aid the display and processing of the data

(c) Idrisi 32 – This was used for the development of land use land cover classes and afterward, for change spotlight analysis of the study area.

3.3.3 Sample frame, size and procedure

Based on the theoretical and practical knowledge of the study areas, Famagusta and Yenibogazici which are respectively, my area of residence and case study area in one of my design courses, I have gain so much familiarity with the land use of these areas, non-the-less, a brief reconnaissance survey with sourced information from previous studies in the study area, a classification scheme was developed for the study area, some extractions were made to inclusively suite this research objective (see Table 5). This produces a more detailed classification with minimal error on land use and land cover identified upon single digit.

Table 5: Land use land cover classification scheme

CODE	LAND USE/LAND COVER CATEGORIES
A	Open land
B	Bare land
C	urban land
D	Scrub_ Forestland
E	Water bodies (wetland)
F	Mediterranean grass

3.3.4 Methods of Data Analysis

The data gotten from images were analyzed as follows;

(i) Conversion from a unit scale to another, majorly acres to hectares, which was then calculated to give the statistic of individual land use/land cover types for each study year of the district, after which the results were compared.

(ii) Markov Chain and Cellular Automata Analysis for predicting change

(iii) Opaque/ Transparency Operations

(iv) Relative Likelihood Classification

Roman figure i, ii, iii steps are beneficial when there is need to identify changes in land use typology, making it necessary in this research. While, detection of percentage change, trend and rate as illustrated in the case study areas makes it crucial for comparison from base year to the next year (1986-1996-2006-2012 and 2013). This is achieved by creating a table that shows figures of areas in hectare and

the percent of land use calculated with the aid of software (ArcGIS, IDRISI). The Changes thereof are later calculated as:

$$(a)\text{Percentage change} = \frac{Observe\ change}{sum\ of\ change} * 100$$

$$(b)\text{Annual change rate} = \frac{percentage\ change}{100} * n$$

* Where n is time (year) variable*

3.3.5 Agent Base Analysis

The second section (explanatory analysis) adopt Agent Base Analysis to create a framework that permits multiple studies of driver, pressure, state, impacts and result in a single research work for such explanation (Valbuena et al., 2010; Agarwal 2002). Having identified key drivers of land use/cover change in the review section, the main actors of these forces become the object of focus as the variable upon which other factors are determined. To support the output derived from the cartography of Famagusta land uses, an in-depth review of the historical land uses was done in other to verify the incidences of land use and land use changes on today's land use consumption as well as the pattern. Through identifiable drivers of change, 2 notable selections (population dynamics, Housing) were made as the determining socio-economic drivers that play significant roles in decision of land use cessation, conservation, extension and or transformation. All combined in the definition of land use/cover change. Secondary data on population and housing were gathered for surveillance to support the land use/ cover change imagery produced.

Chapter 4

DATA ANALYSIS, FINDINGS AND DISCUSSION

4.1 Introduction

The island of Cyprus, once operated as a unit state, is currently two ethnically independent of its neighboring pole (north-south). Now, the Republic of Cyprus, populated entirely by Greek Cypriots, is situated to the south pole of the island, while the Northern Cyprus, dominated by Turkish Cypriots is located northward of the island. Time line has shown the various stages in the development of Gazimağusa (Famagusta), North Cyprus. Most especially those related to the political, psychological, economic and strategic planning aspect of the later resurgence from the war incidence (Doratli, N., Hoskara, S. O and Fasli, M., 2004; Boğaç. C 2009). Stages of evolution dated back to the medieval period have had a clear description of the activities and impacts of human conducts, which in many researches, are divided into before and after 1974, and otherwise classified here as pre-Famagusta and after establishment of Famagusta for easy understanding since the focus is on Famagusta (Gazimağusa). Several times before the present stage of development, inhabitants have had to address themselves to the culture of the soil due to the rise and fall of different leadership, all together forming a total of 16 regimes, [Neolithic (7000 - 3900 BC)] [Chalcolithic (3900 - 2600 BC)] [Early Bronze Age (2300 - 1850 BC)] [Middle Bronze Age (1900 - 1600 BC)] [Late Bronze Age (1650 - 1050 BC)] [Geometric Period (1050 - 750 BC)] [Archaic Period (750 - 475 BC)] [Classical Period (475 325 BC)] [Hellenistic Period (325 - 58 BC)] [Roman Period (58 BC -

AD 330)] [Byzantine Period (330 - 1191)] [The Lusignan Dynasty (1192 - 1489)] [Venetian Period (1489 - 1571)] [Turkish Rule (1571 - 1878)] [British Rule (1878 - 1960)] [Independent Cyprus and the Turkish Intervention] (http://en.wikipedia.org/wiki/Famagusta retrieved on 21/05/2014; history of North Cyprus http://www.cyprusive.com/?CID=8, retrieved 28/05/2014; Şebnem Önal, Uğur Dağli & Naciye Doratli, 1999). Within these periods, the land /cover has also been subject to changes alongside the human-political-economic changes. Distinctive ideology towards land (use and cover) cannot be far-fetched considering the role of various leadership that has come to play in the political history of Cyprus. While some have found the agricultural land as a means to boost the economy of the country, others interest tends to put the richness of the forest heartland of Mesaoria for example into timber, which is coveted for their sailing vessels.

4.2 Location

Famagusta located on the east coast of the Northern Mediterranean Country, Cyprus. With 120km^2 and a 64, 269 area and population respectively, it is situated on 35.122724^{0}E, 33.927924^{0}N, all within a projected coordinate system: WGS_1984_UTM_Zone_36N (see figure 5).

Figure 4: Famagusta location

4.3 Historical Land use before establishment of Famagusta.

From the historical archives of various conquerors of Cyprus, the prosperity and flourishing ceramic making, the extensive citrus plantations among other plants, the woodland and timber as well as the stylish architectural constructions were all benefited from the natural wealth of land, such as contribution immensely to the popularity and development of the city. Though the salamis had survived different rise and fall of power, the byzantine period (330-1191) was uniquely different for the city. During this period, Salamis resumed its role as the capital and the then Emperor Justinian (527-565) classified the Island as a province, not leaving out the advent of mulberry which spread out from the development of silk worms, general growth in economy through devotion of large land for sericulture, increasing production of

wine and fig. This increased farming and exportation at period (Doratli, N., Hoskara, Ş. Ö Vehbi, B. O and Fasli, M. 2007; history of North Cyprus http://www.cyprusive.com/?CID=8, retrieved 28/05/2014; Rosamond Hanworth, 1990).

Therefore, it can be stated that the Island enjoyed a peacefully flourishing period, which was soon interrupted after 100years, by the Arab raiders all through 7^{th}-10^{th} century, and like in previous occasions, many towns were evacuated forcefully due to fear and most Christian houses were destroyed by the invaders. This time around, the occupants of Salamis at last spread out and began settling in Arsinoe, today known as Famagusta. The major use of land during these period include; housing, military camps, agriculture and cemetery (history of North Cyprus http://www.cyprusive.com/?CID=8, retrieved 28/05/2014).

4.4 Historical Land Use At and After Establishment of Famagusta

The new settlement of Famagusta called Famagouste in French and Famagosta in Italian, Ammochostos in Greek, and Gazimağusa in Turkish, (en.wikipedia.org/wiki/Famagusta) stilled lived in agony and fear of the destruction until the intervention of Emperor Nicephoros Phocas, mountain castles were built and more fortifications were added to the Island, this time around in Kyrenia and Nicosia in 11^{th} century (history of North Cyprus http://www.cyprusive.com/?CID=8, retrieved 28/05/2014).

In the 12^{th} till 15^{th} century (1191 - 1489), during this period, the Lusignan Kingdom boosted the economy of Famagusta as the city became the eye for Europe's trade with the East and the main port, on account of its natural harbor which intensify the

urban (housing land uses), construction of citadel (e.g. st. Nicholas) which emerged one of the largest and richest in Europe and fortified wall as at Lusignan period. Gazimagusa became a significant city for sailors and travelers and gradually the taste of wealthy people. A striking significance of this epoch was not only the trooping of merchants like the Genoese and Venetians to the western hemisphere and eastern hemisphere linking city, but the fact that this era remarkably witnessed the beginning of feudal system which apportion land to rich and the poor becomes a laborer for protection sake, this automatically widens the gap between the rich and the poor. Notwithstanding, the economic resources of the city made it one of the most influential in the Mediterranean (History of North Cyprus http://www.cyprusive.com/?CID=8, retrieved 28/05/2014; Önal S., Dagĭ. K. U., Doratl. N. K, 1999; Doratli, N., Onal, S. H., Vehbi, B. O., and Fasli, M., 2007).

Soon enough, the Venetians took over and there comes the genesis of deforestation at full force to meeting shipbuilding. This was not in any other advantage but for the covetous profit oriented venetians (1489 - 1571). Timbers were cut to build ships and sail to increase their trade with the east. The feudal system continuously were persistent and other form of land use at this time was the addition of thick wall as a barriers to invaders (History of North Cyprus, http://www.cyprusive.com/?CID=8, retrieved 30/05/2014).

By 1571, the land was invaded by Turkish who ended the land owning system, subject to armed, relic or religion services or in some cases economic services (feudal). Thus, the serf could own land in perpetuity and pass it on to his children, at this point, there were now lots of empty land in Famagusta which was among other

cities, chosen to be a sit of power, ruled by a governor, meaning institutional area was created, thus increasing the classes of land use and creating a seemingly fair adjustment to existing land use when considered on large scale (detailed scale). Till 1878, the tenure of Turkish ruler account for more drivers of change such as immigration from Turkey, the resultant increase in accommodation, public work such as aqueduct, and the sudden outbreak of famine was on the other hand a physical driver (Hanworth, 1990).

Next to this and in the consistency of what was in place (i.e the existing public amenities), the British further intensify and diversify land use through various projects embarked upon between (1878- 1960), these includes; improvement of port facilities, construction of road, provision of consumable and irrigation water, improving and increasing education standard through establishment of schools, restructuring political institutional sector, accomplished with provision of administrative centers with offices and the advent of rail road, all inclusively supported with the establishment of health facility (History of North Cyprus, http://www.cyprusive.com/?CID=8, retrieved 03/06/2014). These fair adjustment is globally regarded as Land Use Change (LUC).

4.5 Present Socio-Economic Drivers of Land Use-Cover Changes: Famagusta City

To examine the present-age causers or agents of land use/cover changes, some major and important driver were selected based on researches from other case studies as reviewed in the literatures to test the reliability of some socio-economic variables on the observed spatial differences that has or has not been directly recorded in regard to ground cover change and function. With the boundary of this study, Famagusta

would be considered upon population change, housing needs and institutional provision of social amenities.

4.5.1 Institutional Decision Making

Famagusta administrative territory encloses about 15 urban and suburban areas collectively, which are; Anadolu, Byakal, Canbulat, Canakkale, Dumlupinar, Harika, Karakol, Lala Mustafa pasa, Namikkemal, Perterpasa, Piyalepasa, Sakarya, Surici (walled city), Tuzla and Zafer. Many of these areas where developed upon contingency of after war necessities. Places like Karakol district which has had her land cover change effected, resulted from the urgent need for a solution to 3 social factors; war, residential displacement and urban as well as community shrinkage demoralizing Famagusta at large after 1974. This is the case also with other newly established quarters, which have been put in-place due to unfavorable local economic condition, now characterized as some industrial zones in Famagusta, which definitely has emerged with houses, constructed roads and observable bridges in some interlinking manner (Şebnem Önal, Uğur Dağli and Naciye Doratli, 1999) (see figure 6&7 for illustration).

