Urban Green in European Medium-Sized Urban Areas: analyzing the changes with a land system approach

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Abstract

Most works on land system changes take either a quantitative approach on land cover and use or a qualitative approach on land function. The aim of this research is to study urban green in European medium-sized urban areas (MSUA) with an interdisciplinary approach using mixed methods. In the course of this research, the case studies are gradually being reduced: from a study of land cover and land use changes related to urban green in 214 European MSUA to an analysis of urban green functions in 4 shrinking cities: Salamanca, Metz, Magdeburg and Szczecin. This innovative approach based on various types of data (CLC, LUCAS, strategic planning documents and interviews) leads to several conclusions on the way urban green is changing in European MSUA along the three components of the land system: cover, use and function. Additionally, it gives a reflection on methodological problems when considering land system changes with a comparative approach at the European regional scale.

Key words: urban green, land system, cover, use, function, medium-sized urban areas, Europe, NUTS 3, shrinking, Salamanca, Metz, Magdeburg, Szczecin

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1. INTRODUCTION

1.1 Problem setting

Over the last decade, there has been a growing trend of urban greening in most European urban areas whether as bottom-up initiatives or top-down policy-based programs. Green spaces not only improve living conditions and ecosystems but also they play a role in the promotion and branding of cities. This tendency results – at least partly – from the “Green City” concept presented as the magic potion for all cities aiming for sustainable development. The question of green spaces in cities is not new, but two main elements have changed and they need to be understood.

First, unlike the past, when a limited number of groups or individuals expressed an interest, urban greening has become omnipresent. Today, greening cities is not only a concern for public institutions and ethically minded individuals, it is an enticing field for private sector investors, who have come to recognize, that nature is a finite resource that can be converted into a new commodity. Furthermore, society at large is more aware of environmental limits and more concerned with health than ever before; citizens have emerged as important stakeholders in the process of greening the cities.

Secondly, the process of urbanization has intensified land pressure in most parts of Europe, influencing the way urban green has evolved. Indeed, as urban green requires space, it can be influenced by existing territorial structures; conversely, its existence can also dictate territorial patterns. The greening of urban areas fostered by existing structures also creates changes in the land system’s cover and use as well as its function. Indeed, in close conjunction with other existing traditional socio-economic land functions in urban areas, green spaces have become part of almost all urban development projects, adding new components to the land system (urban gardening/agriculture, productive landscapes etc.). Therefore, there is an inherent conflict when it comes to urban greening. On the one hand, there is a growing interest for urban green in most cities, which leads to the establishment of planning strategies that aim to develop green spaces. On the other, the pressure on the land system created by the growth of impermeable surfaces in urban areas limits the ability to increase urban green spaces.

The positive effects of urban green are widely described in various fields of expertise (health, environment, risk prevention, social integration, etc.), but most research focuses on the effects of already existing urban green. However, the opportunities for

future green spaces in cities have not been discussed to the same extent. What is more, most works identify the benefits of urban green either on a local scale (e.g., strengthening social cohesion) or a global scale (e.g. greenhouse gases reduction), omitting or under-estimating the importance of the regional scale. Also, whereas the majority of the European urban population lives in medium-sized urban areas, research in urban studies has focused on large metropolitan areas, leaving out smaller cities. Finally, comparative studies on land system changes in Europe are scarce, especially at the scale of medium-sized urban areas. The lack of research in these areas is significant because a comparative knowledge of the opportunities and challenges of urban green in European medium-sized urban areas will provide some key insights for better decision-making when planning new developments.

In order to examine the opportunities and challenges of future projects involving urban green, it is crucial to understand the current individual urban context. In this study, the complex issue of urban context will be simplified by looking at two aspects in more detail: density and socio-demographic dynamics. In my opinion, these two aspects are the most relevant when considering urban green. Using these two elements, a 4-class Typology Model (Fig. 1) was established on which assumptions were developed based on simple logic. For instance, when looking at density, regions with “low density” generally have a high share of non-built areas, whereas “high density” regions have a low share of non-built areas. Similarly, when looking at socio-demographic dynamics, one is more likely to find high competition for land in growing regions than in shrinking ones. Although one can argue that the rationale based on this 4-class typology is no more than common sense, it has never been tested before. At first glance, space and capital are needed to increase urban green. Therefore, areas with low density and growing socio-demographic dynamics would be the best candidates for developing urban green. In reality, this configuration is rare; growing areas often lack space and shrinking areas often lack financial resources. Indeed, as growing urban regions attract investors, the space available is more likely to be in competition with uses other than green. On the contrary, shrinking cities often experience economic and demographic decline, providing a high potential for green but with limited means to invest in development or even maintenance of green spaces. This study proposes a new conceptual approach combining the 4-class Typology Model and its related assumptions with the observation of urban green and taking into consideration the land system (cover, use, function) changes in European medium-sized areas.

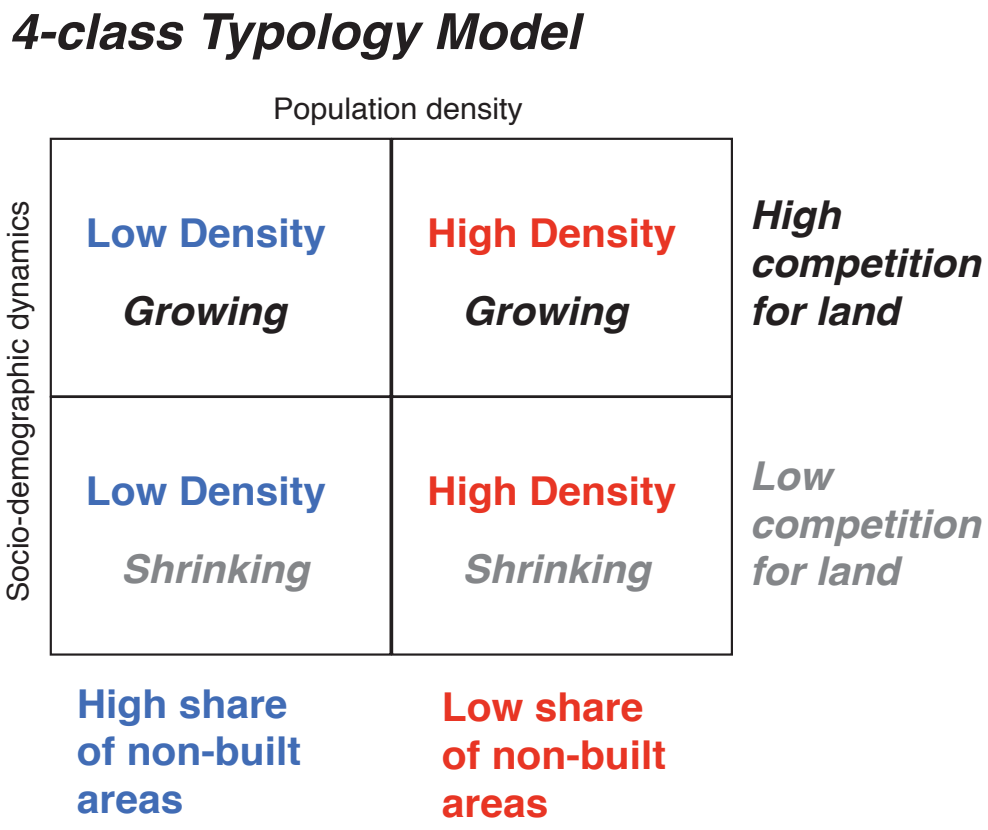

Fig. 1 – The 4-class Typology Model [Author]

1.2 Research questions

The main research question is the following:

To what extent are density and socio-demographic dynamics influencing the way urban greening[(a)] is developing in European medium-sized urban areas[(b)]?

To answer the main research question, there are two secondary questions that will guide how the research will be conducted.

1. Are the rising urban greening activities in the last decade visible on the land system[(c)] changes of European medium-sized urban areas?
2. To what extent existing data allow to observe the land-system changes at the scale of European medium-sized urban areas?

1.2.1 Definitions

[(a)] Urban greening:

Includes all activities implying a temporary or long-term change in the land system (cover, use or/and function) from a non-green to a green area.

[(b)] Medium-Sized Urban Areas (MSUA):

Definition: Urban area between 200,000 and 500,000 inhabitants. Based on a classification published in 2012 by OECD on functional urban areas, a sample of 214 European cities have been defined and adapted to NUTS 3 regions for matter of availability and delimitations of statistical data delivered by EUROSTAT and related agencies (more details in Appendix I).

(c) Land system:

A holistic approach to examining land change that focuses on the following three components:

1. Land cover (LC): the biophysical character of a given surface, it can be observed not only in the field but also with remote sensing methods.
2. Land use (LU): the way humans exploit the land cover to produce, maintain or change it.
3. Land function (LF): the intended and unintended results of a certain land use, often expressed as goods and services that a certain piece of land provides.

As shown in Figure 2, in 2014, a large share of the population lived in cities smaller than 500,000 inhabitants, especially in Europe. Although medium-sized cities are important in the European polynuclear landscape, research on global cities (e.g., Friedmann, 1986; Scott 2001, Sassen, 2001; Robinson, 2002; Taylor *et al.*, 2012) has dominated the urban studies sphere. There are probably many reasons why smaller cities are under-researched, such as the fascination with large metropolitan areas or the fact that academic, state, or other powerful institutions are concentrated in big cities (Friedman, 2014: 2). But, as Bell & Jayne (2009) describe Thrift's statement "one size does not fit all", research on medium-sized urban areas is relevant to challenge the orthodoxies.

Population distribution by city size in Europe and other major regions in 2014

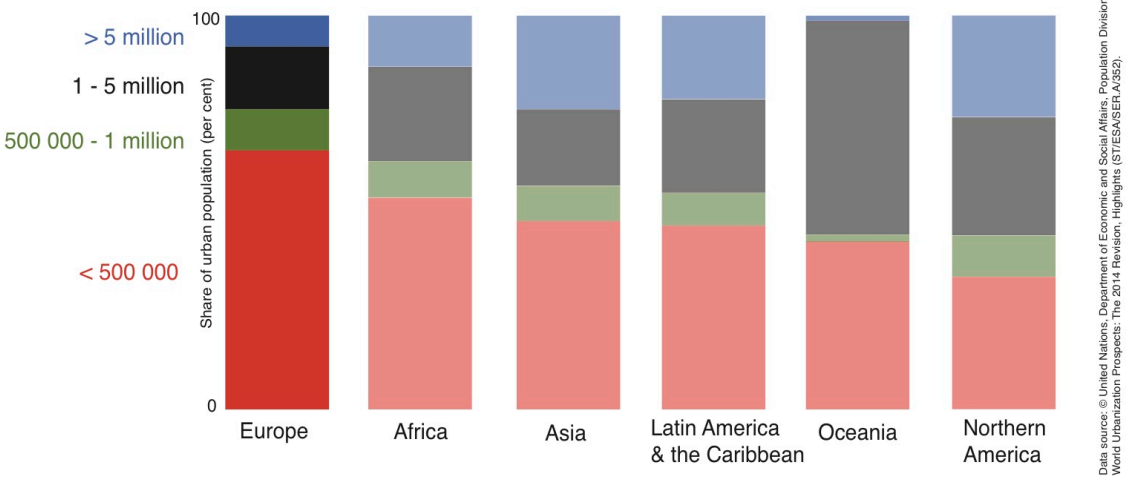

Fig. 2 – Population by city size and by World's regions, [data: UN, adapted by Author]

In addition, MSUA are more likely to adapt their governance (for instance in terms of regional planning) than bigger cities that often host much more complex functions towards regional, national or international levels. This leads to an increase in the number of institutions and therefore stakeholders involved in planning and decision-making (Giffinger *et al.,* 2007).

1.2.2 Hypothesis

Urban density and socio-demographic dynamics frame the way urban greening affects the land system, and the following assumption can be tested:

- Space for green is greater in low than in high density urban areas
- Competition for land is greater:
    a) in growing urban areas than in shrinking urban areas
    b) in more densely structured and populated areas
- The availability of capital to invest in greening is greater in growing urban areas than in shrinking urban areas.

1.3 Objectives and limits

This research looks at changes concerning urban greening with a particular focus on MSUA, regions least valued in urban studies. The objectives are numerous as this comparative research at the European scale is conducted with an interdisciplinary approach. It aims to produce a comprehensive update on the development of urban greening in the last decade and its effects on the land system, as well as to understand how the context (density and socio-demographic dynamics) influences the way urban greening develops and will develop in MSUA. The main focus of this research is its practical implication: it provides some suggestions for drawing future urban projects in various contexts.

Also, from the methodological point of view, the study suggests a new conceptual approach that distinguishes among three elements of the land system, namely: use, cover and function. The purpose of differentiating these three elements is to advance a holistic approach to the land system that considers data on land changes other than remote sensing data, which is the most commonly used. This leads to a reflection on methodological constrains for research on the land-system changes.

Considering this holistic approach is interesting because it provides new paths to read territorial changes; however, it also has considerable drawbacks. Indeed, due to the fact that urban greening can take multiple forms, the definition of urban green switches chameleon-like in the course of this research. This inconsistency also appears in the

areas studied. For instance, the regional areas (NUTS 3) are considered in the first two parts, but the results of the last part are only based on the core city of the regions. Due to lack of reliable data, the purpose of this research can only be partly fulfilled. Moreover, this work is not only limited by the lack of comparable data, it is also limited by the difficulty of researching at a regional level because of the discrepancy between functional urban areas and statistical units on which data is produced.

2. LITERATURE INSIGHTS & RATIONALE

The proposed research cannot be achieved without an interdisciplinary approach. Therefore, this part of the literature insights will briefly discuss various important aspects for understanding the current knowledge of the land system changes as they relate to urban greening. This review, compiled using information from various disciplines, should help develop a new conceptual approach for researching on urban greening.

2.1 Defining urban green – from a theoretical reflection to a practical delimitation

Urban green covers a large number of subcategories that have recently proliferated, giving rise to a surge of new terms. For example, the following are just a few of the terms now used: urban gardening, urban farming, peri-urban agriculture, permaculture, aquaculture, productive landscape, community gardens, green roof-top, social farming. This multitude of terms not only shows a rising interest in city green spaces, but also illustrates the variety of ways in which urban greening is developing in cities today. This variety is the most obvious obstacle to clearly defining urban greening, but territorial changes also raise difficulties in defining this concept. For instance, the growing complexity of the territorial organization has caused the line between the traditional urban-rural divide to blur in both physical and social terms. An extensive body of literature addresses this subject from different angles and at different scales. A short review of selected works on the topic will improve our theoretical understanding of what urban green means today.

First, at the regional scale, urban expansion due to suburbanization has led to an increase of urban infrastructures and activities in rural zones. This has caused not only social and economic changes but also changes in land use competition. The latter is even stronger since rural zones are no longer used for just agriculture and residential purposes, but they are also used for economic activities, recreation (Piorr *et al.*, 2011: 21) and/or “hobby-farming” (Zasada, 2011: 643). This unclear frontier leads

to increasing conflicts between rural and urban uses that need to be resolved (Mcrit, 2010: 7).

The same logic of blurred borders can be perceived at the local scale or even at the single building scale between “culture” and “nature” cleavage. Indeed, one of the trends in contemporary architecture is the so-called ecological architecture (or green/sustainable architecture) that aspires to bring nature into construction; bring nature back to the culture or even bring the exterior to the interior (Bech-Danielsen, 2005). The result of this type of architecture leads to the creation of intermediate forms, where space is a combination of both grey and green.

Mixed used zones and multifunctional strategies are at stake in Europe and elsewhere. They aim to competitively strengthen and reduce conflicts between urban and rural use. The concept “live, work and play” that has grown in popularity in urban planning lately is a good example of that logic. By concentrating on mixed used areas with a large range of activities, the line between urban and rural use is disappearing. Along with multi-functionality, we can also name the omnipresence of “sustainable development” as causing a change in ideologies. The resurgence of green in cities can also be seen as a result of increased concerns about health and an average increase of leisure time.