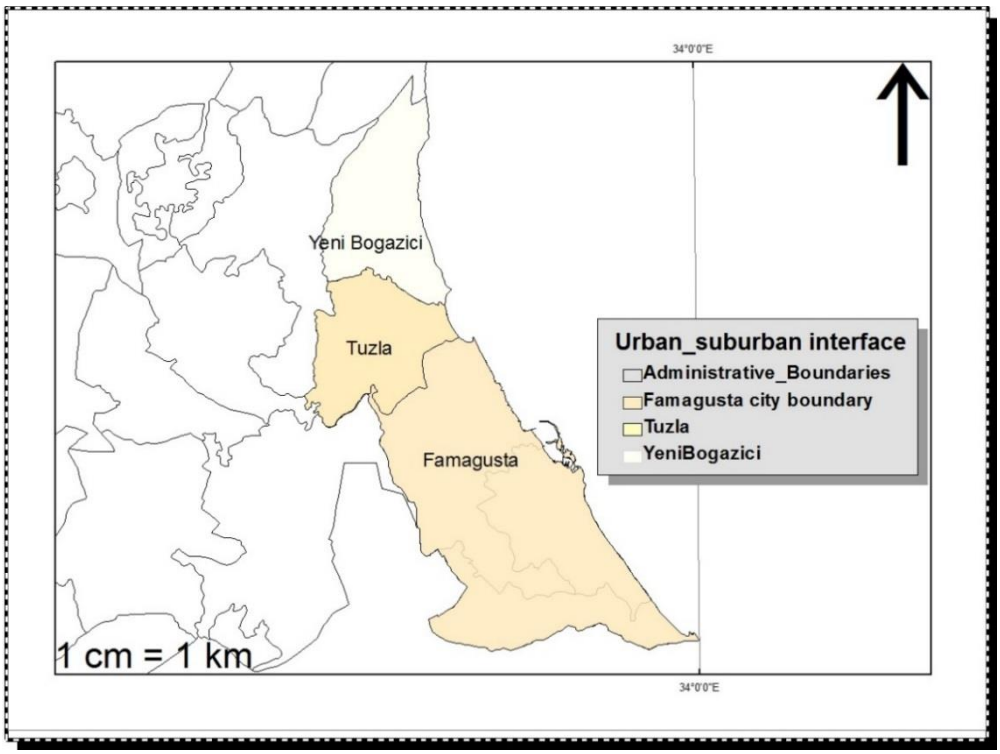

Figure 5: Famagusta city boundary some 10years ago. (Developed by author)

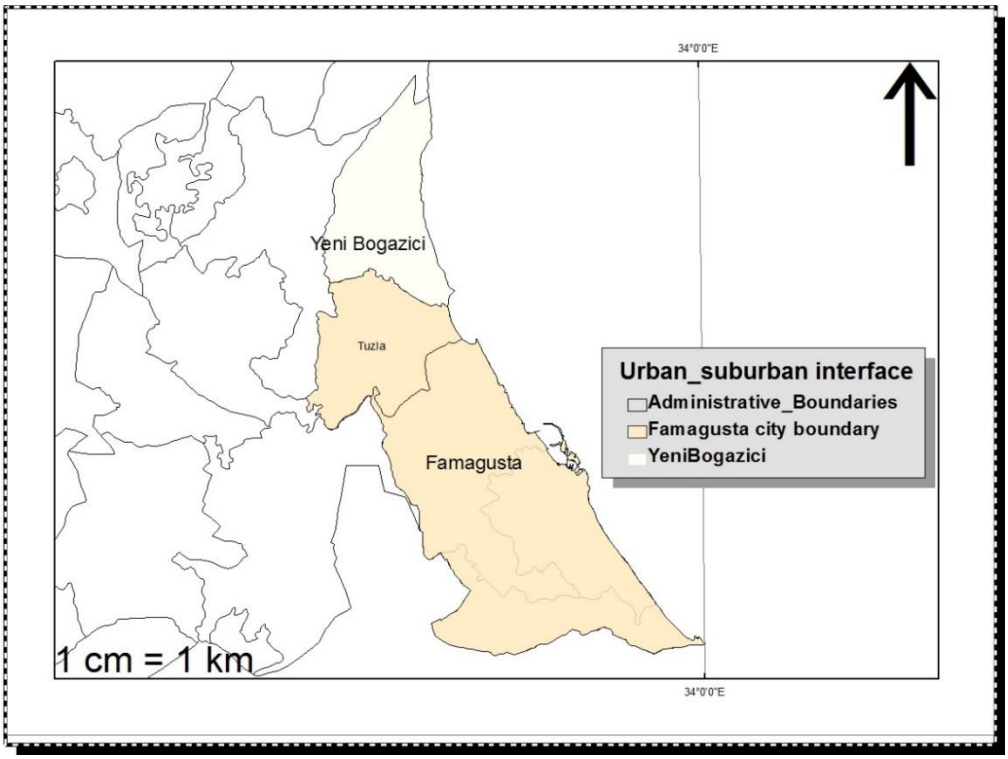

Figure 6: Present Famagusta city boundary. (Developed by author)

4.5.2 Population Growth in Famagusta

Inter and intra-regional movement has always been recorded as a major contributor to population growth in Famagusta; recalling some incidences as described in http://www.cyprusive.com and Famagusta municipality history. This was no news as more people were accommodated from Turkey as means of replenishing the shrink urban area. Ever since which, the growing population has known no bound and has become an undeniable driver of LUCC in Famagusta. As some factors are categorized as indirect, others significantly play the active role, among which population dynamic has endlessly been identified (Ademola 2009; Diego et. al., 2010).

Individual, household and or community might not adequately explain the motive behind local, regional or national migration but certain issues such as crisis, economic, infrastructural, institutional e.t.c readily lies behind every veil of relocation done permanently or temporarily (Ademola, 2009). The advent of population growth could be a deliberate strategy for; depopulation of region A to region B, such as the case was between Turkey and North Cyprus around 1981, which as at then was used to raise the number of people in Famagusta to about 20,000, according to research and studies carried out by the Town Planning Department in 1981 (Şebnem Önal, Uğur Dağli and Naciye Doratli, 1999), an avenue to improve the balance of payment of a country by encouraging in-migration for cheap labor and discourage emigration that will lead to insufficient labor, as the case was observed in Oaxaca and Mexico (Robson & Berkes, 2011). Most unprecedented population growth occurs when and where there is a pull factor such a

touristic, educational and or employment opportunities in the destination zone. According to the 2006 census, the increasing number of people provides the evidence of the growth accounted for 20,000 in 1981 as 64, 269 de facto, and 63,603 de jure (State Planning Organization classification 2006), therefore placing Famagusta as 2nd most populated in North Cyprus. Likewise, in comparison with the 1996 population census, a 21.5% growth rate has been observed and recorded by State Planning Organization in Famagusta only (see Table 6 & figure7)

Table 6: Population comparison statistic 1996-2006

Year	Population Statistic (in 1000)
1996	52.875
2006	64.296

(SPO census 1996, 2006)

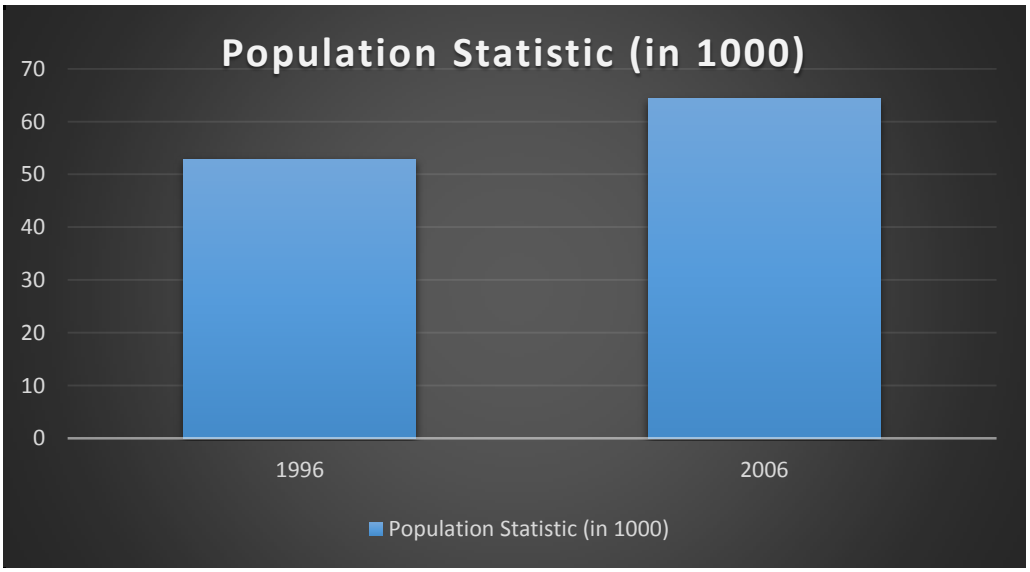

Figure 7: Population comparison chart
(SPO, 1996/2006, chart developed by author)

The effect of either deliberate or in-deliberate population is determined by the level of urbanization, most especially in the provision of both private and institutional (public) amenities. These amenities are the social responsibility either collectively met by a group of individual or that provided by local, state or regional institutions such as schools, hospitals, bridges or roads, small community, town, or city hall, library, cultural centers, residential estates or quarters, policy and religious centers. Increase in population simultaneously effect the establishment or redistribution of these amenities. Thus a great impact is felt on land use and land cover at a time in some cases.

Such an amenity provided for the people of North Cyprus in 1979, then High Institute of Technology, now Eastern Mediterranean University has contributed immensely as pull factor of population in Famagusta. As at fall 2013/2014, the total population of students both local and international was over 16000, a figure almost equivalent to cumulative population of Famagusta in 1981(see Table 8). One of the direct benefactor of this are Karakol, Sakarya, (to mention a few) which today house a large percent of the student of Eastern Mediterranean University due to proximate location. Growing human populations around natural buffer areas accelerates land conversion and isolation, reversibly harming biodiversity and ecosystem function, and can be exacerbated by immigration (Estes. B.A, Kuemmerle. T, Kushnir. H, Christian. V. R, Shugart. H.H, 2012). And for this, a major land use/ land cover change has been evidence with the conversion of some wetland areas for urbanization, supporting education as a pull factor.

4.5.3 Housing

A seemingly recent release form the State Planning Organization Statistics and Research Department on "Building Construction and Parcel Statistics" tells a great deal of the changes happening to the land in Famagusta through the housing sector (Turkish Republic of Northern Cyprus State Planning Organization Statistics and Research Department, 2011). Construction sector so vastly has accumulate an important space in the economy of the TRNC and perpendicular to the population growth the demand for buildings remains at the increase. Based on structured and standardized form of accounting for both fully and partially approved construction certificates, the institutes has been able to publish parcel and construction area in both rural and urban areas collectively (Turkish Republic of Northern Cyprus State Planning Organization Statistics and Research Department, 2011) see Table 7 & 8 Figure8 &9. This output emphatically stresses the development of housing areas with the walls (boundary) of Famagusta which is based on the needs that are to be met.

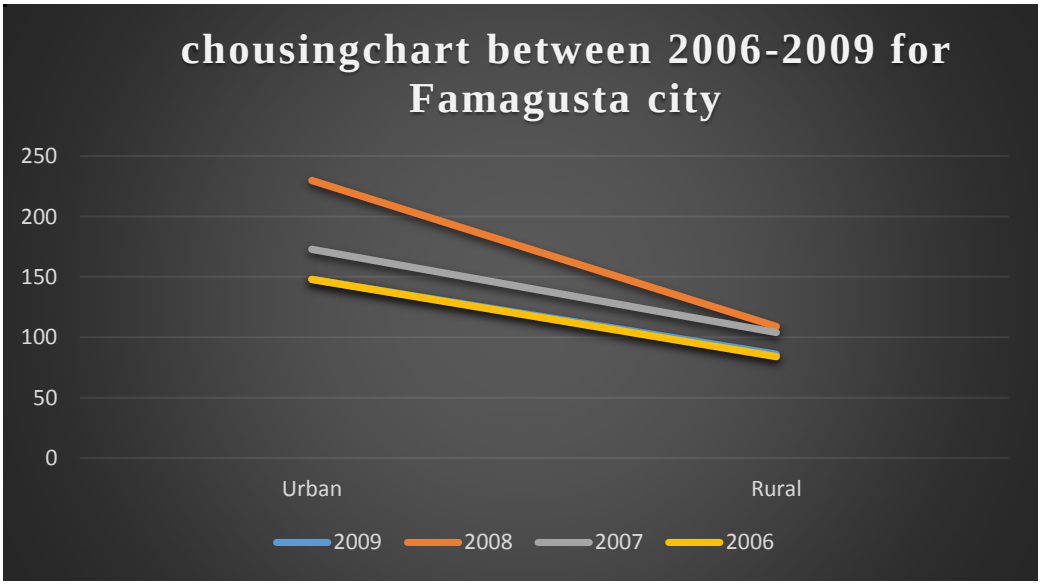

Figure 8: Famagusta housing chart.
(SPO, 2009/2006). Chart developed by author

Table 7: Famagusta private housing index (SPO, 2006-2009)

Area vs year → ↓	2009	2008	2007	2006
Urban	148	230	173	148
Rural	86	109	104	84

Categorize as private_ public in replica of source format (2006-209 only)

The increasing housing construction does not totally rely on individual interest only, Institutional aid in social housing as a way of alleviating accommodation issue also accounts for the increased number of residential houses developed within the domain of Famagusta as recorded by TRNC state planning organization (see Figure 11).

Table 8: Public residential housing in Famagusta, (SPO, 2006-2009)

Area vs year → ↓	2009	2008	2007	2006
Urban	2	2	0	2
Rural	17	3	3	5

Categorize as private_ public in replica of source format (2006-209 only)

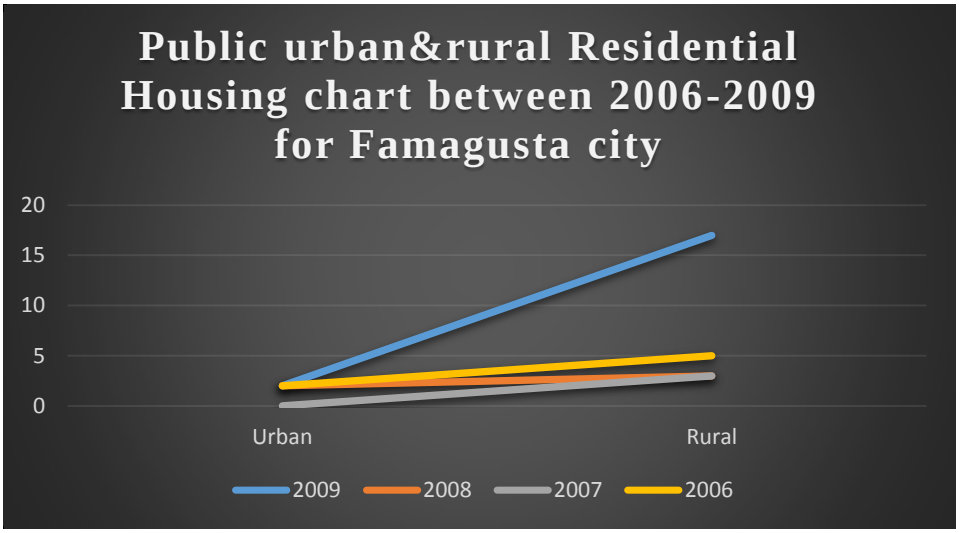

Figure 9: Public residential housing chart
(SPO, 2006-2009). Chart developed by author

Table 9: Residential housing statistic (SPO, 1993-2005)

Year vs Area	Rural	Urban
1993	32	102
1994	42	78
1995	101	71
1996	95	56
1997	186	129
1998	123	140
1999	132	85
2000	63	100
2001	37	145
2002	52	78
2003	63	102
2004	53	102
2005	94	129

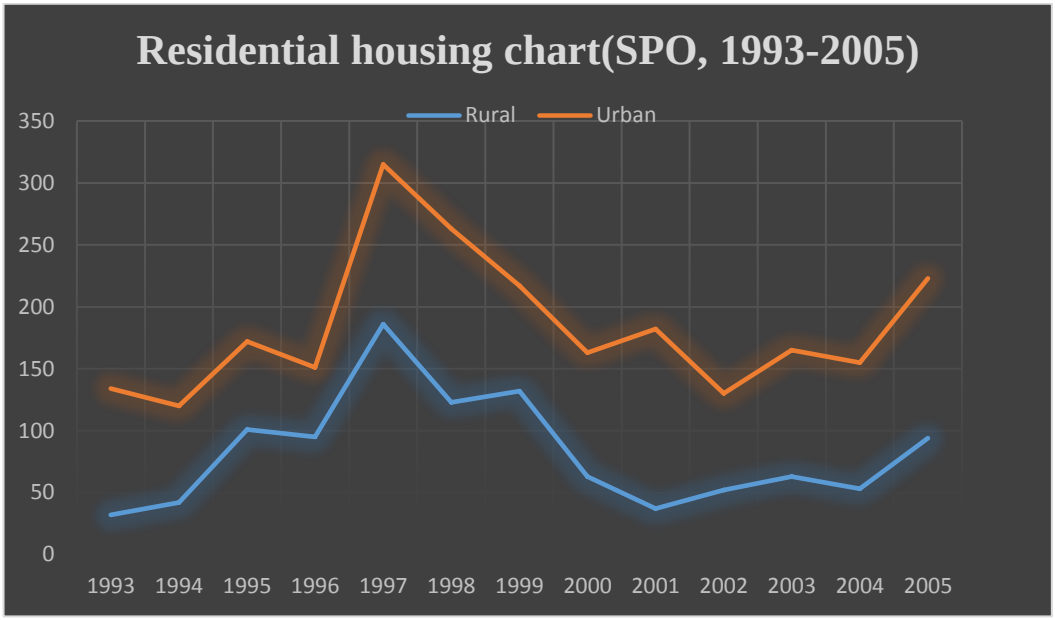

Figure 10: Residential Housing chart
(SPO, 1993-2005). Chart developed by author)

Table 10: Social Housing Development in Famagusta (SPO, 1984-1998)

Social Housing Statistics of Famagusta				
Year vs → ↓ stages	1st Stage	2nd Stage	3rd Stage	4th Stage
1984-1986	80	0	0	0
1985-1987	0	80	0	0
1987-1988	0	56	0	0
1987-1989	0	124	0	0
1990-1992	0	0	88	0
1993-1998	0	0	0	336

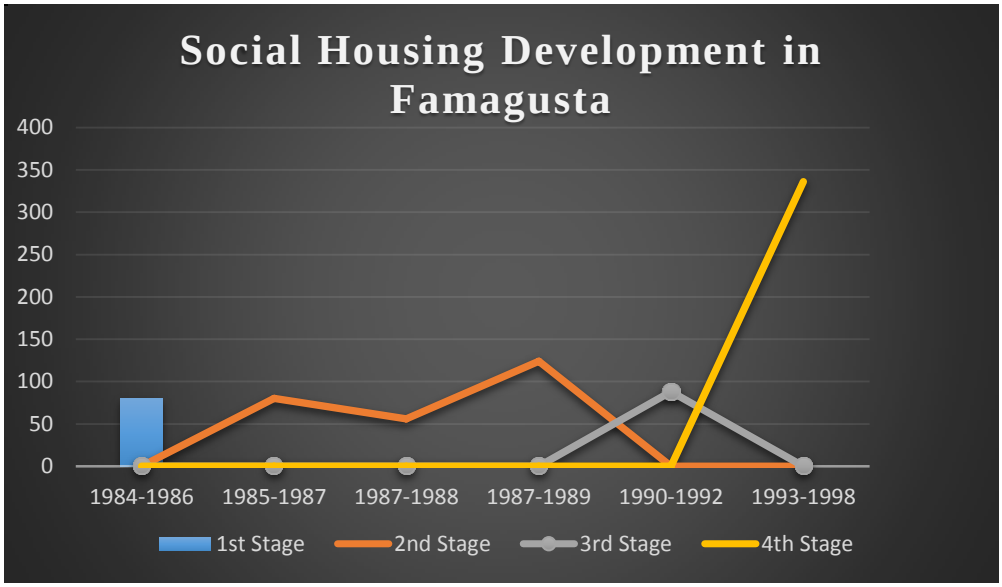

Figure 11: Famagusta Social Housing development chart (SPO, 1984-1998). Chart developed by author

4.5.4 Provision of Amenities

With the increasing population growth pressure on ecosystem services, institutions and planners begin to make tradeoff decisions to provide for the growing needs of the society (Jantz. A. C & Manuel. J.J., 2013). Road, dams, shops, schools, hospitals, police stations, public water supplies, electricity, green areas and the likes are required at large scale with increasing housing and population, therefore meeting these needs becomes necessities and mandatory for the government at the expense of ecosystem services. Provision of social amenities also entails construction on land and in water, permanent and temporary, public and private, above ground and underground, including additions, alterations and repairs as well as immovable and movable establishments (SPO, 2009).