This brief overview of the change of space from a clear function towards a more complex and diverse reality limits our ability to define the features of urban green today. Nevertheless, for investigating land system changes, practical considerations have to be met, and therefore, urban green has to be considered in a pragmatic way, while acknowledging the limits of such an approach. The definition is adapted to the data used; thus it will change along the three part of the piece of work.

For the first part, as defined in Corine Land Cover (CLC) classification, there are two main types of green in cities: “Green urban areas” and “Sport and leisure facilities”, both of which fall in the category “Artificial, non-agriculture vegetated areas”. For the quantitative part, limited to land cover and use changes, the study will consider these two types of green defined by European Topic Centre on Spatial Information and Analysis (EIONET) in the CLC project as follows:
a) Green urban areas: areas with vegetation within urban fabric. Includes parks and cemeteries with vegetation.

b) Sport and leisure facilities: camping grounds, sports grounds, leisure parks, golf courses, racecourses, etc. Includes formal parks not surrounded by urban zones.[1]

For the second part, dealing with another set of data, Land Use/Cover Statistical Area Survey (LUCAS), two main land use classes from the classification 2012 will be taken into account:
a) Recreation, leisure, sport;
b) Unused and abandoned areas.

For the third part, which focuses more on land function, the definition is less strict. It first looks broadly at changes in urban green spaces as they are currently commonly understood and later focuses on two main types of urban gardens: traditional allotments versus urban gardening.

2.2 Land system: cover, use, and function

Although the literature defines land system in a number of different ways, it is understood here as an umbrella term that encompasses land cover, use and function (as previously defined in the research question). Distinguishing between these three layers is important for a full understanding of the changes happening at the regional scale of the territory.

Whereas land cover reflects physical characteristics of space, land use is related to the socio-economic use governed or limited by regulations (land management). To picture the difference, the land cover type “grass” can appear in any type of land use: pasture, urban parks, residential area, sports grounds etc. Also, it is rare to find homogenous land use with a single land cover, especially in urban areas. For example, a residential area can have grass, trees, asphalt and buildings (Fisher *et al.*, 2005: 89).

Interestingly, actual land use is not correlated directly with land use plans (land management). Indeed, in most European countries, there is an inconsistency between public and private law in land management: a plot can be classified as a building zone by public law but the landowner, who is protected by private law, is free to decide if and when he wants to build on it (Weber *et al.*, 2011). This creates a discrepancy between the designated and the actual land use (Ruegg, 2008). What is more, land use – besides the mismatch between zoning and real use – does not completely

[1] A more detailed explanation of these categories can be found in Annex II

reflect all functions that it provides or hosts. This is why it is important to start looking at “land function”, which is defined as intended or unintended goods and services (Verburg *et al.*, 2009: 1328).

Also, it is crucial to acquaint oneself with the differences between cover, use and function in order to meet adapted research methods. This is precisely the subject of an article published by Verburg *et al.* in 2009, which reflected on ways to improve land characterization (Fig. 3).

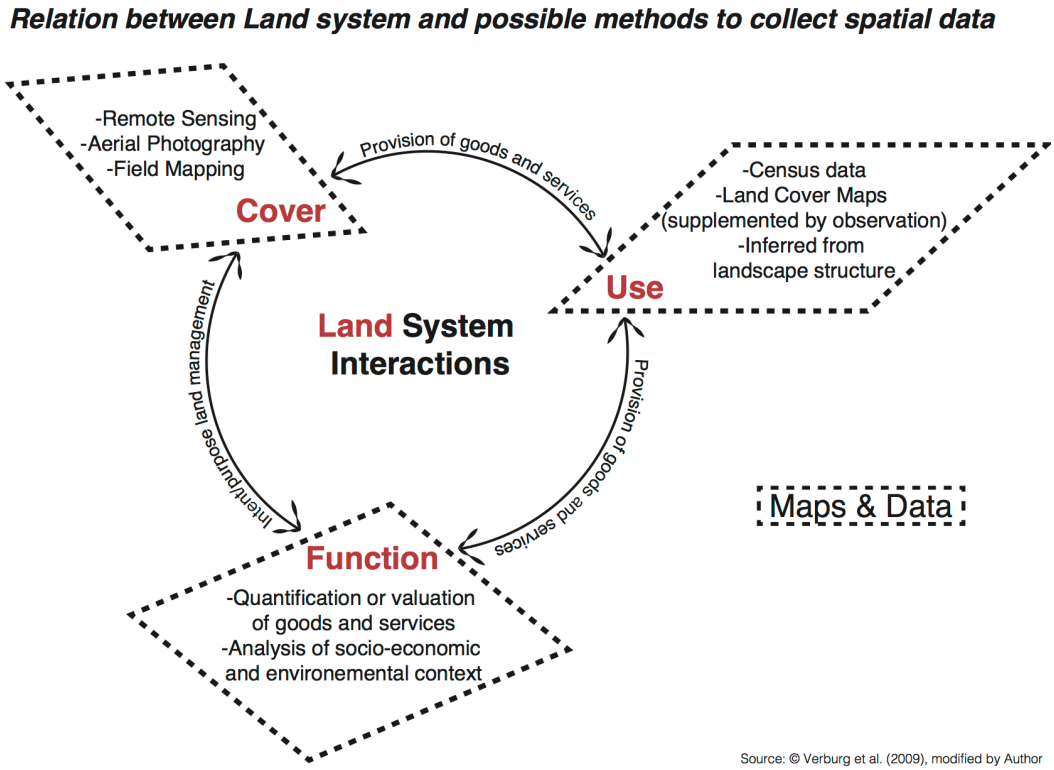

Fig. 3 – Land system interactions & methods to collect data [Adapted from Verburg et al., 2009]

This illustration summarizes the links between the land system’s features and the possible means (maps and data) to describe it. In their article, the authors also presented examples of projects mapping land functions, emphasizing the importance for further research and developing alternative ways to observe and represent land system changes.

Because of data availability, most of the works on land changes only focus on land cover from which land use classification is further assumed. Depending on the scale considered, this could lead to substantial errors in estimations. As Verburg *et al.* (2009) noted: “While agricultural statistics indicate strong decreases of agricultural areas these are, in many cases, not observed in data derived from remote sensing” (1328).

Finally, land functions such as recreation, biodiversity, landscape or ecosystem services that are not directly related to commodity production are therefore difficult to quantify (Verburg *et al.*, 2009: 1332). As cities are hot spots for both population density and socio-economic activities, there is an increasing complexity of land functions, especially in urban areas.

2.2.1 Land cover trends in Europe

In general, since 1950, cities have become less compact. While cities spread by 78%, the population increased only by 33%. This territorial dispersion is even visible in shrinking regions, where population is decreasing (EEA, 2006: 11). Further, in the same report the European Environmental Agency (EEA) stated that the growth of urban areas in Europe during the period 1990-2000 consumed 8,000km^2. This is equivalent to 25% of the total surface area used for agriculture, forest and natural land, or even more telling, the entire territory of Luxembourg. After 2000, the results described in the "State and outlook 2015" (SOER 2015) assessment on land systems are mixed. Although the general trends of annual land take seem to have slowed down during 2000-2006: the preliminary results for the period 2006-2012 are less positive. There is not only an increase in land cover change in general but also in artificial surfaces, which increased at a faster pace than between 2000 and 2006 (EEA, 2012). This process of land take is almost irreversible, especially since less than 10% goes the opposite way. In other words, only a small portion of land is "transferred from urban land into brownfields, and only a minor part of these are reclaimed for arable land use or nature" (Piorr *et al.*, 2011: 21). Interestingly, although urban areas and related infrastructure have increased in past decades, almost all cities also experienced an increase in green areas and parks. Nevertheless, it is important to acknowledge the following: "the current increase in green urban areas cannot replace the loss of natural land" (Lavalle, 2002: 60).

2.2.2 From land cover to land use

The two main sources of information for land cover and use at the European level are the Corine Land Cover (CLC) and the Land Use and Cover Area frame Survey (LUCAS) database. The European Commission initiated the CLC in 1985 and the first set of data was produced in 1990, the second in 2000, the third in 2006 and the last (still incomplete) in 2012. LUCAS started later but was released in more frequent intervals; the data exist for 2006, 2009 and 2012.

Whereas CLC provides information on mixed classification of land cover and use, LUCAS clearly distinguishes between the two. The CLC is composed of 3 levels of classification that facilitate different degrees of information. The first level contains 5

board classes (artificial areas, agricultural land, forests and semi-natural areas, wetlands, water surfaces); the second level encompasses 15 classes with a greater degree of detail; and the third level – the most detailed – has 44 classes. LUCAS uses the same hierarchical class logic but only for the land cover with 8 main classes and not for land use that is classified separately. A detailed comparison of the two datasets will be presented in the *Part II* of the results.

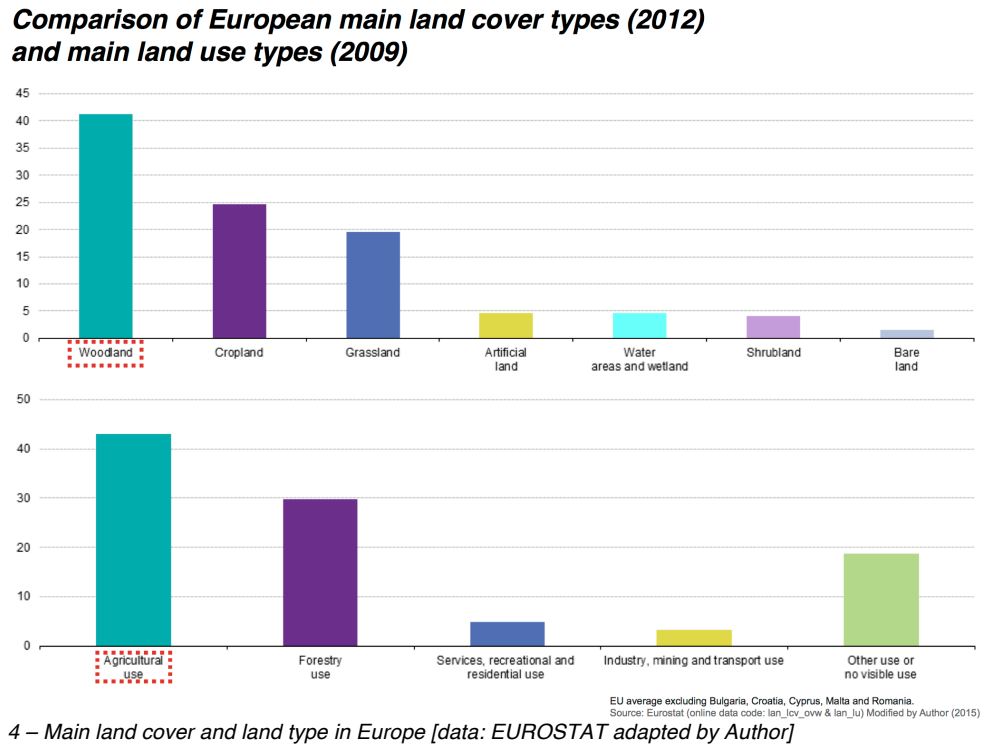

Fig. 4 – Main land cover and land type in Europe [data: EUROSTAT adapted by Author]

As defined earlier, land cover represents the biophysical features of the land whereas land use described the socioeconomic usage of the land. On the one hand we can see that the two elements are strongly connected because biophysical coverage frames the way socioeconomic use develops. The reverse relationship also exists: socioeconomic uses of a given land impact the way biophysical coverage changes. On the other hand it is important to note that the uses do not necessarily match the coverage. Indeed, the comparison of the main land cover types with the main land use types in Europe (Fig. 4), shows that mismatch on a macro scale. According to EUROSTAT, the main land cover type in 2012 was “Woodland” representing about 41% of the total EU-27 territory, followed by “Cropland”, which accounted for 24%. With respect to land uses, the main land use in 2009 was “Agricultural” reaching 43% and the second was “Forestry”, representing about 30%. Although the data are to be compared with restraint because of the year and area differences, they still demonstrate a general trend showing the discrepancy between cover and use, as “Woodland” is the main cover but “Agricultural” is the main use.

In practice, at a European scale, land use is often derived from land cover data. The latter is the result of a certain classification based on certain selected criteria that change with time, as they are adapted to inconstant understandings of territorial patterns. National or regional data are often much more accurate as they are produced with lower spatial resolution and with a higher degree of knowledge on the place (Diaz-Pacheco & Gutiérrez, 2014). Nevertheless, these locally produced data are not comparable as they encompass singular categorizations.

2.2.3 Land functions of urban green areas

The question of urban green functions is rather recent and is studied by a wide range of disciplines. As a result, the discourse is diverse and far from being consistent. In this research based on Verburg *et al.* (2009), urban green functions can be described as actions and effects on vegetation that result in direct or indirect benefits for citizens and for the urban environment. Cities are human creations and have tried to respond to the needs of the population throughout their history. Green spaces emerged to improve the quality of life in urban areas, responding to changing attitudes and shifts in common social values. This explains why green spaces have taken different forms according to places and times.

As Gómez-Gonçalves (2013a) states in his doctoral thesis on urban green, most works analyze a single function according to the author's field of research, ignoring aspects beyond his or her conceptual domain. However, the texts that address various functions of urban green do so from a multidisciplinary perspective, drawing on research conducted by specialists in various fields. Further, in his literature review, Gómez-Gonçalves identified more than a dozen functions of urban green including the ecological-environmental, social, economic, architectural, landscape, urban, multidimensional, health, recreational, aesthetics, psychological, satisfaction of basic needs, symbolic and educational. These categories are numerous and in some cases redundant. In truth, many of them could be subsumed within the social function category. On the other hand, reducing the categories often leads to simplification by using the three generic sustainable development pillars: social, economic and environment. Unfortunately, since this study includes many aspects of the land system, it only provides a general overview of the function and therefore will rather focus only on the social functions of green areas.

Today the creation of green spaces has become a social demand; people place a high value on green spaces, because they are conscious of the profits they generate. Urban green takes on considerable importance and becomes necessary for

coexistence and welfare of citizens – elements that the literature deems social functions (Gómez-Gonçalves, 2013a). These are defined as actions resulting from the presence of green spaces that directly affect the social life in the city (Lee & Maheswaran, 2011). The urban environment is generally a stressful environment for citizens, as opposed to the contact with nature, which promotes relaxation, tranquility and psychological well-being (Maller *et al.*, 2005). Green helps reduce stress, which is known as an individual response to a situation that disturbs a person's welfare. As people come into contact with vegetation in the city, a remarkable decrease in stress occurs (Grahn & Stigsdotter, 2010). Public green areas play an important role in improving human relations by providing places where people can develop social ties. They are democratic places, where no distinction of any kind is made, and they restore social balance by creating a feeling of equality between different users (Tzoulas *et al.*, 2007). Therefore, green areas contribute to both social inclusion, by allowing interaction between different people and the generation of personal benefits by increasing self-esteem or self-worth (Lee & Maheswaran, 2010). Contact between people of the same neighborhood improves the relationships between individuals (Tzoulas *et al.*, 2007) and fosters a sense of belonging and identification within a community (Kazmierczak & James, 2007). Thus, urban green becomes a backbone of neighborhoods, improving living conditions and fostering social interactions.

2.3 Green and the urban land system

2.3.1 Historical overview

As described by Nicholson-Lord (2003) in his book "The Greening of the Cities", the relation between the city and the green during the history of urban expansion varied from admiration to disregard, later to negligence and back to protection. The latter first materialized by the so-called green belts implemented in most large European cities of the time in the very beginning of the 20th Century as a countermeasure to rapid population growth due to industrialization (Amati, 2008). According to Kühn (2003), the original functions of green belts were the following: "(…) controlling further urban growth, in avoiding the merge of cities into each other and in separating the typical characters of town and countryside" (20). Later, other regulations were introduced in most European states to protect the land from destruction. Containment policies, preservation planning and zoning are generally evaluated favorably, but they are also criticized because they place developments far from the city cores, which create an additional pressure on the cities (Shoard, 2002; Robinson, 2004; Gallent, 2006; Glaeser, 2009). Some land use regulations are also criticized for their inability to address "small-scale functional transformations beyond physical land cover changes" (Zasada, 2011: 645). According the Kabisch & Haase (2013), there is "an overall

increase in urban green spaces from the year 2000 to the year 2006, while the data reported nearly no change between the year 1990 and the year 2000" (213). Nevertheless, today, in some cases the protection of green areas around the city seems to draw less attention than the creation of new urban green areas in the centers.