With the accumulating plot areas, both green spaces and road accumulated simultaneously in Famagusta. Good illustration is evidenced in the statistics produced by the State Planning Organization for the years 2001-2009. (See table 11 & figure 12)

Table 11: Social amenity_ parcel statistic of Famagusta (SPO, 1996-2009)

Year vs parcel	Plot Area(sqft)	Green area(sqft)	Road area (ft)
1996	4 98,200	5,600	1,500
1997	0	0	0
1998	241,002	0	2 73
1999	26,958	0	0
2000	2 19,921	1 8,490	559
2001	410,045	9,600	1,570
2002	157,270	6,600	1,011
2003	34,200	0	324
2004	100,000	5 ,900	36
2005	572,930	45,962	4,452
2006	208,800	18,000	1,565
2007	267,420	11,500	1,180
2008	805,279	46,110	2 ,264
2009	7 04,063	0	8,579

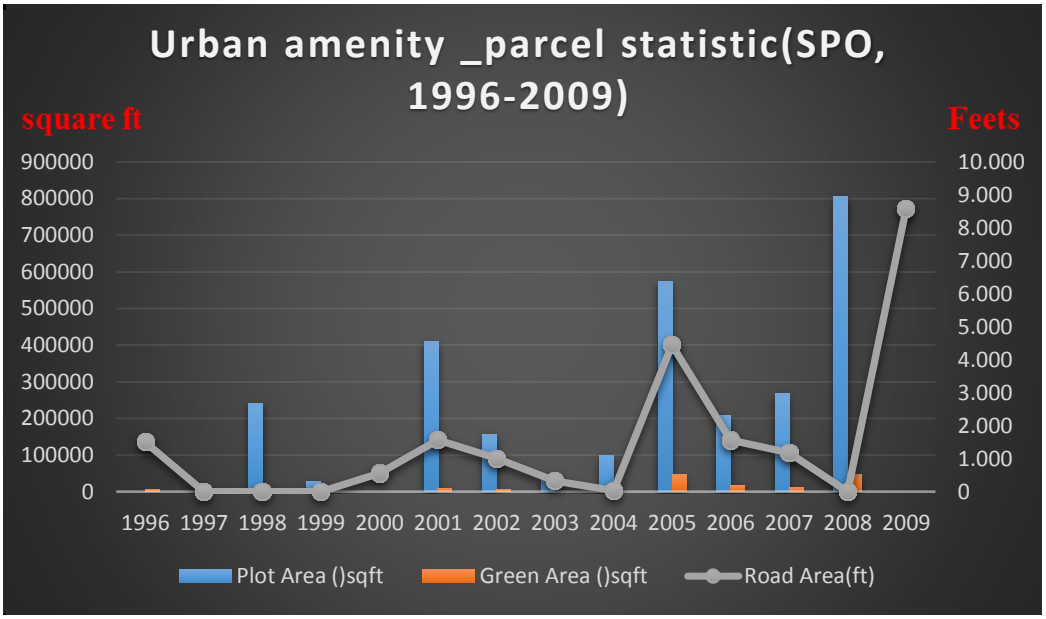

Figure 12: Amenity _parcel statistic
(SPO, 1996-2009). Chart developed by author

Table 42: Rural amenity _parcel statistic (SPO, 1993-2009)

Year vs parcel	Plot Area(sqft)	Green area(sqft)	Road area (ft)
1993	532,907	27,260	2 ,060
1994	582,280	1 0,804	2,000
1995	919,280	19,004	3,776
1996	1,104,165	117,413	5,020
1997	954,300	19,500	245,300
1998	1,279,056	77,300	10,616
1999	595,660	45,000	4,500
2000	9 7,600	0	0
2001	3 30,074	0	210
2002	812,126	76,514	5 ,016
2003	7 12,249	51,508	4,358
2004	350,600	17,000	2,947
2005	370,044	24,280	3,226
2006	172,800	9 ,600	1,306
2007	247,500	0	657
2008	187,300	1 1,900	2,104
2009	73,700	0	0

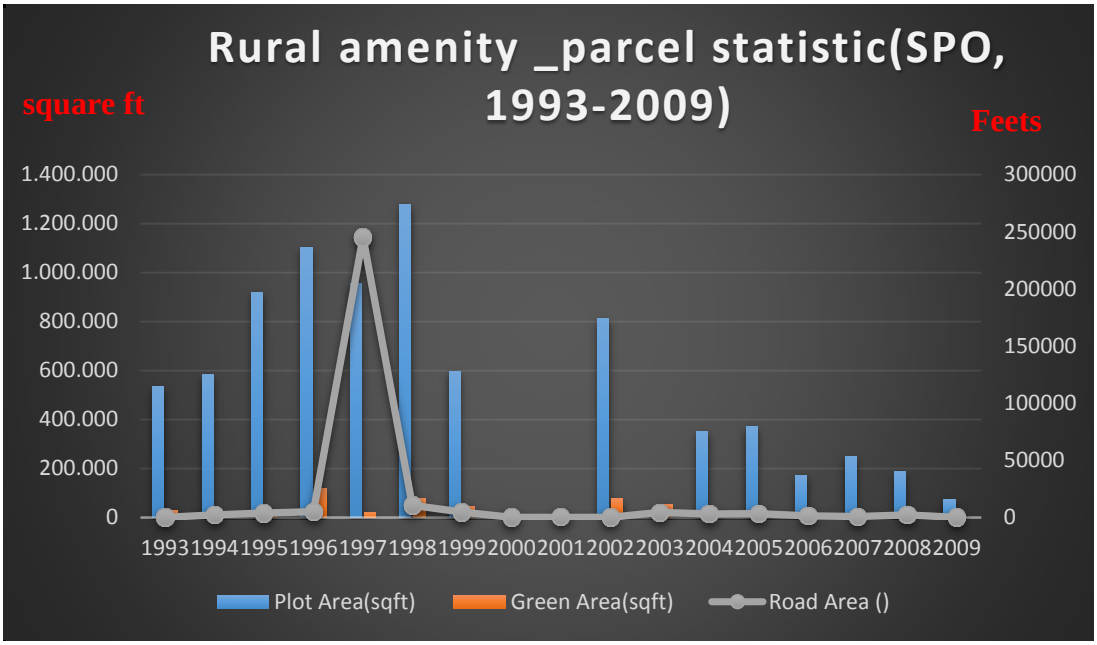

Figure 13: Rural amenity _parcel statistic
(SPO, 1993-2009). Chart developed by author

4.5.5 Economic Condition

Increasing demand for improved quality of life is a reflection of a suitable economic policy condition, this directly and indirectly lays change upon consumption of land and space, demand for privacy and better living conditions and access to green space (Lloyd-Jones 2004). Thus indirectly, linear relation can be observed between minimum wage increase policy in North Cyprus as a whole and the corresponding increasing personal possession of land which has exacerbated the limitation to natural reserves and other ecological amenities. See relation between minimum wage statistics (Table 13), rise of individual dwelling units (TRNC at large,) and correspondent increase in Famagusta for 2005- 2009/2010 (see table 14). This shows that economic transformation in an administrative area under any scale, be it macro or micro could have either a direct or traceable consequence on land consumption rate.

Table 13: TRNC Minimum wage statistic 1986-2010 (SPO, 2011)

Years	Minimum Wages (TL)	Date of Coming to Action
1986	75,000	1 January 1986
1987	90,000	1 January 1987
1988	121,000	1 January 1988
1989	205,001	1 January 1989
1990	340,500	1 January 1990
1991	520,000	1 January 1991
1992	806,000	1 January 1992
1993	1,373,000	1 January 1993
1994	3,000,000	1 January 1994
	5,000,000	1 August 1994
1995	9,420,000	1 January 1995
	11,590,000	1 September 1995
1996	14,800,000	1 January 1996
1997	23,000,000	1 January 1997
	33,800,000	1 September 1997
1998	50,250,000	1 January 1998
	67,000,000	1 September 1998
1999	85,000,000	1 January 1999
	103,000,000	1 June 1999
2000	137,000,000	1 January 2000
	160,000,000	1 July 2000
2001	200,000,000	1 January 2001
	240,000,000	1 August 2001
2002	320,000,000	1 January 2002
	380,000,000	1 October 2002
2003	440,000,000	1 January 2003
	500,000,000	1 August 2003
2004	550,000,000	1 March 2004
	627,000,000	1 July 2004
2005[1]	720	1 June 2005
2006	780	1 January 2006
	860	1 August 2006
2007	950	1 February 2007
2008	1,060	1 January 2008
	1,190	1 September 2008
2009	1,237	1 October 2009
2010	1,237	1 October 2009

* [1]After 2005 wages is indicated as new Turkish Lira.

The consistent relationship between the data above, the output statistic of deposable income and ownerships of dwelling in North Cyprus at large relates to the increased housing statistic presented in table 8 and figure 8 above, and those inclusive in related housing charts above.

Table 14: Relative table on disposable - dwelling ownerships (SPO, 2005-2010)

Year vs parcel →	Public Disposable income (YTL)[1]	Private Disposable income (YTL)[2]	Ownerships of dwelling (current price%)
2005	2,381.1	10,945.9	2.3
2006	2,781.6	12,309.1	3.0
2007	2,965.3	12,345.5	3.1
2008	3,005.1	11,792.1	3.5
2009	1,937.1	12,013.4	3.8
2010	2,508.5	11,942.8	3.9

*1&2 are based on old Turkish Lira.

4.5.6 Observed Land Use-Cover Changes: GIS Model

Land use change is crucial phenomenon and attribute of urban and sub-urban areas in every part of the world. This is a major characteristics of urbanization, resulting from demographic and institutional decisions and also from development. Urbanization is considered to be an important discuss and its impact whole land area, especially in places with limited physical extends has to be studied (Bahrain, 2003).

The variation in the land cover distribution of Famagusta's urban and suburban interfaces supports the need for a consistent monitoring and check on the land use and land cover conversions taking place on this part of the Island. Below is a representation of the land use/cover distribution within Famagusta urban and suburban interface (see table 15 and 16).

Table 15: Land use- cover distribution: case study area

	1986		1996	
LANDUSE/LANDCOVER CATEGORIES	AREA (HA)	AREA (PERCENT)	AREA (HA)	AREA (PERCENT)
URBAN	132.9249	2.31	227.2958	3.95
OPENLAND	473.5809	8.23	668.0771	11.61
BAREGROUND	544.3591	9.46	685.3401	11.91
MEDITERANEAN GRASS	1424.195	24.75	1401.178	24.35
WETLAND	1465.058	25.5	1369.529	23.8
SCRUB_FORESTRY	1711.912	29.75	1397.15	24.28
TOTAL	5754.325	100	5754.325	100

	2006		2012	
LANDUSE/LANDCOVER CATEGORIES	AREA (HA)	AREA (PERCENT)	AREA (HA)	AREA (PERCENT)
URBAN	356.1927	6.19	661.7474	11.5
OPENLAND	709.5083	12.33	639.3055	11.11
BAREGROUND	911.4851	15.84	901.1273	15.66
MEDITERANEAN GRASS	1298.751	22.57	1190.57	20.69
WETLAND	1099.076	19.1	880.4117	15.3
SCRUB_FORESTRY	1379.312	23.97	1193.447	20.74
TOTAL	5754.325	100	5754.325	100

Table 16: Land use- cover distribution: Famagusta urban and suburban interface

Time-Step 1 (1986)

In 1986, urban area occupied the least of the land use areas, taking up 356.1927 hectares, which is just as minute as being a little above 2%, while scrub_ forest dominating the area with 1711.912 hectares, equivalent to 29.75% of the entire combined land area. The margin goes a great deal in denoting the present state of urbanization at that time, also considering the wetland condition of the area, the ecosystem services derived. The Mediterranean grass was reasonable enough to

describe the vegetation characteristic of a salt water region with its high percent dominance, making a covering of more than 24%, bare land and open land respectively covers 9.46% and 8.23%. Being an existing city area, Famagusta has had a dispersed for of urban distribution, but with larger concentration at the north_ east of the city. This location is northward of the wall_ city which still retains its left over built-up areas (see table 15 & Figure 14).

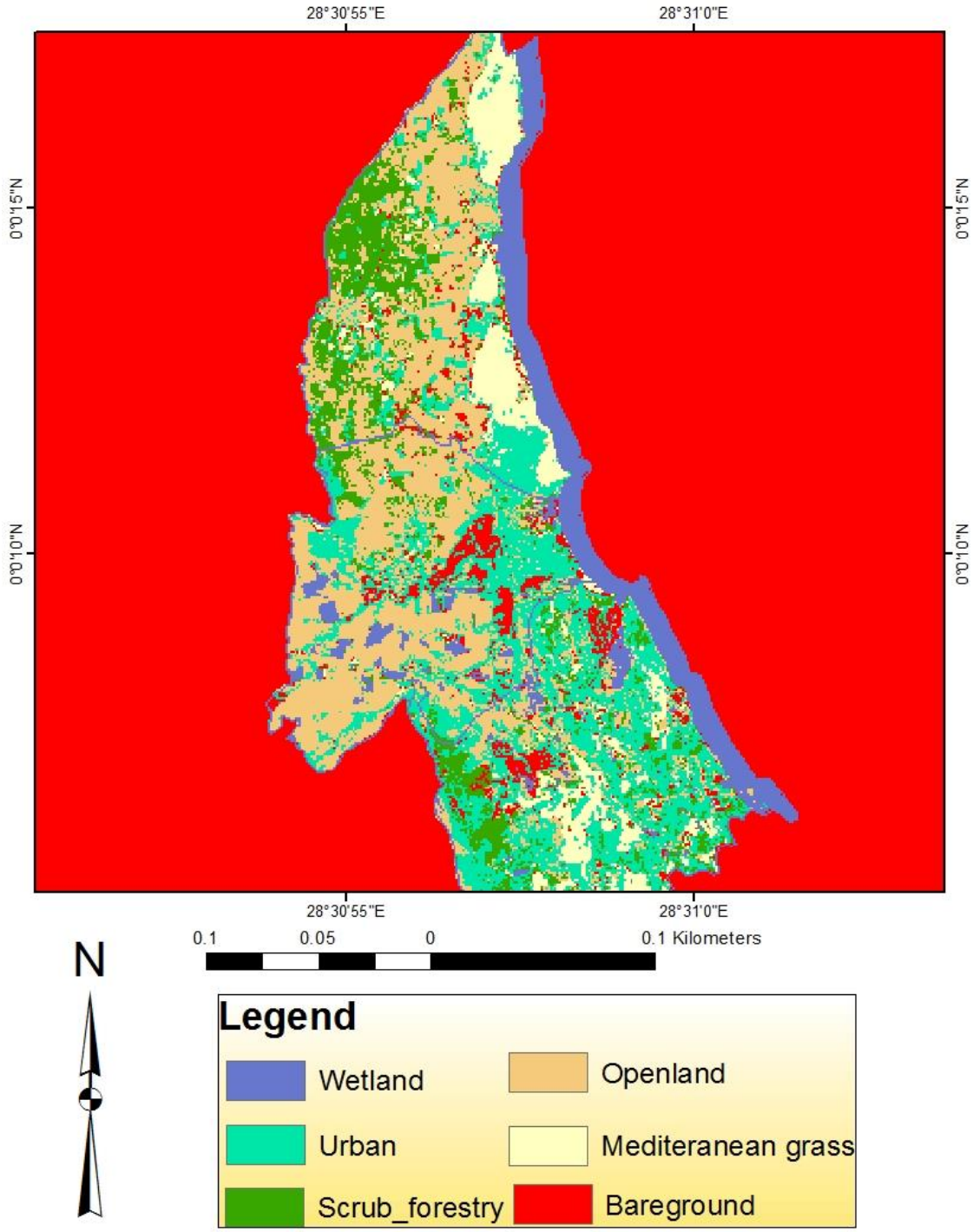

Figure 14: 1986 land use- cover state of Famagusta urban and suburban interface (Image developed by author)

Time-Step 2 (1996)

A sharp change in urban direction was observed in 1996, a concentration of development was shown in a north_ west direction, generating a slant pattern of growth into Tuzla. With this suburb, the south_ west clustering relates properly with the pressure influence from Famagusta. As can be observed, the compactness around the boundary line is a good description of urban sprawl from Famagusta city area. This is quite noticeable with the produced 3.95% urban coverage in this epoch. Open land and bare ground increases at 11.61%, 11.91%, with the construction rate and possibly the need for pasturing respectively, such an increase undoubtedly gives other valuable land cover characteristics in exchange for the new appearance, and therefore it is not surprising but unpleasant to see the decrease in scrub_ forest 24.28%, wetland 23.8% and Mediterranean grass 24.35% within this time frame (see table 15 & Figure 15).

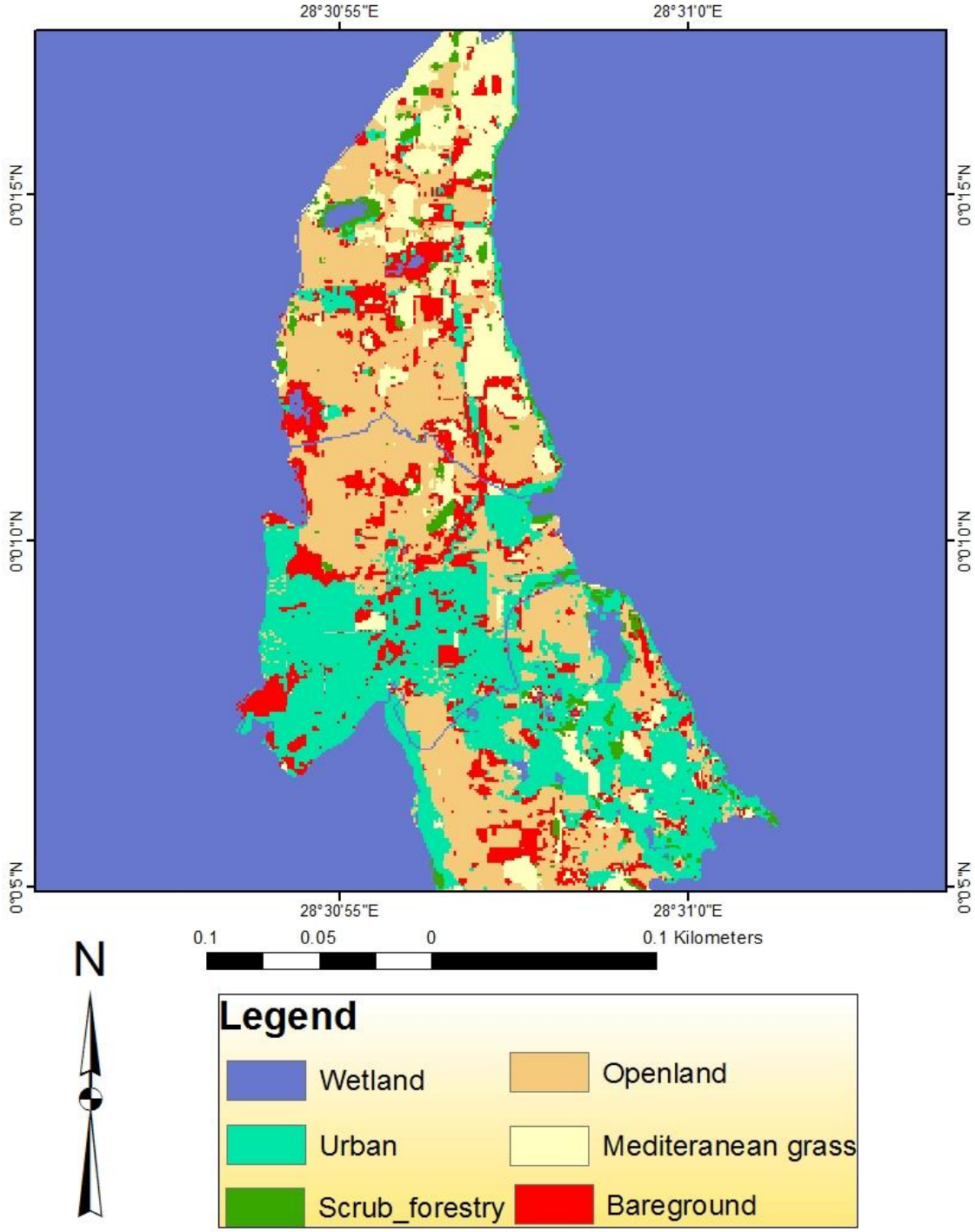

Figure 15: 1996 land use - cover state of Famagusta urban and suburban interface (Image developed by author)

Time-Step 3 (2006)

Within 10years interval (1996-2006) and on the 3rd time-step this research, the urban surface cover was almost doubled from 3.95% to 6.19%. same scenario as has been observed from the first time-step (1986) is still repeating itself .i.e, while some classes are increasing their coverage, others are loosing theirs. Dotted and sparse growth has begun to relate Tuzla with YeniBogazici, noticeably along the linear transport route. Although the right hand view of the image show some concentrated scrub_forest land, this is possibly related to the now grown shrubs within the military buffer zone. The increasing bare ground surface (11.91 to 15.84) at the expense of mediterranean grass (24.35 to 22.57), to be more precise, at the extreme suburban area which is in this study Yenibogazici calls for further research within climatic view point. Not alone is there lose of grass vegetation, the forest type capable of being produced within the area is consistently at risk of extintion. Along side the wetland area, the available expanse is now 19.1 and 23.97 individually (see Table 16 & Figure 16).

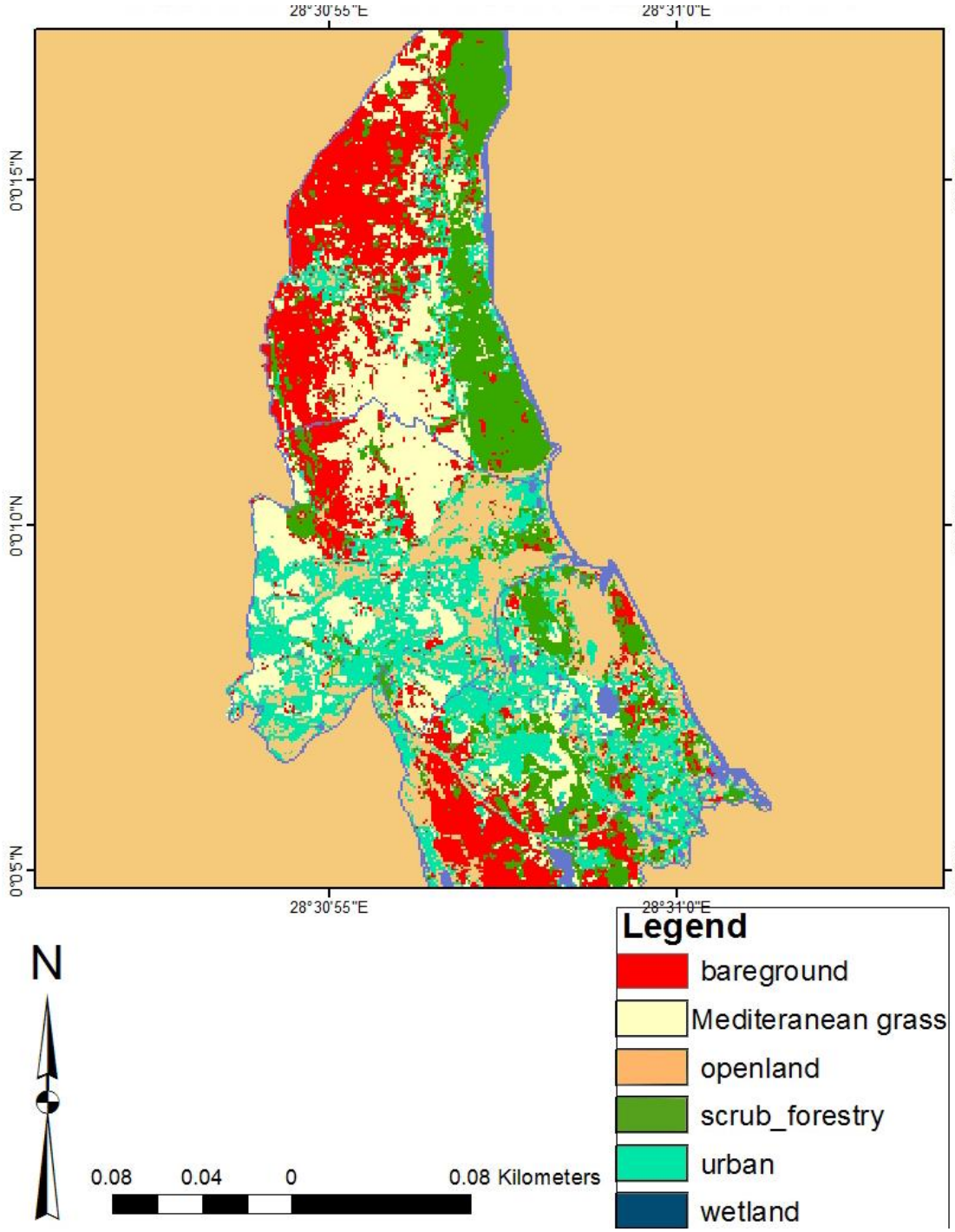

Figure 16: 2006 land use- cover state of Famagusta urban and suburban interface (Image developed by author)

Time-Step 4 (2012)

At this point (2012), urban growth within the 4th time-step has increased to 661.7474 hectares which is 11.5% of the total land area with 3 decades, at such increase, the forest decrease (from 1379.312ha to 1193.447ha) was unavoidable, also the change in open land 11.11% (709.5083ha) and bare land 15.66 (911.4851ha) remain persistent and apparently, a reduction to 15.3% (1099.076ha) in wetland area while Mediterranean grass accounting for 20.69% (1298.751ha) can also be observed in the image below (see Table 16 & Figure 17).