2.3.2 Greening today

It is important to distinguish existing "natural" green areas from the new urban green that take place on surfaces classified as "artificial". Although the borders between the two are often blurred, it is possible to identify the difference between an urban park designed for users with a certain number of infrastructures and a protected natural park. In practice, there are green areas ranging from one extreme to the other. The distinction between "natural" green and non-natural green is even more difficult today with the growing number of urban green activities that take place not only on the ground but also on roofs or walls. These new forms of urban green suggest a new reality: green does not only take place on soils. For instance vertical green won't have a direct impact on the land cover or building's main use but could diversify its function by adding a new component to the building.

2.4 Density and greening

The research and academic works related to the debate between the compact and the sprawling city are abundant (Moliní & Salgado, 2012: 1077). Although both intrinsically contain advantages and disadvantages, a majority of works advocate for high urban density. It is generally considered more sustainable because it reduces carbon emission and has less impact on the land (Glaeser, 2009). Indeed compact cities are often seen as the most environmental-friendly urban settlements today. However, while the term compact city is relatively precisely defined, the notion of density on which it relies is a broad term. It encompasses various forms and can be expressed in very different ways leading to different meanings: population density, residential density, dwelling density, spatial density etc. This list is worthy of further in-depth analysis, but such an analysis is beyond the scope of this work. Rather, only two types of density indicators will be considered in the empirical part: population density and soil sealing.

2.4.1 Density helps or blocks urban greening?

There are numerous works suggesting that, in general, green spaces per capita decrease as the population density increases, but this was never fully tested. Indeed, the discrepancy between urban area changes and selective housing density changes

in some parts of the city is complicated to measure. According to Gaston & Fuller (2009), who compared changes of urban green in 386 European cities, the decrease of green spaces per capita is more due to “people being packed into the urban matrix, than buildings replacing existing green spaces” (354). Further, Kabisch & Haase (2013), also comparing urban green in 202 European urban areas, reached interesting conclusions “a decrease in population does not automatically lead to a decline in residential areas and a subsequent increase in urban green space on a large scale” (113). Additionally, in the context of discussing the United Kingdom as an example of the most densely populated part of Europe, “population density and proportion of cover by urban green space are uncoupled” (354). Burton’s (2000) results led to similar conclusions but focused more on access than cover. Specifically, Burton found that “access to green space is only weakly related to compactness” (1982).

High population density can be both an opportunity and a challenge for urban greening. It is an opportunity where there are high numbers of inhabitants per square kilometer but low soil sealing, for example, in areas with high constructions. On the contrary, it can be a challenge in a context of a high number of inhabitants per square kilometer and a high rate of soil sealing, as for instance, in dense residential areas.

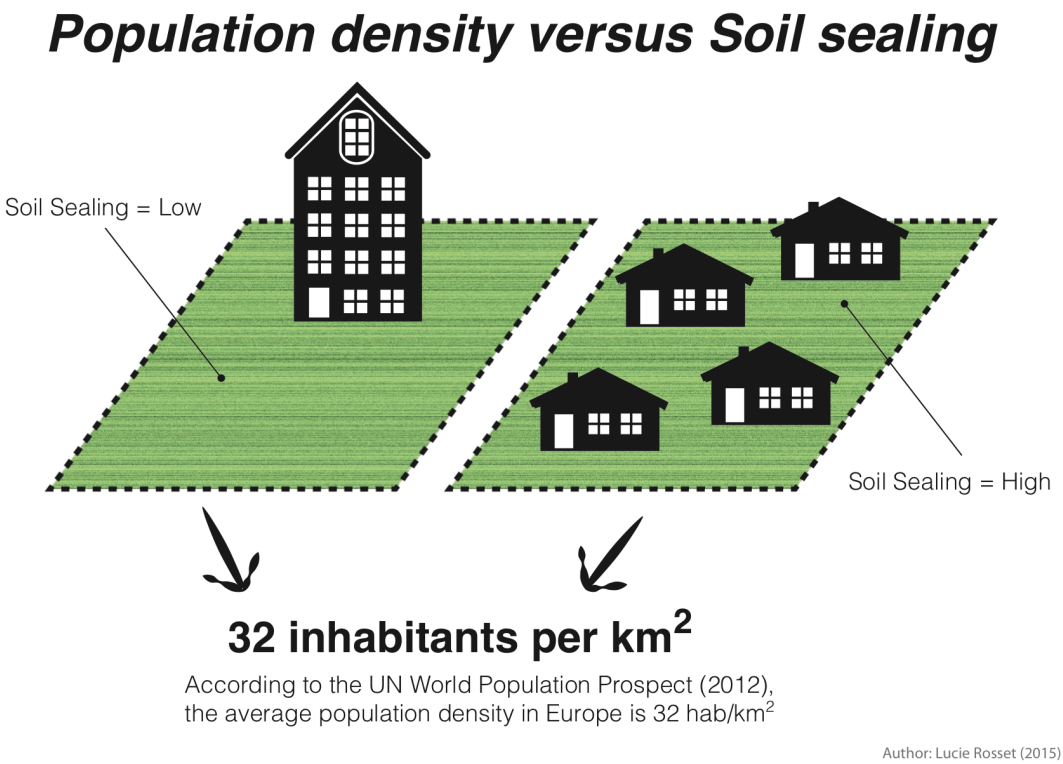

Fig. 5 – Different ways to measuring urban density [data: UN, created by Author]

Figure 5 illustrates the difference between population density and soil sealing. In both fields, there is a density of 32 inhabitants per square kilometer but it is clearly visible

that one field is less covered by impermeable surface than the other and therefore would potentially offer more opportunities for greening. In theory, it is easy to understand the difference between these two stereotypes, but the reality is often much more complex.

2.4.2 Urban greening and its effects on density

Some people argue that urban greening can have an overall negative impact by reducing population density and therefore enhancing urban dispersion. As Mok *et al.* (2014) argued recently, urban agriculture could lead to reducing population density in some cases. This argument closes the viscous circle previously discussed – i.e., while intuition suggests that population density can reduce urban green, urban green can lead to a reduction in population density.

To conclude this section on density and greening, there are two important points to take away. First, although density can appear and be measured in various forms, only population density and soil sealing are taken into account in this study. Second, density and green are mutually related, but only weakly, because there are many other factors that also affect their relationship, including: environmental features, political decisions and socio-demographic dynamics. The next section will consider the latter and its impact on urban green.

2.5 Socio-demographic dynamics and greening

This section explores some links between socio-demographic dynamics and green. Again, it will not provide a full understanding of the relationship between the two elements but enhances a broad reflection. As opposed to growing, the wording "shrinking"[2], describes urban areas experiencing economic and/or demographic decline. The expression "and/or" suggests that one can occur without the other but also that there is a two-way relationship between the economy and changes in population. Economic decline often correlates with population decline and vice versa.

2.5.1 Growing versus Shrinking: the state of urban regions in Europe

In the history of most cities there are periods of growth and others of decline in terms of economy and demography. In Europe although regional differences exist especially between Western and Eastern Europe, paths are similar. Due to deindustrialization,

[2] The term shrinking or *Schrumpfende Stadt* in German emerged for the past decade to describe the process of counter urbanization especially in both American post-industrial cities and European post-socialist cities.

private motorization and increased mobility in the mid-twentieth century, there was a general trend of economic and population decline in cities, a process known as suburbanization or deconcentration. Later, together with the process of reurbanisation, cities again became hot spots for population and socio-economic density. According to Turok and Mykhnenko (2007), analysis for the period 1960-2005 "the growth of European cities has generally slowed" (165). Moreover, especially because of the economic crisis, a particular phenomenon has been affecting Europe for the past few decades: two-speeds developments, in which there are clearly growing and shrinking regions. Despite the creation – already 1975 – of EU cohesion policy, which was implemented by the European Regional Development Fund (ERDF) and aimed at addressing theses gaps between regions, significant differences still persist. The opposite realities between growing and shrinking regions have a significant impact on the future of territorial organization and therefore should be considered by urban planners.

2.5.2 Opportunities and challenges for green areas in shrinking regions

> *« Demographic change and spatial polarization tendencies in Europe will contribute to an increasing number of cities affected by shrinking processes in the near future, though, which makes it ever more necessary to search for and exploit the chances of urban shrinkage, instead of continuing to fight against this process." (Knoop, 2014: 1)*

In Europe, as well as all over the world, the spatial distribution of the labor market is not homogenous: some privileged regions experience growth, while others simultaneously are shrinking. This is a known reality, but until the recent wave towards exploring innovative ways for cities' successful shrinkage (Hollander, 2011; Bontje *et al*., 2012; Großmann *et al*., 2013; Luescher & Shetty, 2013), urban planning and its main tools – land use regulations – were fostered by and created for growth (LaCroix, 2010). Additionally, most of the works that discuss shrinking cities focus on either the United States or Germany; there is a clear lack of research on planning shrinking cities in other parts or the world. Indeed as Martinez-Fernandez *et al.* (2012) acknowledged, urban shrinking "is now global and multidimensional – but also little understood in all its manifestations" (213). Further, according to the same source, Shrinking Cities International Research Network's (SCIRN) set forth one explanation for shrinkage that is particularly interesting with respect to the instant research on MSUA. SCIRN argues that shrinking occurs partly because larger, so-called "global cities" are draining most activities and specialized work forces, thus leaving smaller urban areas with less potential for growth.

Urban gardens and the rise of urban green in general exist in both shrinking and growing cities, but the way they develop and the location of the plots dedicated to green tends to be different. For example urban agriculture is located mainly in the periphery of the growing regions whereas in shrinking cities it can reach central locations in neighborhoods experiencing strong decline. Demographic and economic decline is reflected in the urban fabric by abundant vacant space because of the lack of strong market demand. Vacant space offers opportunities for urban green. Indeed, some even take this fact to argue that "green urbanism strategies" could be easier to implement in shrinking cities than in growing ones (Hollander *et al.*, 2009: 18). Others however, posit that population decline does not necessarily mean a decrease of the built environment (Kroll & Haase, 2010, 728). Additionally, shrinking regions lack resources to create or maintain public infrastructures (Hollander *et al.*, 2009: 17). To sum up, vacant space has potential for urban greening but the lack of funding presents a clear challenge.

2.5.3 Who invests in greening the cities?

Cities are key stakeholders in stimulating, planning and investing in green infrastructures (Merk *et al.*, 2012). But cities often have to apply for grants by competing within their national redistribution system. According to Giffinger *et al.* (2007), before the changes of European Structural and Investments Funds (ESIF), most institutional systems of redistribution disproportionally fostered larger cities than smaller ones. MSUA needed to lobby and compete for public funds within their institutional contexts. Since 2007, the funds are mainly focused on deprived regions with a strong emphasis on the creation of strategic plans. Whereas certain regions are accustomed to strategic planning, it is completely new for others, especially in Central and Eastern Europe where planning was centralized during the communistic era (Földi, 2014). Strategic planning is mid/long term planning that typically has the following elements: a vision for the future, multiple stakeholders, political compromise and a focus on certain objectives. Strategic management, on the other hand, targets actions for implementation, monitoring and evaluations. In most shrinking regions, the main motivation for creating strategic plans is to obtain EU funding for urban development.

Besides public funding, the practices of Public-Private Partnerships (PPP) or Tax Increment Financing (TIF) are popular, especially in shrinking regions where public institutions lack financial resources (Merk *et al.*, 2012). Since nature became viewed as a new commodity in which to invest, there are more private stakeholders involved in the preservation or creation of green spaces. In general, growing cities are more likely to find both public and private investors for green space than shrinking cities.

The various arguments presented in this chapter "Literature insights and rationale" discuss numerous works on urban green in European cities from various perspectives. There is no comparative research on how density and socio-demographic dynamics are influencing the way urban greening is developing and changing the land system patterns. According to Kasanko *et al.* (2006): "European urban land use and population trends have inspired less research during the past years" (112). Further, they examine three possible reasons why there is a low interest in comparative studies at the European level. First, the relative territorial stability of European cities compared to other parts of the world can be perceived as a reason for the lack of interest. Second, urban policies at the European level are weaker than national policies that are more likely to enhance tangible research. Third, a more technical issue, beside the difficulty of collecting them, available data are hardly comparable because of the variety of sources. (Kasanko *et al.*, 2006: 112).

To close this chapter and before presenting the methodological aspects of this study, I would like to underline some key points discussed above. First, the definition of urban green is purposely inconsistent throughout the research in order to adapt to an interdisciplinary approach. Second, the land changes can be described by the land system, an umbrella concept that encompasses three levels: cover, use and function. Third, urban green is not set in stone; it differs with the context and time. Fourth, density can be expressed in various forms; this work only considers population density and soil sealing. Fifth, the relationship between population density and urban green is bi-directional but empirical findings show only a weak or no relation between the two, suggesting a multifactorial approach. Sixth and last, I argue that socio-demographic dynamics are one of the factors playing an important role in the way urban green develops and will develop.

3. DATA & METHODOLOGY

The proposed research is anchored in various disciplines, the methodology is inspired by Verburg *et al.* (2009), and as described earlier distinguishes among three levels of the land system: land cover, land use and land function.

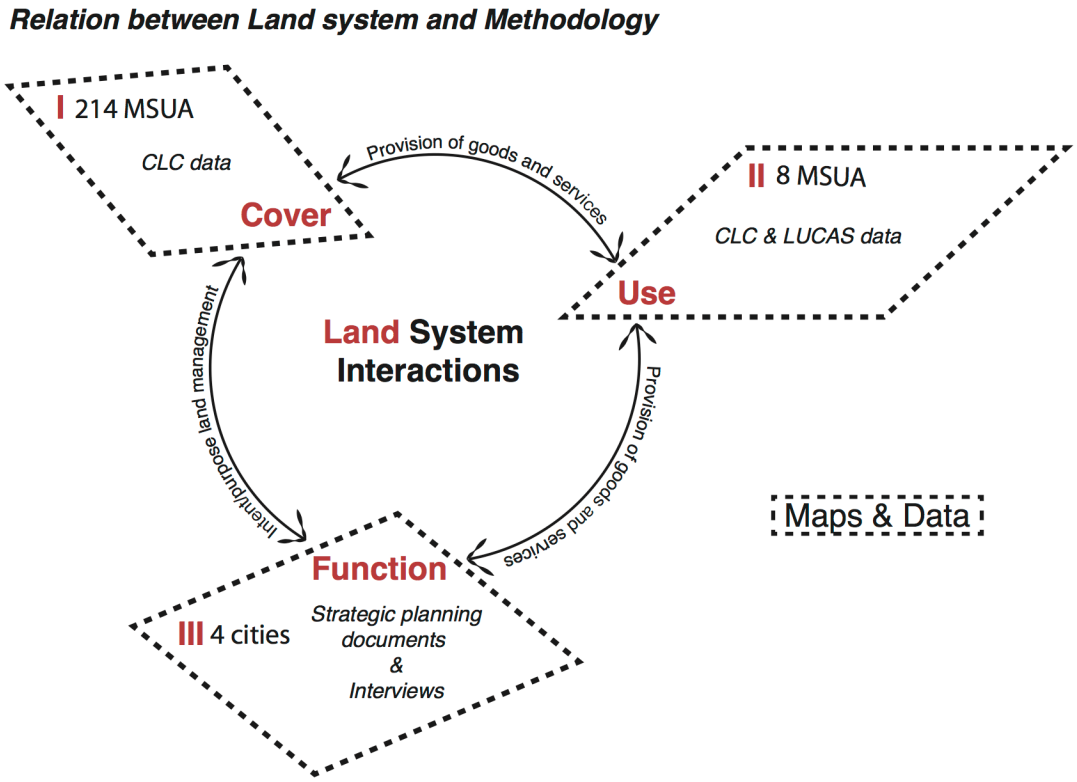

Fig. 6 – Methodology illustrated through the land system [Author based on Verburg et al. (2009)]

As Figure 6 shows, three levels structure the methodology. The first two parts focus on land cover and use based on Corine Land Cover (CLC) and Land Use and Cover Areas Survey (LUCAS) data. The third part, based mainly on interviews and strategic plans, considers the land functions in four shrinking cities.