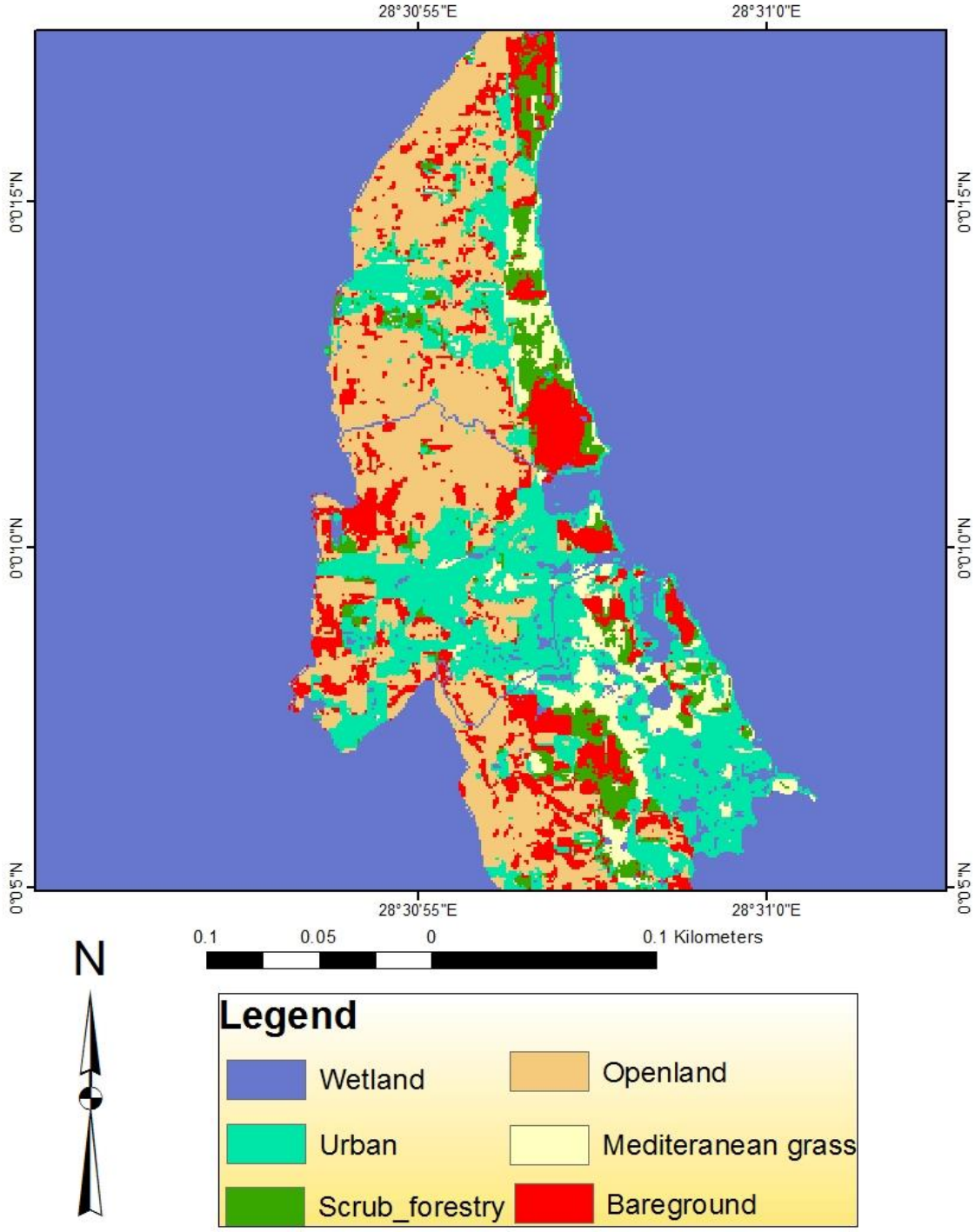

Figure 17: 2012 land use- cover state of Famagusta urban and suburban interface (Image developed by author)

4.6 Transition Probability Matrix

Due to the uncertainty of the specific land use that may or may not change to the other, a probability matrix was developed to give the output of column (A) multiplied by the total units of cells in each land use of the proceeding land use class. Therefore, the preceding class becomes the rows, while the proceeding class take the position of a column (see table 17).

Table 17: Transitional Probability table derived from the land use land cover map of 2006 and 2012

CLASSES	URBAN	OPENLAND	BAREGROUND	MEDITERANEAN GRASS	WETLAND	SCRUB_FORESTRY
URBAN	0.2235	0.5206	0.0928	0.0685	0.0558	0.0387
OPENLAND	0.0065	0.9851	0.0028	0.0017	0.0027	0.0012
BAREGROUND	0.1494	0.6717	O.0652	0.0472	0.0381	0.0284
MEDITERANEAN GRASS	0.1677	0.6397	0.0706	0.0513	0.0393	0.0314
WETLAND	0.1053	0.7725	0.0434	0.032	0.0286	0.0182
SCRUB_FORESTRY	0.1776	0.604	0.081	0.0549	0.0479	0.0346

(Table developed by author)

The land use class occupying the rows are previous year classifications while the while those within the column are present or proceeding year's classification. Thus from the output above, urban area has 0.2235 probability of retaining its urban status while the chances of becoming a wetland or scrub-forest are respectively thin (0.0558 and 0.0387). On the contrary, it has greater likelihood of becoming an open

land with 0.5206.It is also with 0.0928 a probability of becoming a bare ground or a Mediterranean grass 0.0685, though not obvious quite a bit visible compared to wetland and forest (see table 17).

On a closer look at the open land area, there was little probability that it became an urban area (0.0065) while at almost 1% likelihood (0.9851), it retained its status as open land, while 0.0012 shows the faintest possibility that it became a scrub-forest within that time-step. As observed further, there was 0.0028 possibility that it became a bare land which is likewise not rigid for a reality (see table 17).

For the next column (bare ground), its consistency with the previous land use class was based on the statistics produced at 0.6717 shows that, to a larger extend, it probably remained within same class while to a more possible degree, although not so high but greater when compared with the likelihood of other classes, it was 0.1494 possibly an urban area (see table 17).

The Mediterranean was also more of same class as at 2012 than any other while it slightly had a chance of 0.1677 of being an urban area while, its chance for wetland or scrub-forest were at 0.0393 and 0.0314 probability (see table 17).

Much more than becoming an urban area or even retaining its position within the land use-cover, the wetland was more of likelihood to have become an open land, while it was almost impossible to become a forest area. It had a 0.1053 probability to have added to the observed urban growth of the area and as, slight chance of being bare land (0.434), a wetland (0.0286) or Mediterranean grass (0.032) (see table 17).

The scrub_ forest at its own expense rather contributed to the open land within that time-step with the 0.604 than retain its position. This is simply illustrated with the output of 0.0346 degree of being a scrub_ forest in 2012, while the likelihood of change to wetland (0.0479), a grass land (0.0549) or a bare land probability was shown for 0.081. Among all and next to the chance that the forest area became an urban area was shown with the 0.1776 percent (see table 17).

4.7 Land use projection

After 10yrs projection from 2012 into 2022, the urban area is not expected to have over aching growth of 19.97, yet such percentage is definitely significant in this context as this is similar to the total percent of wetland in 2006 (19.1). Such trans-position could to some reasonable extent call for monitoring in other to avert the occurrence of this change. On the other hand, the open land area has consistently expanded its coverage from 8.3 in 1986 to 34.9%. Mediterranean grass land reduction (16.54). More devastating than the present or the past, wetland will almost be in extinction considering the rate of reduction from 25.5% in 1986 to 4.13% in 2022, and a reduction in the coverage of bare ground at 10.04% has been projected for same year (see table 18 and Figure 18).

Table 18: Projected land use - cover for 2022

LAND USE LAND COVER CLASSES		URBAN	OPENLAND	BAREGROUND	MEDITERANEAN GRASS	WETLAND	SCRUB_FORESTRY
2022	**AREA IN HECTARES**	1149.139	1967.404	577.7342	951.765	237.6536	870.6294
	AREA IN PERCENTAGE	19.97	34.19	10.04	16.54	4.13	15.13

(Table developed by author)