3.1 Part I

The very first step of this part was the selection of the case studies. They were selected on the basis of the OECD classification of Medium sized urban areas (MSUA) published in 2012. From a sample of 228 MSUA listed by OECD, the sample was reduced to 214 because of compatibility concerns, when comparing the MSUA to NUTS 3 regions (more details in Appendix I)

A statistical analysis of the sample of 214 European MSUA was carried-out. These regions were classified according to their density and socio-demographic dynamics into the 4-class Typology Model presented in the introduction. The indicators used for this purpose were the following:

- For urban structure: population density in 2012 (except Zwickau DED45 2011) and soil sealing 2006 (Norway: data missing; Switzerland: data 2009)

- For socio-demographic dynamics: Growth Domestic Product in Purchasing Power Parity (GDP-PPP) 2004-2008, unemployment rate 2009 and population change 2007-2011

Some remarks concerning the data are needed. Soil sealing is expressed in square meters per inhabitant. Although not completely satisfactory, GDP-PPP is still one of the main economic indicators used because of a lack of viable alternatives. Unemployment rate is used as both an economic and social indicator; but one has to bear in mind that it does not consider immigration and therefore it can distort reality. Population change sums up both, natural balance and net migration. The latter aspect, as it is selective, is more relevant for rendering city economic dynamics. Finally, the dates of the data vary because of data availability. (More details in Appendix III)

As a further step, an analysis of the land use changes for 2000-2006 was carried out based on Corine land use (CLC) data. The analysis is only focused on two main categories: green urban areas (141) and sport & leisure facilities (142)[3]. The method for comparing the changes in urban green was the aggregation of single plots changes in each of the 214 NUTS 3 regions. The results show whether the urban greening trends are visible on the land system of European MSUA and enabled us to test the validity of the assumption made in the 4-class typology. The first part focuses on quantitative analysis based on both descriptive statistics and remote sensing images. This provides a good overview on the structure of European MSUA as well as the changes of their land cover (and induced land use) with a particular attention to green areas. The results lead to the selection of 8 case studies for further investigation.

Limits of CLC data

The CLC data is the main existing tool for analyzing territorial changes on a European scale and was largely used by policy makers, urban planners and researchers. Although applied positively for many purposes, the degree of accuracy and the quality of the data have been questioned lately (Diaz-Pacheco & Gutiérrez, 2014). For example, the relatively low spatial resolution can lead to the underestimation or even the total omission of small-scale developments thereby masking the suburbanization process or omitting abandoned land. Also, “for local approaches CORINE 2000 cannot provide a meaningful database” (Siedentop & Meinel, 2004: 8). Data from 1990, 2000 and 2006 are available to the public[4], but data for 2012 are not available yet because

[3] 141 and 142 are codes used in the CLC classification

[4] Here the public could be called « expert public » as the data are only available in GIS format; this requires not only some skills but also access to the programs that the public at large does not usually have.

national corrections are still being processed (in 2015). This creates a time lag, as the data on the changes are published and understood with a delay of a few years.

3.2 Part II

Considering LUCAS helps to obtain a better understanding of the land system changes. The main aim of the second part is to complete and challenge the results from the first part by considering another type of data: LUCAS (2006, 2009 and 2012). This data is relatively new and its data collection is unconventional as it relies on observation by surveyors on the field. This explains why there are very few studies based on it. Therefore, this part will consider an innovative approach. The idea is to experiment possible way to explore what information is provided by LUCAS data and how it relates to CLC data. This part uses mixed qualitative and quantitative methods and will consider the following categories:

- U360: Recreation, leisure and sport:
  - U361: Amenities, museum, leisure: "Areas utilized for cultural purposes, amenities and leisure, recreation, amusement and show activities"
  - U362: Sport: "Areas utilized for sport activities"
  - U364: Nature reserves[5]
- U400: Unused and abandoned areas

3.3 Part III

This part focuses on urban green functions considering only the four core cities of the shrinking regions selected for part II. Since the research on land functions is relatively new, there is no agreed methodology. We propose a qualitative analysis of both strategic planning documents and interviews. The strategic planning documents are the following:

- Salamanca: *Tormes+, Estrategia de desarollo urbano sostenible 2015-2020* (published in septembre 2014)
- Metz: Metz 2030, *une ville attractive, durable et solidaire* (published in July 2013)
- Magdeburg: *Integriertes Stadtentwicklungskonzept der Landeshauptstadt Magdeburg 2025* (published in August 2011)
- Szczecin: *Strategia Rozwoju Szczecina 2025* (published in December 2011)

[5] This category exists only in the classification of 2009.

In total, 16 informal interviews were carried out during June and July 2015 with key stakeholders from public bodies, private planning sphere, academia and civil society at large. The complete list of interviewee is available in Appendix V. The interviews were informal in the sense that there was no systematic matrix of questions. Also the interviews were not recorded and therefore no transcription is available. The results are presented in the form of a discussion based on notes taken during the interviews or additional information provided by the interviewees per email.

Finally, the sum of the three parts using mixed methods, should give a full overview of the land system changes related to urban green. This will enable us to reflect on the validity of the assumptions that urban greening has different impacts on land system change according to the density and socio-demographic dynamics of a given urban area.

4. RESULTS

4.1 Part I – Urban green changes in European MSUA

This part aims to provide a general overview of the urban green changes in European MUSA. Based on Corine Land Cover (CLC) data for 2000-2006, the analysis of changes is handled through the use of the 4-class typology.

4.1.1 Applied 4-class Typology Model on European MSUA

As a first step, 214 NUTS 3 regions were classified into 4 typologies according to their structure (low or high density) and socio-demographic dynamics (shrinking or growing) into 4-class Typology Model (see chapter 1).

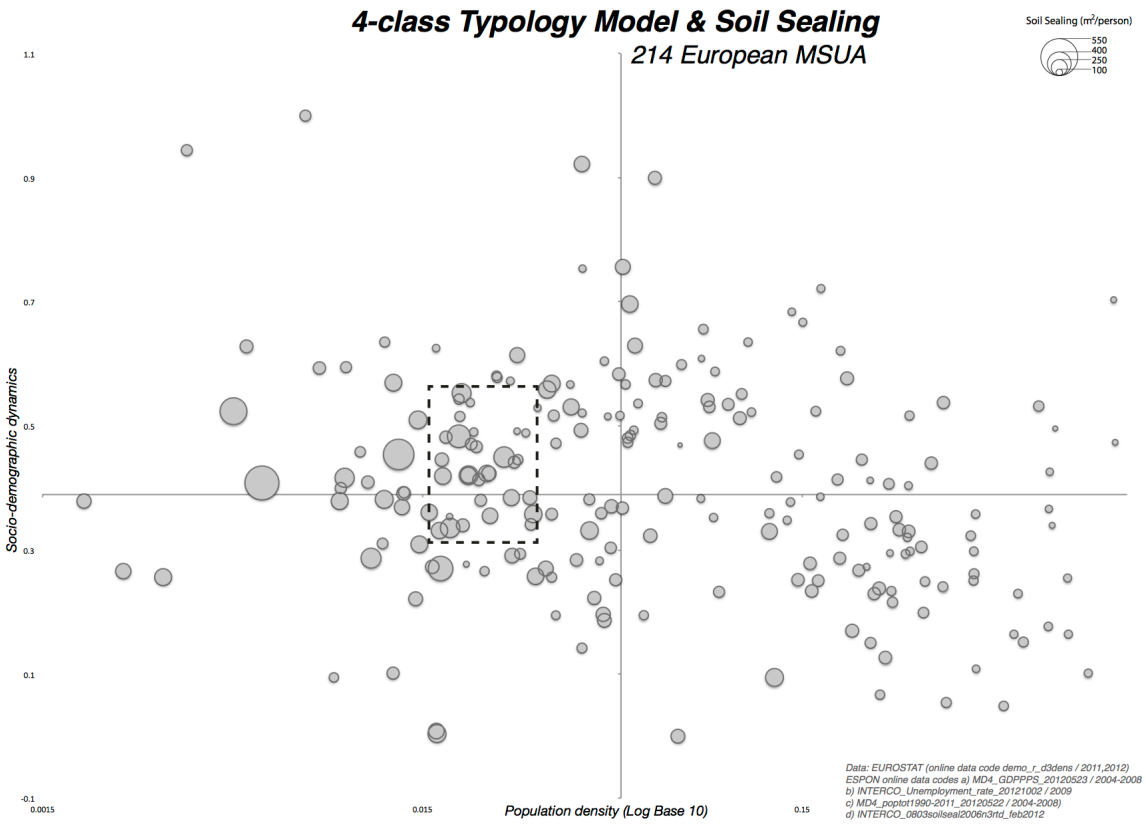

Fig. 7 – Applied 4-class typology to European Medium-sized urban areas [data: EUROSTAT & ESPON, created by Author]

Figure 7 shows the 214 European MSUA under the 4-class Typology Model. In addition, the soil sealing is represented by the size of the dots (see corresponding urban regions listed in Appendix III). First, it is important to note that for visual acuity, the population density on the X-axis is represented in logarithmic scale (base 10). The scatter graph shows a relatively uniform distribution of the NUTS 3 regions with few outliers. Interestingly, the area of the graph surrounded by a rectangle contains a high concentration of regions with relatively low density as well as socio-demographic dynamics close to the median and soil sealing that exceeds the European average[6], of between 180 and 350 square meters per person.

[6] According to a European Commission (2012) report, the European soil sealing average was 200 square meters per person in 2006.

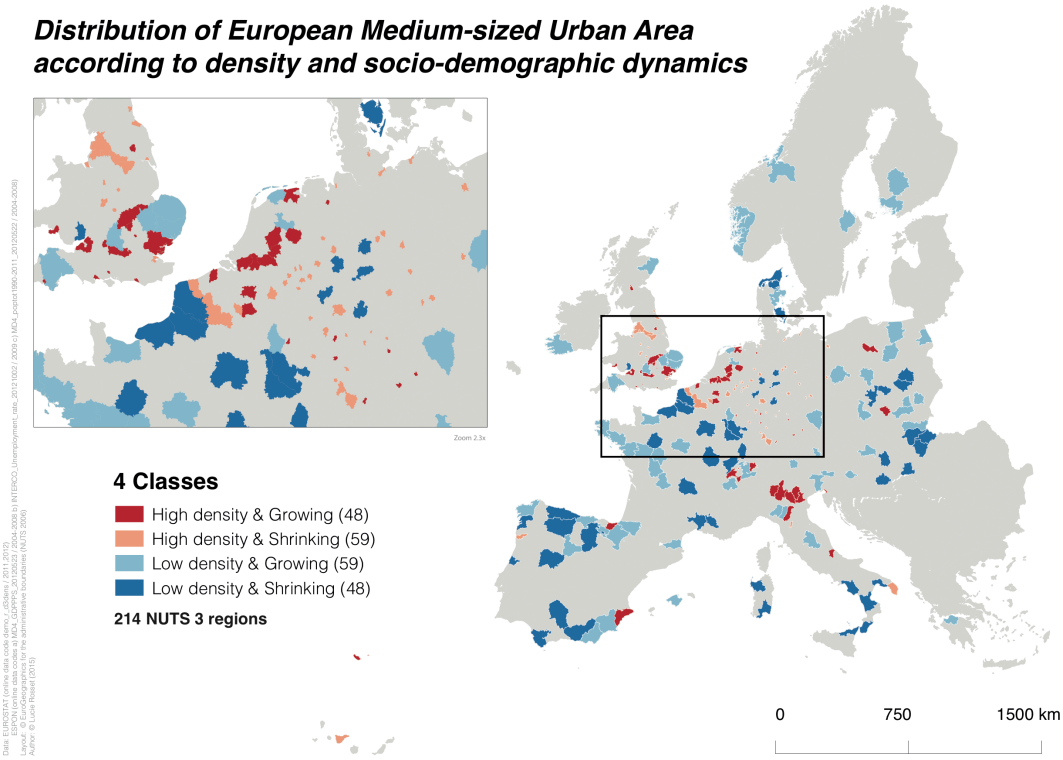

Fig. 8 – Spatial distribution of the 4 typologies in European MSUA [data: EUROSTAT & ESPON, created by Author]

The map above (Fig. 8) shows the MSUA in the same 4-class typology but also shows the regional trends. To begin with, we see that the NUTS 3 regions are not proportional. As discussed shortly in the methodology, NUTS 3 regions are based on existing administrative subdivisions and their population is supposed to fit within the range between 150,000 and 800,000 inhabitants. Indeed, most of the regions in the United Kingdom, Belgium, the Netherlands, and Germany are very small and even difficult to see on the map. It is not surprising that these regions are geographically located in the so-called blue banana[7], the heart of highly urbanized Europe from northern England to northern Italy. But rather unexpected is that most of them are in the shrinking category, as more than 86% of the class “high dense & shrinking” are German (58%) and British (28%) regions. The explanation for that can be found in the Shrinking Cities International Research Network’s (SCIRN) argument that shrinking cities do so because of the surrounding global cities attractiveness that host most economic activities. Although there are probably many factors at play SCIRN’s argument fits particularly well in this research as MSUA have small core cities and can be easily impaired by larger urban areas.

[7] The French geographer Roger Brunet developed this concept in 1989.

As for other regions in France, Southern & Eastern Europe and Scandinavian countries that are rather classified as “low dense” no particular pattern for socio-economic dynamics is visible except a light trend following the traditional dichotomy between growing north and shrinking south.

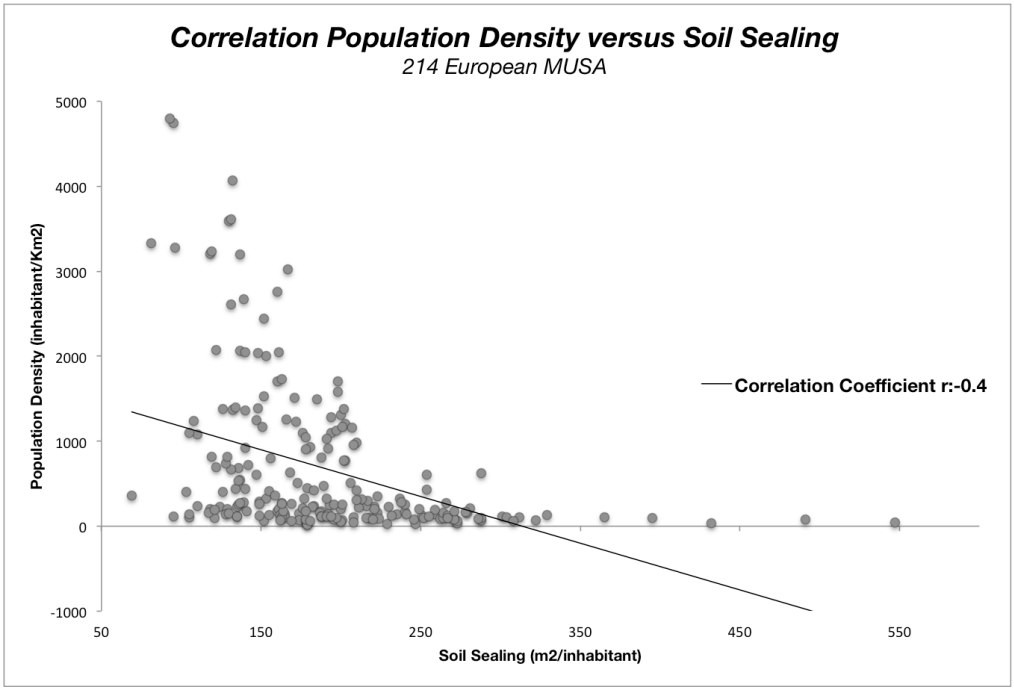

Fig. 9 – Correlation test between population density and soil sealing. [data: EUROSTAT & ESPON, created by Author]

Based on the scatter graph and the map (Fig. 7 & 8), one topic that requires further testing is the correlation between population density and soil sealing. As Figure 9 shows, population density and soil sealing are slightly negatively correlated. The negative relation follows intuition, when population density is high the impermeable surface per inhabitant is low. Nevertheless, the correlation between the two is rather weak with a correlation coefficient of -0.4. The crucial point to understand about this minor correlation is that the differentiation between population and built density is relevant for researching on the potentials for urban green.