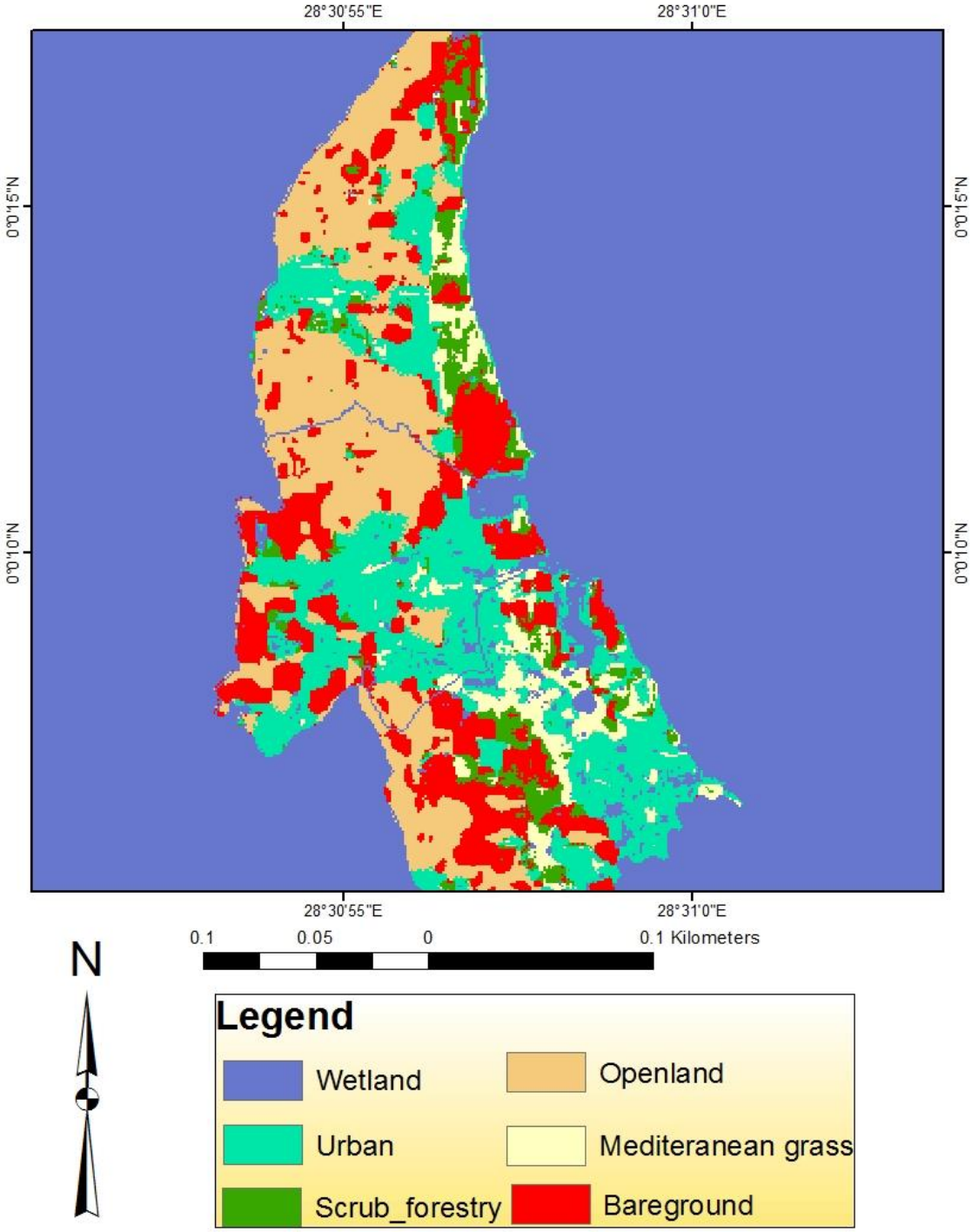

Figure 18: Projected land use - cover state of Famagusta urban and suburban interface 2022 (Figure developed by author)

4.8 Findings and Discussion

In other to show the relationship between Famagusta's development outward to her suburban interface, this image identified the boundary of Tuzla which is now inclusive in the municipality and later extended to display the linear growth seemingly producing a spatial merge between Tuzla and Yeni Bogazici toward the north (Karpas) to properly illustrate the extent, direction and pattern of the different land uses/cover. Intuitively, an individual can examine and understand the flow of urban development at the expense of valuable ecosystem services. Changes of such are measurable, to check and control unwanted and probably inappropriate direction of developability and uses, at the suburban and or urban areas (see table, 16, 17, 18 and 19, 20, 21 for percentage changes and annual change rate).

Table 19: Land use - cover percentage changes

	1986_1996		1996_2006	
LANDUSE/ LANDCOVER CATEGORIES	AREA (HA)	AREA (PERCENT)	AREA (HA)	AREA (PERCENT)
URBAN	-94.3709	1.64	128.8969	2.24
OPENLAND	194.4962	3.38	41.4312	0.72
BAREGROUND	140.981	2.45	526.145	3.93
MEDITERANEAN GRASS	-23.017	-0.4	-102.427	-1.78
WETLAND	-95.529	-25.5	-269.778	-23.8
SCRUB_FORESTRY	-314.762	-5.47	-17.838	-0.31

(Table developed by author).

Table 20: Land use_ cover percentage changes

LANDUSE/LANDCOVER CATEGORIES	1986_1996	1996_2006	2006_2012	2012_2022
URBAN	0.164	0.224	0.531	0.847
OPENLAND	0.335	0.072	-0.122	2.308
BAREGROUND	0.245	0.393	-0.018	-0.565
MEDITERANEAN GRASS	-0.04	-0.178	-0.188	-0.415
WETLAND	-2.55	-2.38	-1.91	-1.117
SCRUB_FORESTRY	-0.547	-0.031	-0.323	-0.561

(Table developed by author).

Table 21: Annual change rate

	2006_2012		2012_2022	
LANDUSE/ LANDCOVER CATEGORIES	AREA (HA)	AREA (PERCENT)	AREA (HA)	AREA (PERCENT)
URBAN	305.5547	5.31	487.3916	8.47
OPENLAND	-70.2028	- 1.22	328.0985	23.08
BAREGROUND	-10.3578	-0.18	-323.3931	-5.65
MEDITERANEAN GRASS	-108.181	-1.88	-238.805	-4.15
WETLAND	-218.6643	-19.1	-642.7591	-11.17
SCRUB_FORESTRY	-185.865	-3.23	-322.8176	-5.61

(Table developed by author

From the result of the annual growth rate, generally, there is less than 1% urban increase, irrespective of that, the difference of growth rate between 1986_1996, was just at 0.164 compared to what is expected to be experienced in 2022 (0.847), and similarly, the margin between the growth rate in same 1986_1996 as related to 2012_2022 as open land increases by 2.308 % yearly is one that calls for concern. The trend of fluctuation in the expansion and reduction of bare land especially with the high percent reduction that is expected in 2022 also calls for more investigation and check on the likely expected pattern and distribution of land use within and around Famagusta. More of concern is the rate at which the environment losses its potential components, in place of vegetation and water bodies. Wet land is expected to reduce further by 1.117% yearly and as a result of this, there is a very high chance that all that will be left will be at 4.13 there about while the forest would barely support the ecosystem with just 15.13% thereabout as well. Although, it cannot be said that socio-economic factors are 100% determinant of this changes, but for the sake of this study, we have limited our findings to the contributions made by human drivers in determining the extend of alteration in their spatial territory. Therefore physical drivers more precisely, climatic variables should be looked into for further discovery to avoid several disconnection between man and nature. The negative impact of this would span from loss of social space to loss of bio-specie (see figure 19, 20 and 21)

Figure 19: Social use of wetland in Karakol area of Famagusta (Image taken by author).

Figure 20: Adaptive use of wetland as social space Karakol, Famagusta.

Figure 21: Some bird species feeding on organism in wetland area Karakol Famagusta. (Image taken by author).

In addition, while some find such an ecological area as a social place, others find comfort in such microclimate area to be useful for nap (see figure 21)

Figure 22: Micro-climate function,Karakol Famagusta (Image taken by author).

While we consider the positive benefits of providing care and priority for the environment generally, but with more emphasis on the ecosystem, it will be reasonable to give clues to what negligence would result in physically, likewise in terms of our health especially with reference to pollution (see figure 23).

Figure 23: Effect of poor management of ecosystem services
(Image taken by author).

Chapter 5

CONCLUSION

Addressing the factors determining the degree of land consumption at the peri-urban area do not fail to include population growth. So far, land-use research has focused on urban growth which is predominantly a subject of population growth. Making it important and at the same time necessary to include land use planning in the development of any urban or suburban arena. It is a truth that effectiveness and efficiency of land usage can be achieved through housing development, this is owing to the fact that housing promotes social equity, generates economic growth and as well promotes environmental conservation only through its planning, construction, design and management. Therefore, it is of a fundamental importance to lay down thorough planning system, development and regulations in order to achieve this. With proper planning, the observed urban shrinkage in wall city causing ethnic segregation (the >90 % aboriginal occupancy) could probably be omitted.

Depreciating ecological environment in Famagusta area and even outwardly to the suburban area is one of concern to both the government, planners and ecosystem and environmentally conscious individuals, considering the fact that more of the brown field is expected to be seen in years to come. When looking into availability of land for industrial development, it could be agreed that this serves potentially valuable to the community but on the other hand, the expected weather condition should also rise simultaneously which poses more threat than benefit. Considering the result of the probability matrix, the tendency of an open land remaining open even in 10years

time from the last time step (2012) to 2022 of my projection, there is almost 1% certainty, which means there is high tendency of gaining browner field and from the reality check, there are visible places rendered wasted under the camouflage of "industrial areas" which are in sincerity not beneficial even to the land use class.

More so, compatible use of space (land use) can also be achieved within a well-structured land use policy, which limit the land consumption rate and to a very large extend reduces land fragmentation. In addition, biodiversity are put into consideration and more easily conserved within a planned urban area when there is necessity for urban sprawl when such incidences are inevitable through such methods as selective conservation. Accessibility and walkability are made easy to deal with, without neglecting role and functions of public spaces, within a compatible land use, limiting increase use of car against that would be in-place in a dispersed spatial allocation of settlement.

Another benefit of land use plan is the huge possibility that the system would support a check and balance system of government as each arm is designated with roles and obligations between different administrative levels, it brings about clear coordination mandate, clear sequence of assessment, techniques, method and procedures of land use planning. Inclusively, a proper urban and suburban land use plan serves as a tool to limiting waste and air pollution.

The focal concentration on dwelling ownership as related to the level of disposable income gives cracks to inadequate economic contributions on land use, it would rather be suggested to increase investment on local economy (such as agriculture,

larger whole and retail trade) to avoid excessive increase in vacant and abandoned houses but should re-strategize to assist employment rate and economic development index. In other word, the responses to the economic opportunities mediated by market and policies be considered as a factor for land use/cover change in both urban and suburban areas, particularly with increasing pull factors in the urban areas that compels suburban encroachment.

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APPENDIX/APPENDICE

Definition of terms

Land: Is fundamental for most biological and human activities on Earth. Agriculture, forestry, industries, transport, housing and other services use land as a natural and/or an economic resource. Land is also an integral part of ecosystems and indispensable for biodiversity and the carbon cycle (Eurostat 2009).

Urban land: urban land can be defined as - "land that is built over within a threshold population size, within a context of a settlement structure other than that on a landscape of nucleated villages or a mix of hamlets and isolated dwellings that can provide potential significant policy indicating the costs of delivering key services such as health and education, sustaining her economy (income and wealth) separately from direct dependence on land" (Bibby & Shepherd, 2001).

Suburban Land: Precisely, there are yet no uniform agreement as to what exactly makes up a suburb. Suburbs have been defined according to many different dimensions from location and transportation spheres to culture and physical appearance. Giving this uncertainty of angle of description, one approach is to neglect the term; another is to be very sensitive and precise when it has become unavoidable. Far beyond what it means but the context of thoughts and expression about suburbs shapes how they can see such areas being developed and redeveloped in the future" (Ann Forsyth 2012).

With the spread of urban settlement, the team suburbs began to surface in terminology, firstly used to express the large villa and estates constructed outside the city. Then as a roman word 'suburbani", it has origin traceable to a Roman statesman, Cicero (http://en.wikipedia.org/wiki/Suburb retrieved on 26/3/2014).

Either referred to as suburbs, extended city or City's outskirts – As of 1950s, most of these places where described with rural character. Ever after 1960 census, this intriguing consciousness towards expansion of domain into places typically of rural quality. The grouping of all the inhabitants, building blocks as urban would bear the tag "distinguished domain, population, and residential blocks whose environment is typically rural". While 1970, 1980, and 1990 censuses, distinguished some territories as rural from every suburb despite having close proximity to and within an urban characterized area. For the 1990 census, this grouping has been used in certain places outside urban contiguous areas (NJSDC 1990, US Census Bureau 1995).

Bourne & Ley describe it as a thing apart, a human habitat wholly dependent on the city's prior and adjacent existence. It represents the most important element of growth in modern expanding cities, being distinguished in the landscape by its location at the urban periphery and recreating there in modified ways the intricate form of city's built environment. It provides the dominant settings for rearing of families, the learning of properties and political relation and through life-cycle stages, the constant recasting of roles in an urbanizing society and polity. To the extent that suburb is in time draw into the greater mass of the urban area, its physical form, socio-economic and political structure contributes to the character of the emergent city. Whatever emphasis, urban area itself is incomplete without consideration of suburb in urban development (Bourne & Ley, 1993).