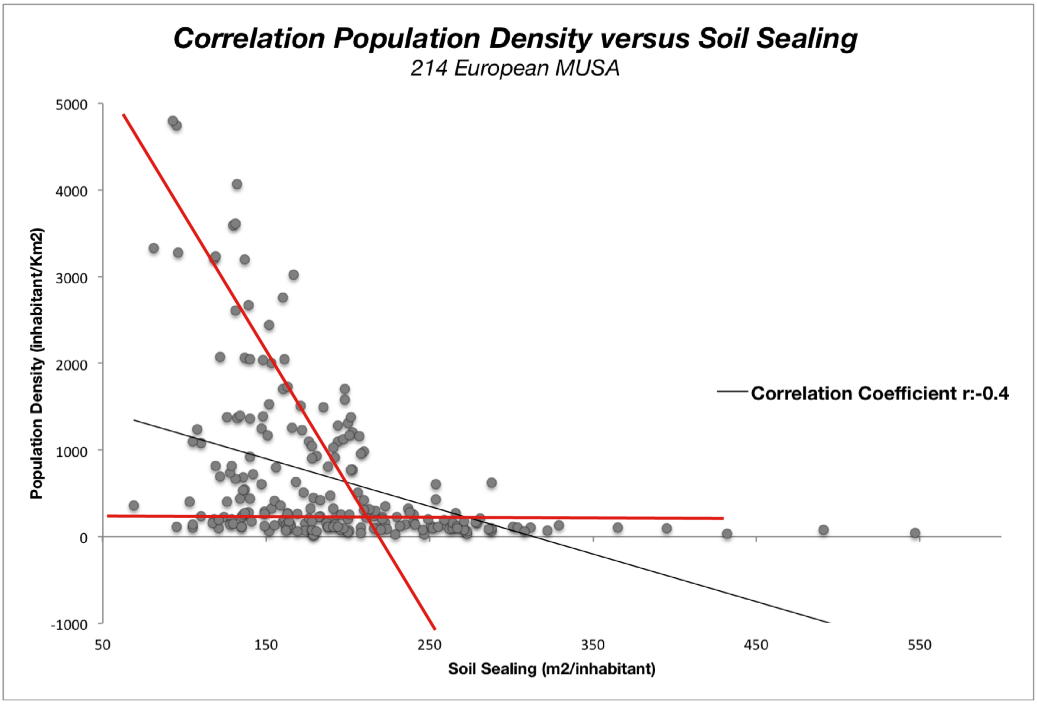

Fig. 10 – Two opposed trends in the correlation. [data: EUROSTAT & ESPON, created by Author]

Further, the Figure 10 shows the same graphs but the red lines outline two major opposite trends, very high correlation and no correlation at all. Figure 11 gives a more detailed view, highlighting 20 regions accounting with high correlation and 20 regions with no correlation using different colors. It clearly appears that in urban regions in Germany and the United Kingdom the correlation between population density and soil sealing is strong. On the other hand, this correlation is not true for urban regions in Spain, Italy, France, Hungary, Poland and Scandinavian Countries. The table accompanying the graph (Fig. 11) with the 40 highlighted regions shows that the two opposite trends are related to the disproportional territorial sizes of NUTS 3 regions. Indeed, whereas the median size of the 20 correlated regions is less than 100 square kilometers, the size for the 20 non-correlated regions is about 100 times bigger, reaching more than 10,750 square meters. In other words, most of small NUTS 3 regions show a high population density and a low soil sealing whereas most of the large NUTS 3 regions have a low population density and a rather high soil sealing.

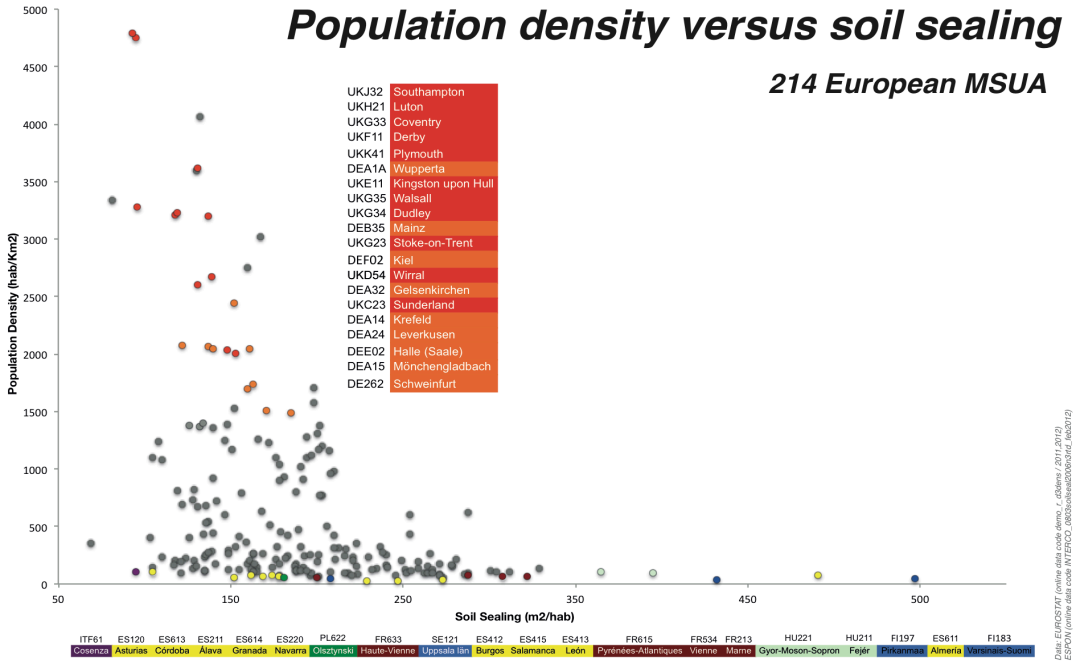

Fig. 11 – Regional distribution of the correlation's opposed trends. [data: EUROSTAT & ESPON, created by Author]

This section presented the 4-class Typology Model applied to a sample of the 214 European MSUA. The description of the classification as well as the analysis of the correlation between population density and soil sealing shows that the application of this model has important drawbacks especially because of territorial entities for which data are displayed at the regional level (NUTS 3). As no alternative solution was found to deal with this issue, the analysis of the land cover changes will follow that imperfect classification.

4.1.2 Land cover and use changes in European MSUA

The 4-class Typology Model was refined with Corine Land Cover (CLC) data with a particular attention to the changes in the period 2000-2006 of two types of land uses in the category "Artificial, non-agricultural vegetated areas":

1) Green urban areas (141)
2) Sport and leisure facilities (142)

(See detailed description of these classes in Appendix II)

These two classes when summed up will be considered as a new class named "Urban green". A detailed analysis of the changes enables us to outline trends on land use changes in European MSUA concerning the two categories mentioned above (141 and 142).

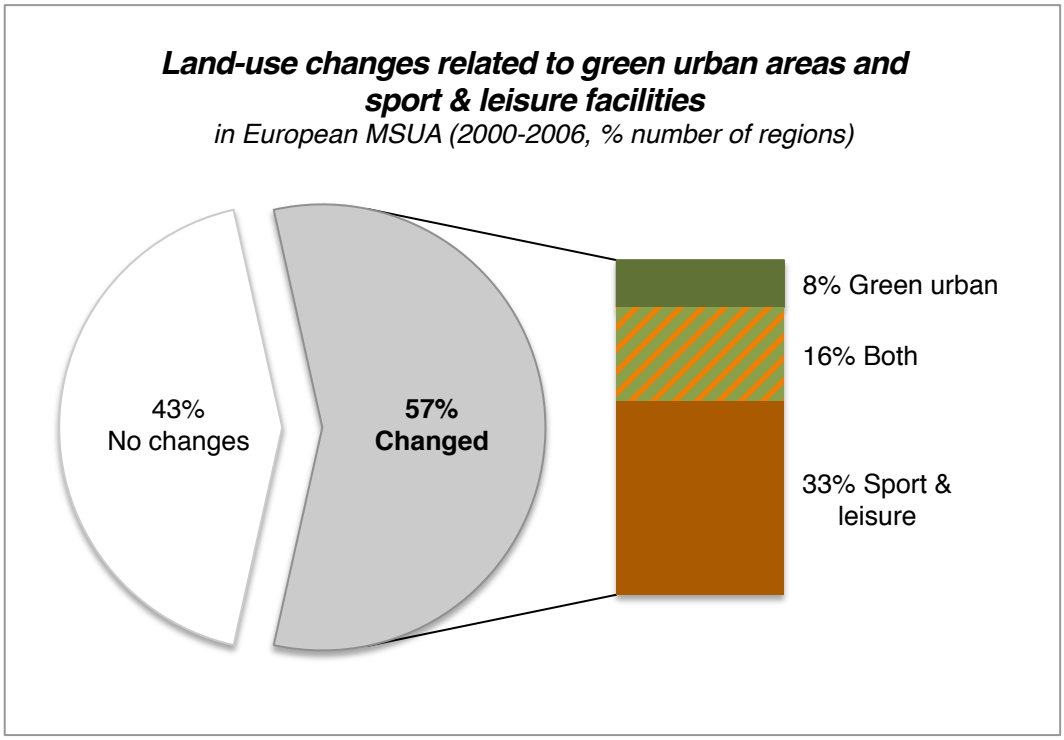

Fig. 12 – General overview of territorial changes (expansion and reduction) related to green urban areas and sport & leisure facilities [data: EEA, Corine Land Cover (CLC), created by Author]

First, during the short six years period, territorial changes related to 141 or/and 142 occurred in 121 regions, representing about 57% of the 214 MSUA analyzed (Fig. 12). While 70 regions, or approximately one third of the total sample, registered a change implying only sport & leisure facilities, 35 regions had a change in both green urban areas and sport & leisure facilities. Finally, 16 regions representing about 8%, only transformed their green urban areas during the period 2000-2006.

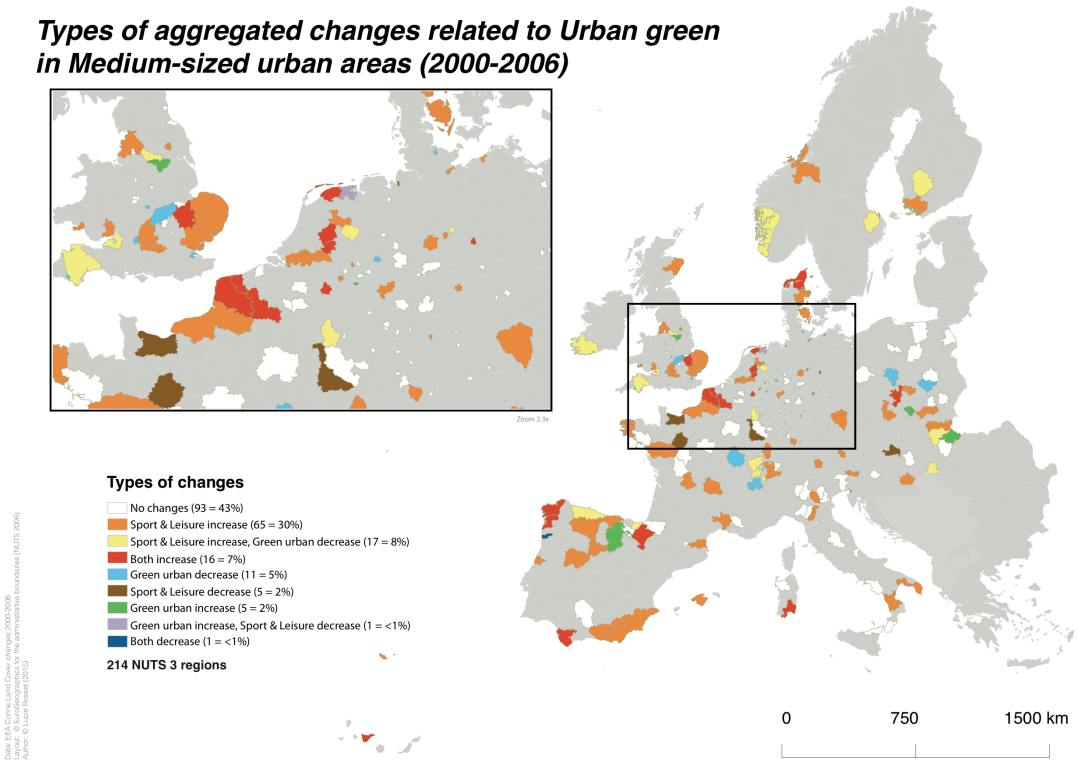

Fig. 13 – Map with all land cover and use changes related to categories 141 and 141 in European MSUA [data: EEA, Corine Land Cover (CLC), created by Author]

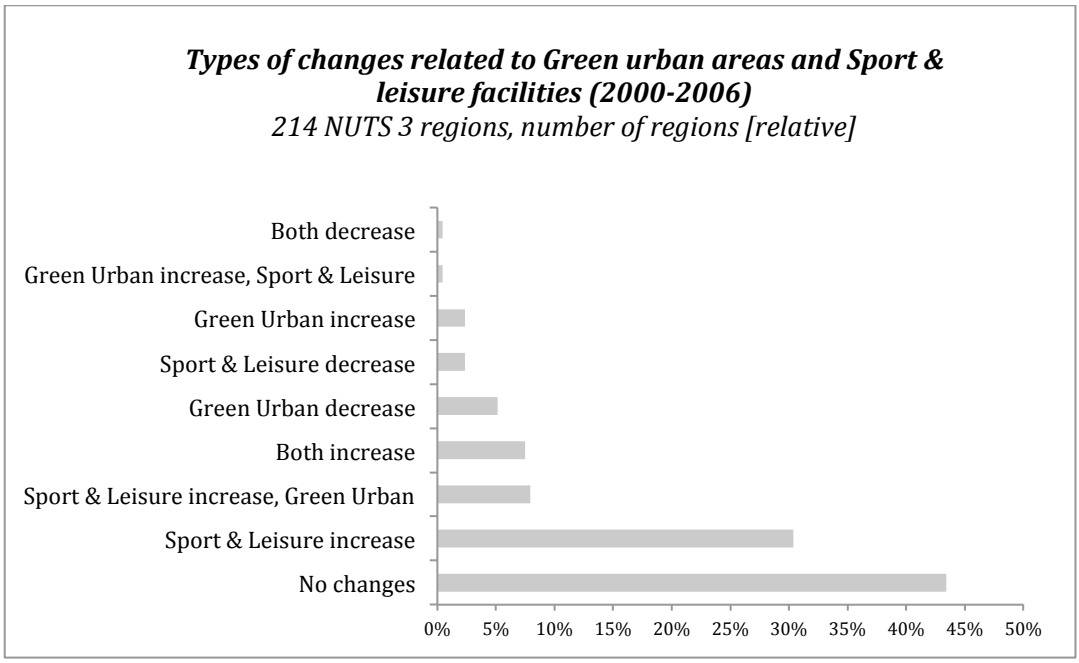

Fig. 14 – Distribution of the region according to types of changes [data: EEA, Corine Land Cover (CLC), created by Author]

As shown in the map and chart (Fig. 13 & 14), 30% of the regions had an increase of their sport & leisure facilities; 8% expanded their sport & leisure facilities but simultaneously reduced their green urban areas and in about 7% of the regions both categories increased. Further, the share of regions with a decrease (5%) of green urban areas is slightly higher than with an increase (2%). Indeed, this is also visible in

Figure 15, more regions registered a decrease in green urban areas than an increase: 22 regions versus 29 regions. On the contrary, a large majority of the MSUA have expanded their sport & leisure facilities.

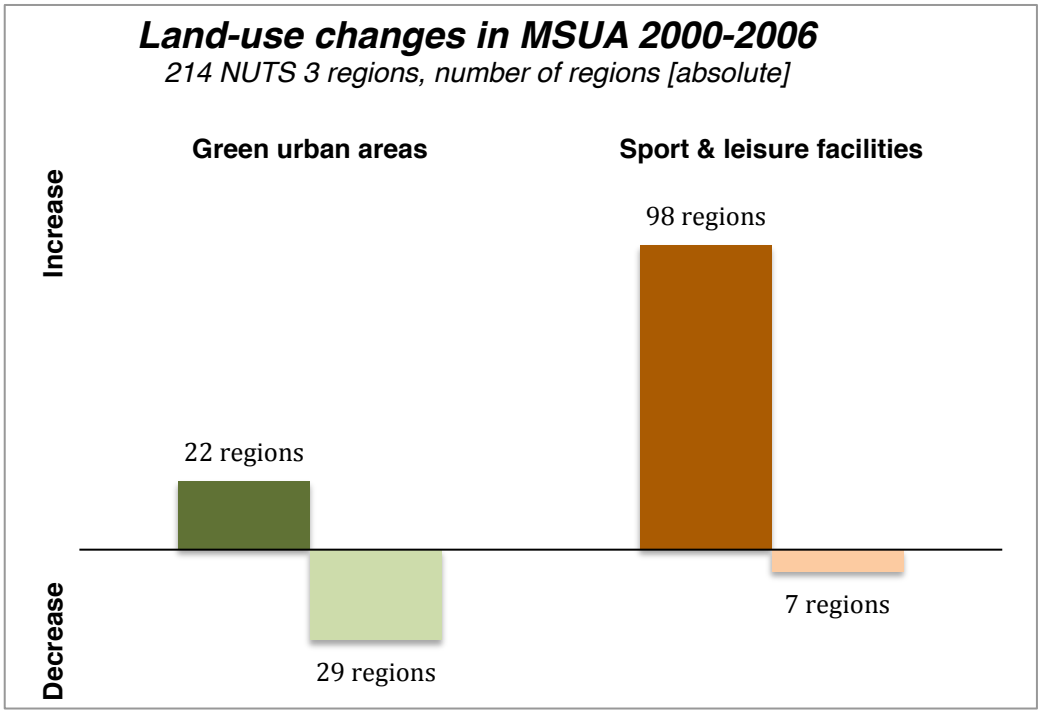

Fig. 15 – Number of regions and type of change in 141 or 142 [data: EEA, Corine Land Cover (CLC), created by Author]

This chart examines the sum of regions in absolute numbers without considering the changes in terms of surface. When looking at the changes of the surfaces (Fig. 16) between 2000 and 2006, even if a larger number of regions have reduced their land dedicated to urban green, there is an increase in their total surface. This necessarily means that the gains in the 22 regions were greater than the overall losses in 29 regions. Indeed, the balance between gains (8.35 km^2) and losses (0.62 km^2) shows an expansion of the total land devoted to green urban areas. Concerning the sport & leisure facilities, their surface increased significantly and reached a total gain of almost 100 km^2. Contrary to green urban areas, the expansion of sport & leisure facilities in terms of surface is proportional to the absolute number of regions listing changes.

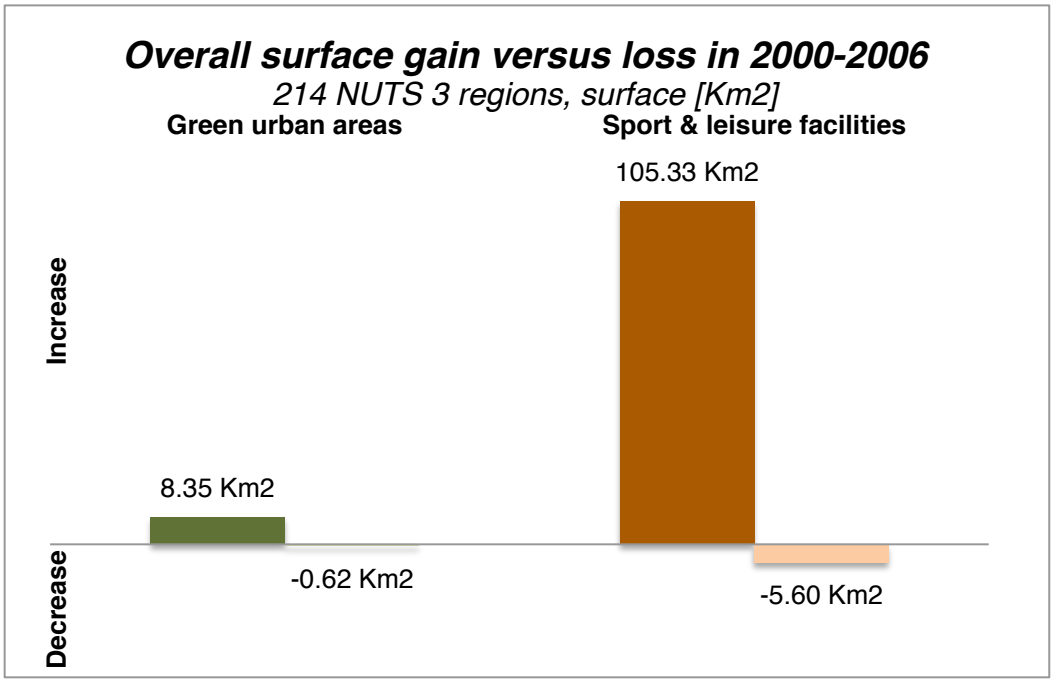

Fig. 16 – Surface gains and losses of 141 and 142 [data: EEA, Corine Land Cover (CLC), created by Author]

Two maps below show the balance between gain and losses of green urban areas (Fig. 17) and sport and leisure facilities (Fig. 18). There is no particular spatial pattern visible. Nevertheless the comparison of the two confirms the trends outlined earlier; although there is an increase of urban green in terms of surface, there are more regions with a decrease of urban green. Also, whereas the majority of regions recorded no changes concerning their urban green areas, most of them increase their sport and leisure facilities.

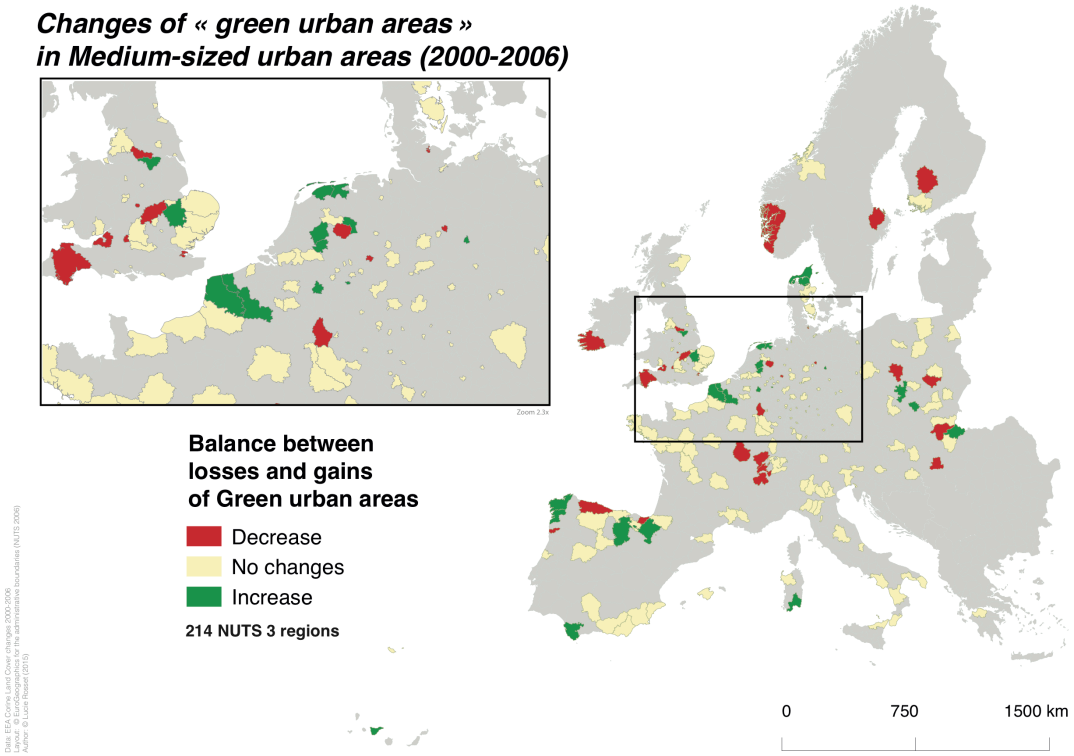

Fig. 17 – Map with land use changes related to 141, [data: EEA, Corine Land Cover (CLC), created by Author]

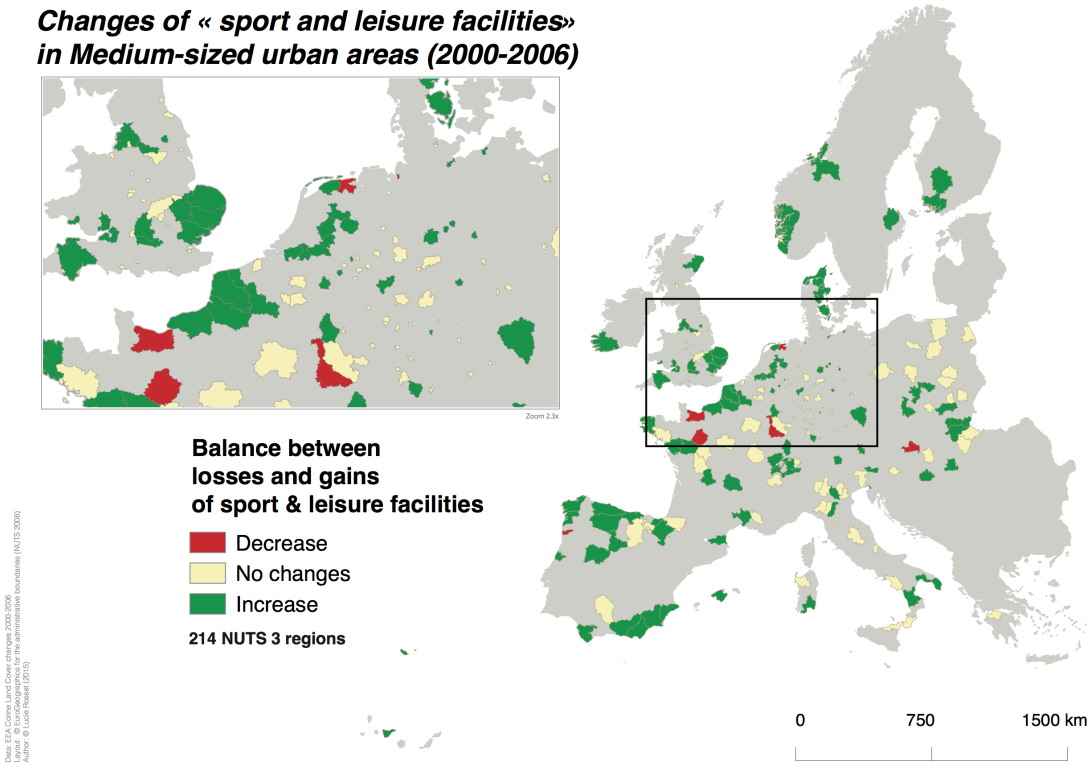

Fig. 18 – Map with land use changes related to 142, [data: EEA, Corine Land Cover (CLC), created by Author]

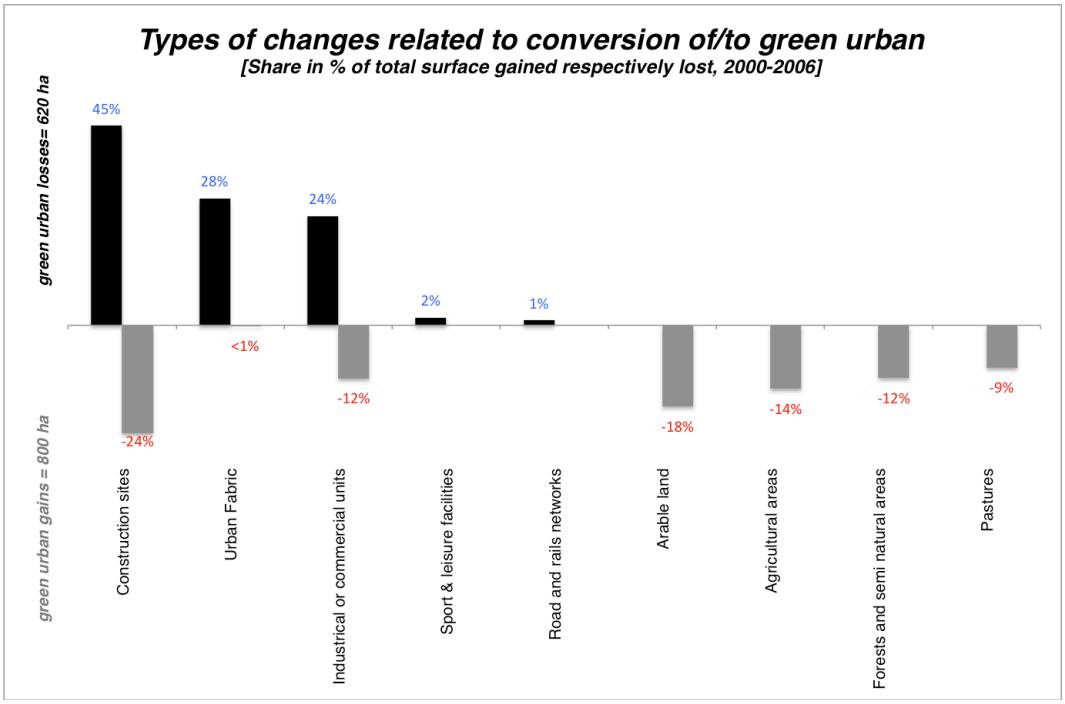

Fig. 19 – Land use main changes to and from urban green (141) [data: EEA, Corine Land Cover (CLC), created by Author]

It is important to note that in contrast to possible predictions, the reduction of green urban areas does not seem to be directly correlated to the growth of sport & leisure facilities. Indeed, from the entire sample of 214 MSUA, only two regions Wolfsburg (DE913) and Pirkanmaa (FI197), changed plots of green urban areas in favor of sport & leisure facilities. Moreover these changes involved very small surfaces, both fewer than 6 ha, representing about 2% of the total green urban areas converted into another use. As shown in Figure 19, most of the changes are in favor of construction sites (45%), urban fabric (28%) and industrial and commercial units (24%). On the other hand, the increase of the surface used for green urban areas acts to the detriment of construction sites (24%), arable land (18%), agricultural areas (14%) as well as forest and semi natural areas (12%), industrial and commercial units (12%), pastures (9%) and urban fabric (<1%).

Concerning the intensity of the changes in land use, or in other terms, the share of plots affected by changes compared to the regions' total territorial surface, is between -0.63% and 0.45% for green urban areas and between -0.07% and 0.48% for sport & leisure facilities.