From rural or and urban to suburban transition illustration based on settlement types and character likewise provides a contributory definition of suburban area (see Figure 24)

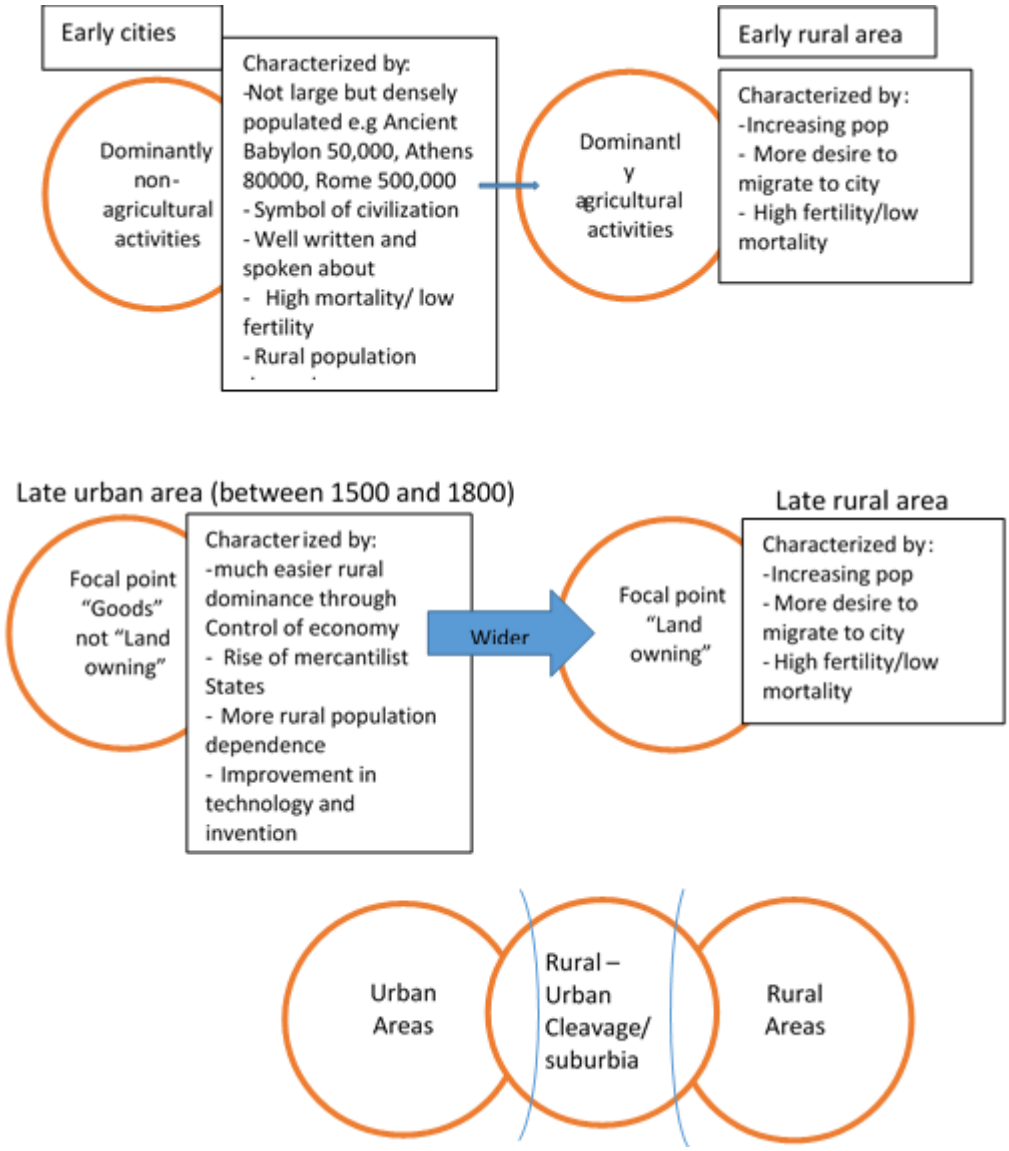

Figure 24: Suburbia formation from settlement characteristics (Weeks 1996)

Internal rural-to-urban migration, natural increase, international migration- a single or combination of these processes and most importantly, the reclassification of places from rural to urban after the world war gave rise to the use and increased the process of suburbanization (see Figure 2)(Weeks 1996). These areas are widely known for their confusing character due to the heterogeneous combination of rural, urban (Tiran 2011), and the expected suburban life.

Differentiating Urban, Rural and Suburbs

Over a long period, population sizes and economic condition have been some of the major attributes to distinguish settlement types on the scale of rural/urban, metropolitan /nonmetropolitan. Although, there still arises several variations from country to country, but most federal governmental offices such as Bureau of Economic Analysis (BEA), Economic Research Service (ERS), General Accounting Office (GAO), Metropolitan Statistical Area (MSA), Office of Management and Budget (OMB), Standard Industrial Classification (SIC), Urbanized Area (UA), US. Department of Agriculture (USDA), notwithstanding the additions and subtraction to form a more complex or simpler models other than the ones put forward, have been found to contain in their report on rural/urban definition some model similarity (USGAO, 1993).

Criteria for Defining Metro/Urban or Non-Metro/Rural

"Metro/urban or non-metro/rural" areas can be defined using several criteria. There are two principal "rural" or "urban" definitions used by the US federal government, these includes system adopted by Office of Management and Budget's (OMB), using the "Metropolitan/Non-metropolitan" system of classification and the other by Bureau of the Census which defines with "Urban-Rural classification of populations" (Thomas et al., 1998).

Recently adjusted in 2002, but relevant in the criteria for "urban or rural", the definition developed by the Census Bureau for the 1990 census. United State of America defines urban as comprising all district, population, and housing units in urban characterized parts and in locations of 2,500 or places with more population

beyond the border of urban contiguous areas. Mainly, urban consists of district, population, and group of building blocks such as estate in;

1. Incorporated cities villages, administrative division, and towns, though with some exclusions that does not apply to the rural portions of "suburban" with persons of 2500 or more.
2. Census indicated places of 2,500 or more persons.
3. Other integrated or unincorporated places included in urbanized areas (US Census Bureau, 1995).

Meanwhile, third phase of this definition was included at the realization of the wide area omitted by classifying selected area as “urban under special rule”. Thus the adoption of “urbanized area” (UA) brought the many large, closely built-up areas that were excluded from the urban category base on “un-incorporation” into urban consideration, and to cope with the issue of “extended city” (US Census Bureau, 1995).

According to standards released in January 1980, as defined by the Office of Management and Budget’s (OMB), metro is designated by a metropolitan statistical area (MSA) of minimum: a city of 50,000 or more occupants or a contiguous area (implementing the standard of Bureau of Census in its rules) of 50,000 inhabitants and inclusively an additional MSA population of at least 100,000, for New England, 75,000 is adopted (USDA, 2013).

Such contiguous area (UA) comprises one or more focal point which is the city and the next densely settled surrounding territory that jointly have a minimum of 50,000 persons. The urban fringe/suburbs generally consists of neighboring territory having a denseness minimum of 1,000 persons /sq. mile (US Census Bureau, 1995).

In the same spirit of defining the character of a territory as either urban or rural, Office of Management and Budget's (OMB) standards stipulates that each MSA must have a large administrative district in which the central city is located (the central county) and added immediate counties (fringe counties), once they are resourcefully and socially incorporated with the central county. Therefore, those counties not included in the MSA are then referred to as non-metro/rural area (USDA, 2008, 2013 & USGAO 1993).

And as for the Economic Research Service (ERS), metro counties are distinguish by their physical magnitude and non-metro counties by their degree of their social conditions or proximity to the big socially reliable areas. Considerably, USDA defines with codes, categorizing codes zero to three as metro, and four to nine as nonmetro."1 [e.g., 4 = Urban population of 20,000 or more, adjacent to a metro area, and 9 = absolutely rural or urban population of fewer than 2,500, not directly physically related or close to a metro area]"(USDA, 2013).

On the other hand, European nation's criteria for classification commonly conducted by Directorate-General for; Agriculture and Rural Development, Eurostat, the Joint Research Centre (JRC) and the Directorate- General for Regional Policy, uses Organization for Economic Cooperation and Development (OECD) approach which

classifies on regional bases, areas as predominantly rural, intermediate or predominantly urban depending on the following criteria (Eurostat regional yearbook, 2010):

1. Working profile as well as the range of functions performed, the population potential, and political and administrative status of the main urban center.
2. Urbanization level, i.e. the degree of urban vs. rural character of a given area. This includes spatial forms – the morphology of settlement, as well as the density and redistribution of population.
3. Interdependence of, and interaction between the urban, periurban, and rural zones of rural – urban regions (Korcelli, 2008).

More so, the classification criteria analyze a place as predominantly urban (PU), if the share of population living in rural local administrative unit 2 (LAU2) is below 15 %; Intermediate (IN), if the share of population living in rural LAU2 is between 15 % and 50 %; Predominantly rural (PR), if the share of population living in rural LAU2 is higher than 50 % . While at the local level, a place is regarded a rural area if the population density is below 150 inhabitants per km² (Eurostat regional yearbook 2010).

More recently, this criteria has been found insufficient has overlaps and underestimations exist as places with few land area but with adjacent population yet sparse are classified as urban while others with extensive land mass, dense population (=low population density) are regarded under the rural classification, such cases as Aldea de Trujillo in Spain, Badajoz and Cáceres in Spain and Uppsala in Sweden (Eurostat, 2010). Thus the grid system has been introduced as an approach,

with classification of grid cells of 1 km² as either urban or rural. To be considered as urban, grid cells should fulfill two conditions: a population density of at least 300 inhabitants per km² and a minimum population of 5 000 inhabitants in contiguous cells above the density threshold. Except this, the other cells are considered as rural (Poelman, 2010, Eurostat regional yearbook, 2010, Allen et al, 2012).

The research provided in United Kingdom (Bibby & Shepherd, 2001), discussed more of this approach thereby "urban" or "rural" areas can be defined. This new definition and classification of urban and rural areas places its main emphasis on the morphology of rural settlements (i.e. their physical form) and the wider geographic context of such settlements. This approach ensures that the focus remains clearly on the most enduring – physical - aspects of settlement. A focus mostly adopted by land planners and designers, models are often produced with the inclusion of road pattern (primary, secondary or tertiary) and other details as the building heights and spacing proportion among others.

Truth being told, there are several criteria defining or classifying rural-urban areas that has been used in Europe, majority of which has emerged to suit the purpose of a research discussion or say certain policy decision, based on functionality, migration, commodity and information flow/administrative criteria (see Table 18).

Table 52: Some bases for classification adopted in Europe

Underlying concepts	**Typological criteria**	**Classes of typology**
City – regions; urban Systems	Functional profile, rank in urban and regional systems	Hierarchical structure of Functional Urban Regions (Functional Urban Areas)
Socio-ecological models of urban spatial structure; Morphological area	Settlement forms: mono-centric, sectorial, polycentric patterns	Metropolitan - urban - rural regions
Rural - urban dichotomy rural - urban continuum	Urbanization level, population density, size structure of settlement	
Stages of urban development	Differential patterns of interregional population redistribution	Patterns of intra-regional Specialization and interdependence
Urban – rural partnership	Functional linkages (flows) between rural, periurban and urban zones	

(Korcelli, 2008)