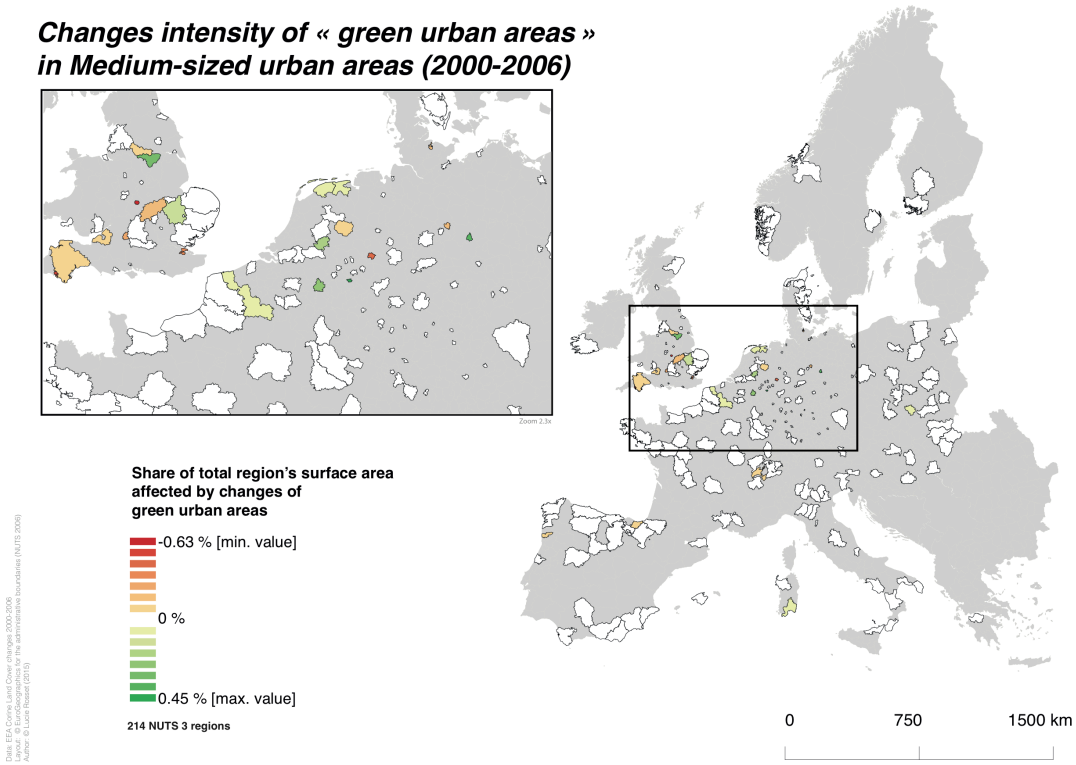

Fig. 20 – Map of the land use changes intensity related to 141, [data: EEA, Corine Land Cover (CLC), created by Author]

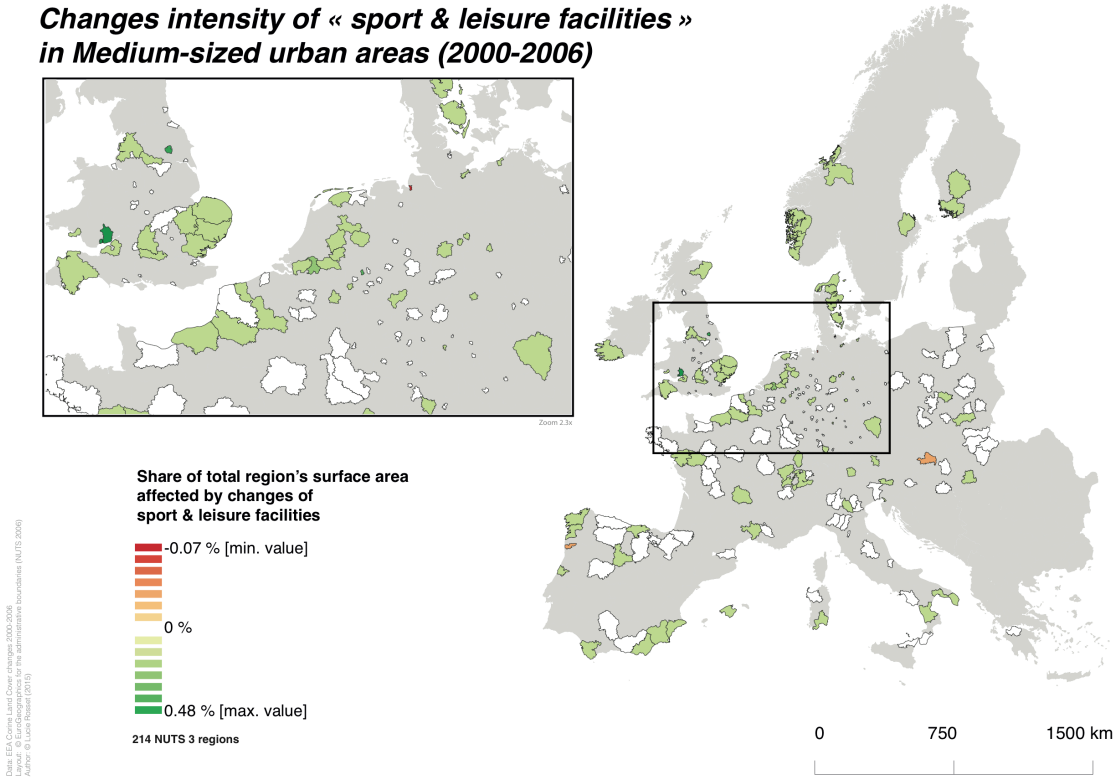

Fig. 21 – Map of land use changes intensity related to 142, [data: EEA, Corine Land Cover (CLC), created by Author]

The spatial distribution of the intensity of the changes in categories 141 and 142 can be observed on maps (Fig. 20 & 21). Whereas changes in sport and leisure facilities concern a majority of the regions with an increase up to almost 0.5% of the total

regions' territory, the changes in urban green are less frequent. They are rather concentrated in the northern part of Europe and their intensity is higher in negative (-0.63% in Coventry UKG33) than in positive (0.45% in Leverkusen DEA24) shares. This short regional description could provide us with a general idea of the trends; a very detailed description of the land cover changes at the single plot scale is available in Appendix IV.

4.1.3 Results grouped under 4-class Typology Model

This sample can also be analyzed with a greater degree of specificity by considering the 4-class Typology Model that encompasses the aspects of density and dynamic. Interestingly, as it is noticeable in Figures 22 and 23, the assumptions on land use formulated with the 4-class Typologies Model seem to be confirmed by the results of each class separately. Figure 22 indicates that the classes behave differently, especially in categories "No changes" and "Sport & leisure increase". In the "No changes" category, the classes with a high density are largely above the average (43%) and the ones with a rather low density are significantly below average. The reverse is true for the "Sport & leisure increase" in the second line of the table: classes with a low density are above the average (30%) and those with a high density are below. This agrees with the assumptions made by the 4-class Typology Model, i.e., regions with a low density intrinsically have a higher share of non-built areas and therefore more opportunities for territorial changes. The opposite rationale is valid for regions with a high density – a low share of non-built areas and therefore less space available for green.

Low density & Shrinking	High density & Shrinking	Low density & Growing	High density & Growing	Land-use changes (Data: EEA, CLC 2000-2006)
31%	**59%**	31%	**52%**	No changes
35%	17%	**44%**	25%	Sport & Leisure increase
8%	3%	12%	8%	Sport & Leisure increase, Green Urban decrease
13%	7%	7%	4%	Both increase
4%	7%	3%	6%	Green Urban decrease
4%	2%	3%	0%	Sport & Leisure decrease
4%	3%	0%	2%	Green Urban increase
0%	0%	0%	2%	Green Urban increase, Sport & Leisure decrease
0%	2%	0%	0%	Both decrease

Fig. 22 – Table with shares by type of land cover changes divided into the 4 typologies [data: EEA, Corine Land Cover (CLC), created by Author]

Figure 23, shows the same statistics (land-use changes related to 141 and/or 142), but ranked by characteristics: structure (low/high density) and dynamic

(shrinking/growing). First, this table confirms the remark on the divergence between low and high density. Second, another dichotomy appears, shrinking regions are changing less in terms of land-use than the growing regions. Indeed, the growing regions contain more territorial changes (60%) than the shrinking ones (53%). This trend is particularity interesting in the frame of this research that in a further step aims to look at urban green in shrinking regions.

Low density	High density	Shrinking	Growing	Land-use changes (Data: EEA, CLC 2000-2006)
31%	**56%**	**47%**	40%	No changes
40%	21%	25%	**36%**	Sport & Leisure increase
10%	6%	6%	10%	Sport & Leisure increase, Green Urban decrease
9%	6%	9%	6%	Both increase
4%	7%	6%	5%	Green Urban decrease
4%	1%	3%	2%	Sport & Leisure decrease
2%	3%	4%	1%	Green Urban increase
0%	1%	0%	1%	Green Urban increase, Sport & Leisure decrease
0%	1%	1%	0%	Both decrease

Fig. 23 – Table with shares by type of land use changes divided into 4 characteristics (low/high density, low/high dynamic) [data: EEA, Corine Land Cover (CLC), created by Author]

Part I of the results laid out the applied 4-class typology model and discussed the problems related to the NUTS 3 sizes that cause a biased classification. A high negative correlation between population density and soil sealing was detected in small NUTS 3 regions, but no correlation is noticeable in large NUTS 3 regions. Further, the general overview of land cover changes for the entire sample of 214 MSUA reveals an increase of both green urban areas and sport & leisure facilities, but the latter to a greater extent. Whereas most of the losses of urban green are in favor of urban fabric and industrial and commercial units, the gains are at the expense of arable land, agricultural areas, forest and semi-natural areas and industrial and commercial units. The territorial changes related to urban green never represent more than 0.7% of the total surface of the NUTS 3 regions. The trends demonstrated in the last subchapter confirm the assumptions made in the 4-class typology model that regions with “low density” have a high share of non-built areas therefore more available space for changes. On the other hand “high density” regions have a low share of non-built areas and less opportunities for territorial changes. Similarly, when considering socio-demographic dynamics, it is more likely to find high competition for land in growing regions than in shrinking ones.

4.2 Part II – Land cover, tell me what is the land use?

This chapter focuses on 8 regions selected for further investigation. Based on the results of *Part I* on CLC data, it compares the information that can be gained from an alternative set of data: LUCAS survey. Although it is alternative data, it is complementary as LUCAS data is used in the validation process of CLC data. In other words, LUCAS supports the production of CLC by providing land use and land cover information and in-situ photos (Büttner & Eiselt, 2013). Whereas both datasets describe land cover and land use, they differ in how they collect data and how they organize their classifications. The aim of this part of this research is to analyze what are the visible changes in land cover and use when considering only LUCAS data. The chapter starts with a detailed summary of the changes related to urban green in the 8 selected regions by using CLC data mainly handled in *Part I* at the scale of European MSUA. It continues with the description of land use changes and the possible interpretations of LUCAS data. Further, before closing this chapter, there is a comparison and discussion of the classification methods used by the two datasets.

4.2.1 Eight selected regions for further investigation

Salamanca (ES415)	**Parma** (ITD53)
Moselle (FR413)	**Innsbruck** (AT332)
Magdeburg (DEE03)	**Vaud** (CH011)
Szczecin (PL424)	**York** (UKE21)

These regions have been selected for the second part. They were chosen because they satisfy at least one of three main criteria. First, they are regions with a high proportion of green areas. Second, they appeared interesting in the CLC data analysis because as they converted various plots into green urban areas and/or sport & leisure facilities. (See Appendix IV) Third, after a brief online investigation, they seem to be interesting for research on urban green because they put forward their green heritage as a main attraction.

4.2.2 CLC information

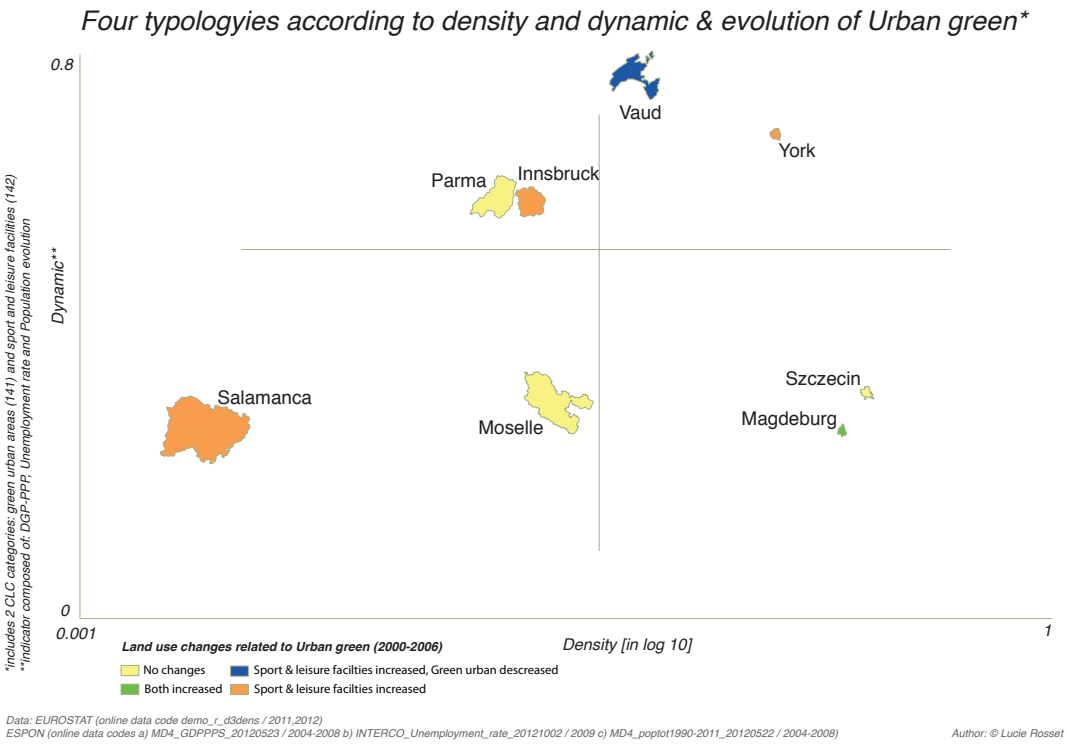

Fig. 24 - Features of the 8 selected NUTS 3 regions [data: EUROSTAT, ESPON & EEA, Corine Land Cover (CLC), created by Author]

The chart above (Fig. 24) shows the 8 selected regions organized according to the 4-class Typology Model, with the size and shape of the regions as well as the respective land use changes related to urban green represented by colors. Magdeburg is the only region where both categories increased: a “dump site” of about 35.1 ha was converted into green urban areas and 33.5 ha of pastures have become sport & leisure facilities. In York, Salamanca, and Innsbruck only sport & leisure facilities increased and green urban areas remained the same. In York one large plot of agricultural land (about 128.5 ha) was transformed into sport & leisure facilities. In Salamanca 5 plots totaling 56.8 ha where transformed in favor of sport & leisure facilities: 38.1 ha of agricultural land, about 10.0 ha of construction site, 5.8 ha of arable land (two plots, 4.9 ha and 0.9 ha), and 3.0 ha of forest. In Innsbruck (Fig. 25), 5.7 ha of sport & leisure facilities were transformed into construction site but the losses were largely compensated for a total of 172.4 ha that turned into sport & leisure facilities of which the large majority was natural grassland (165.7 ha) and the rest coniferous forest (6.7 ha). In the Vaud region, whereas 20.2 ha of construction site were transformed in favor of sport & leisure facilities, 3 plots of green urban areas totaling 27.2 ha were converted into both industrial & commercial units (14.8 ha) and construction site (12.4 ha). In Parma, Moselle and Szczecin no changes in urban green occurred between 2000-2006, but the regions have a consistent share of green areas and they all put a strong emphasis on their green heritage in their official websites.

CLC data shows territorial changes by mapping the areas to a minimum scale of 25 ha but changes are detected up to 5 ha. Figure 25 illustrates how the data are displayed with the example of Innsbruck mentioned above in the description of aggregated changes. The clear advantage of CLC data is that it can be quantified in terms of surface changes.

Innsbruck (AT332) land cover & use changes displayed by CLC (2000-2006)

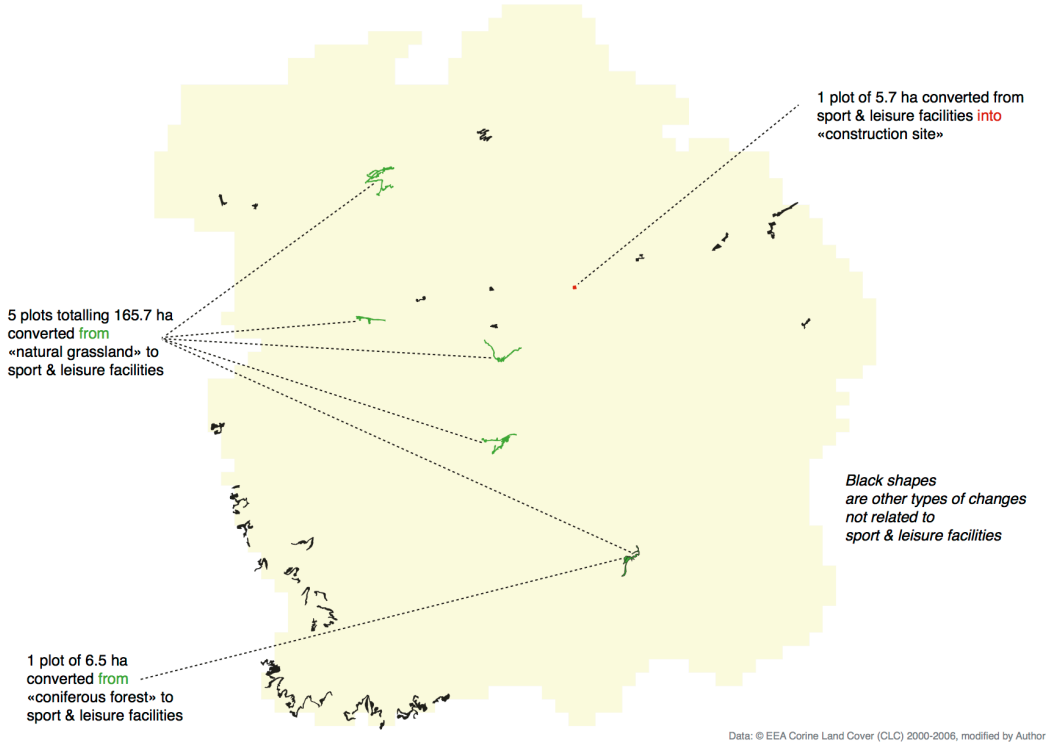

Fig. 25 - Example of the way CLC displays land use and cover changes – the case of Innsbruck [data: EEA, Corine Land Cover (CLC), created by Author]

Although criticized by some because of its area delimitations errors or misclassification (Diaz-Pacheco & Gutiérrez, 2014; Büttner & Eiselt, 2013; Siedentop & Meinel, 2004), the CLC data is a very interesting tool to examine land cover and use changes at the European scale. Some of the mistakes in CLC data are corrected thanks to reinterpretations based on in-situ LUCAS data. The next section will focus on the LUCAS survey, which is an alternative and complementary source of information when considering land cover and use.

4.2.3 LUCAS information

Based on in situ field observations by surveyors, LUCAS data provides a land cover and land use dataset that uses its own detailed classification. The LUCAS survey counts 1.1 million points over the European territory that are systematically spaced every 2 kilometer in the four cardinal directions.

Because of data availability[8] this part considers only 6 regions: York, Magdeburg, Innsbruck, Szczecin, Moselle and Salamanca. There are two main types of data provided by LUCAS: “microdata” with the land use and cover classification for each point and photos of the four cardinal directions around the point. The so-called microdata display not only the land cover and use data but also render very detailed information. To illustrate the variety of information in LUCAS microdata, we can for example name: the description of the types of species, the estimation of the height of the trees, or even the extraction of a soil sample to be analyzed. These details, collected by surveyors on the field, are not only useful for the validation of CLC data but also to monitor and control environmental changes. The objective of this part is examining the possible ways to using LUCAS data when looking at land cover and use changes.

There are various ways to access the LUCAS data; EUROSTAT provides an online interactive map of LUCAS data with the points demonstrating both cover and use. The maps can be downloaded directly from the website in a PDF format. To obtain the photos and the microdata one must order it at EUROTAT office of the European Commission in Luxembourg as it requires considerable memory space.

These maps (Fig. 26) showing York NUTS 3 region (UKE21) are good to visualize how the points and their classification are displayed in LUCAS survey. When clicking on a point, it is possible to see the photos of the four cardinal points.

[8] Parma is not available at the NUTS 3 level but only at the NUTS 2 encompassing a larger area. Vaud is not available.

York (UKE21) land cover & use changes displayed by LUCAS (2009-2012)

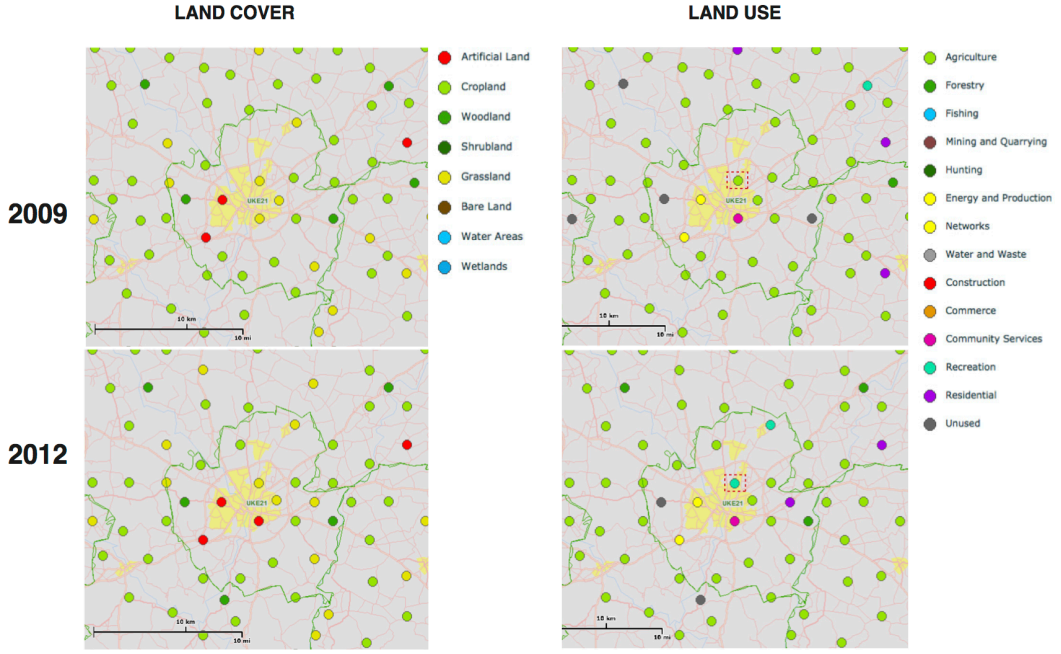

Fig. 26 - Example of the way LUCAS display land use and cover changes – the case of York [data: EUROSTAT, Land Cover and Use Area Survey (LUCAS), Adapted by Author]

Framed in red (Fig. 26) you can see a point where the cover is in the category « Grassland » more precisely in the microdata we can even know that it is « Grassland with sparse tree/shrub cover ». Whereas the cover didn't change from 2009 to 2012, the use changed from « fallow land » (2009) to « amenities, museum & leisure » (2012). The 8 photos below are the pictures of that point in the 4 cardinal directions taken by the surveyors in 2009 and 2012 (Fig. 27). It can be easily seen, on the pictures towards the south, that the trees are the same but vegetation suggests that the period of the year may differ. Indeed, the one in 2012 seems to be taken in autumn whereas the one from 2009 in summer. Also as the distance to the trees is almost the same, we can assume that the location had no or little variation between the two survey years. The biggest difference from one measurement period to another is especially visible in the pictures to the south and to the west: they both show desire lines on the ground witnessing the frequent presence of people walking in the area. This is probably one of the reasons why the surveyor in 2012 evaluated the use as recreational rather than as "fallow land" as classified in 2009.

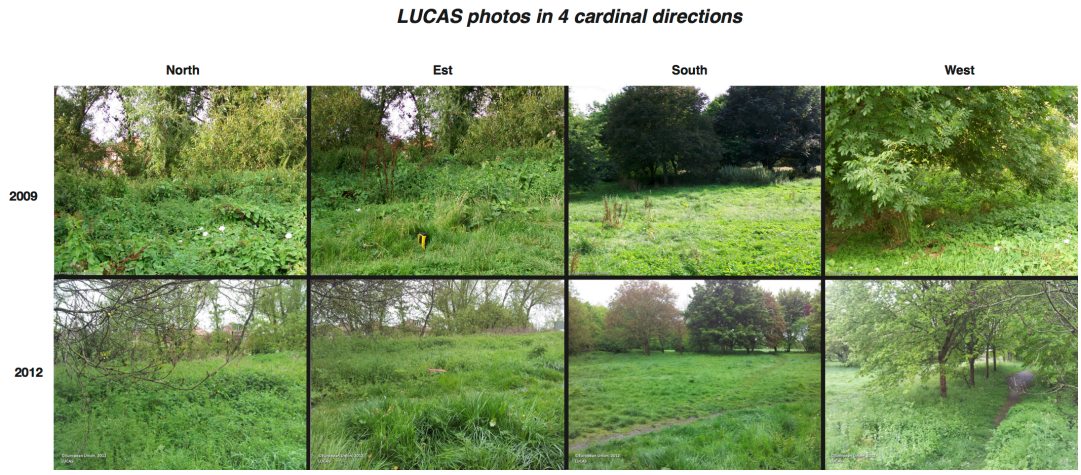

Fig. 27 - Example of the LUCAS photos in 4 cardinal directions – the case of a point in York [data: EUROSTAT, Land Cover and Use Area Survey (LUCAS), Adapted by Author]

This example of York gives a good overview of the kind of information that is displayed by LUCAS data. Whereas the data is collected on a punctual scale of about 3-meter radius, CLC measures areas in the scale of 25 ha. In order to make both datasets complementary, the photos are needed to fill the gaps between these two distinct mapping scales (Büttner & Eiselt, 2013).

The table below (Fig. 28) is a summary of all the point changes recorded that concern the categories recreation, leisure & sport (U360) and unused (U400) between 2006 and 2012. First we can observe that there are four times as many points concerning the category unused than the category recreation, leisure & sport. For U360 category, the trends are the following: whereas the losses and gains of « amenities, museum & leisure (U361) » are balanced, the subcategory « sport (U361) » lost more than 80% of the points mainly in favor of residential or agriculture. This change seems disproportionately high especially when one think that out of 10 « sport » points in Salamanca, 9 disappeared in 2012. It is probably due either to variations of the point location from one year to another or coding errors. Other change patterns, highlighted with colors, are surprising. We will comment on these particularities following the order of the letters corresponding to colors in the table.

Land use points changes related to «recreation, leisure & sport» and «unsued» in Magdeburg, Innsbruck, Szczecin, Moselle, York and Salamanca, LUCAS (2006-2012)

DEE03 (4)
From road (2006) to residential (2009) to road again (2006)
From production of non-metal natural goods (2006) to machinery and equipment (2012)
From road (2006) to fallow land (2009) and road again (2012)
From road (2009) to production of non-mineral goods (2012)

AT332 (9)
From unused (2009) to forestry (2012)
From forestry (2009) to Semi-natural and Natural areas not in use (2012)
From amenities, museum and leisure (2009) to agriculture (2012)
From unused (2009) to forestry (2012)
From unused (2009) to Semi-natural and Natural areas not in use (2012)
From unused (2009) to Semi-natural and Natural areas not in use (2012)
From unused (2009) to Semi-natural and Natural areas not in use (2012)
From amenities, museum and leisure (2009) to community services (2012)
From unused (2009) to Semi-natural and Natural areas not in use (2012)

PL424 (8)
From kitchen garden (2006) to amenities, museum and leisure (2009, 2012)
From unused (2006) to amenities, museum and leisure (2009,2012)
From agriculture (2006) to unused (2009) and back to agriculture (2012)
From wetland (2006) to nature reserve (2009)
From unused (2006) to forestry (2009)
From wetland (2006) to nature reserve (2009)
from unused (2006) to nature reserve (2009) and than Semi-natural and Natural areas not in use (2012)
From agriculture (2006,2009) to abandonned area (2012)

FR413 (47)
From agriculture (2006) to unused Semi-natural and Natural areas not in use (2009,2012)
From forestry (2006) to unused and to Semi-natural and Natural areas not in use (2009,2012)
From unused (2009) to agriculture (2012)
From agriculture (2006) to forestry (2009)
From agriculture (2006) to sport (2009,2012)
From roads (2006) to unused (2009) and to Semi-natural and Natural areas not in use (2012)
From unused (2006) to commercial, finance, business (2009)
From residential (2009) to Semi-natural and Natural areas not in use (2012)
From unused (2006) to agriculture (2012)
From unused (2006) to commercial, finance, business (2009,2012)
From fallow land (2006) to agriculture (2009,2012)
From agriculture (2009) to community services (2012)
From roads (2006,2009) to forestry (2012)
From roads (2006) to agriculture (2009,2012)
From roads (2009) to forestry (2012)
From amenities, museum, leisure (2009) to agriculture (2012)
From agriculture (2006) to residential (2009,2012)
From unused (2006) to agriculture (2009,2012)
From unused (2006) to hunting (2009) and than to Semi-natural and Natural areas not in use (2012)
From roads (2006) to agriculture (2009) and back to roads (2012)
From agriculture (2006) to fallow land (2009) and back to agriculture (2012)
From fallow land (2006) to agriculture (2012)
From agriculture (2009) to forestry (2012)
From roads (2009) to residential (2012)
From roads (2006) to agriculture (2012)
From residential (2006) to agriculture (2009,2012)
From roads (2006,2009) to residential (2012)
From agriculture (2006,2009) to roads (2012)
From fallow land (2006) to agriculture (2009) and than kitchen garden (2012)
From amenities, museum, leisure (2006) to sport (2009) and than to Semi-natural and Natural areas not in use (2012)
From agriculture (2009) to Semi-natural and Natural areas not in use (2012)
From amenities, museum, leisure (2006) to sport (2009) and than to Semi-natural and Natural areas not in use (2012)
From agriculture (2009) to Semi-natural and Natural areas not in use (2012)
From unused (2006,2009) to forestry (2012)
From unused (2009) to forestry (2012)
From agriculture (2006) to residential (2009,2012)
From roads (2009) to residential (2012)
From residential (2006,2009) to kitchen garden (2012)
From roads (2006) to forestry (2009,2012)
From agriculture (2006) to residential (2009,2012)
From storage (2009) to sport (2012)
From agriculture (2006,2009) to roads (2012)
From residential (2009) to kitchen garden (2012)
From agriculture (2006) to residential (2009,2012)
From forestry (2006) to nature reserves (2009) and back to forestry (2012)
From forestry (2006) to nature reserves (2009) and back to forestry (2012)
From forestry (2006) to nature reserves (2009) and back to forestry (2012)

A B C D E F

Data: © EUROSTAT: LUCAS microdata NUTS3 level

UKE21 (4)
From unsused (2009) to Semi-natural and Natural areas not in use (2012)
From fallow land (2009) to amenities, museum & leisure (2012)
From agriculture (2009) to amenities, museum & leisure (2012)
From unused (2009) to forestry (2012)

ES415 (61)
From unused (2006) to agriculture (2009) and than to forestry (2012)
From sport (2006) to fallow land (2012)
From unused (2006) to agriculture (2009,2012)
From unused (2006) to fallow land (2009) and than to agriculture (2012)
From sport (2006) to agriculture (2009)
From forestry (2009) to unused (2012)
From unused (2006) to hunting (2009) and than to agriculture (2012)
From unused (2009) to agriculture (2012)
From unused (2006) to agriculture (2009)
From unused (2006) to hunting (2009) and than to agriculture (2012)
From unused (2009) to agriculture (2012)
From agriculture (2006) unused (2009) to than back to agriculture (2012)
From unused (2006) to agriculture (2009)
From unused (2006) to water supply and treatment (2009)
From hunting (2009) to Semi-natural and Natural areas not in use (2012)
From unused (2006) to forestry (2009)
From unused (2006) to agriculture (2009,2012)
From unused (2006) to forestry (2009,2012)
From agriculture (2006) to hunting (2009) and than to Semi-natural and Natural areas not in use (2012)
From unused (2006,2009) to agriculture (2012)
From unused (2006) to roads (2009)
From agriculture (2006,2009) to Semi-natural and Natural areas not in use (2012)
From agriculture (2009) to Semi-natural and Natural areas not in use (2012)
From fallow land (2006) to unused (2009) and than to agriculture (2012)
From unused (2006) to hunting (2009) and than Semi-natural and Natural areas not in use (2012)
From hunting to Semi-natural and Natural areas not in use
From unused (2006) to fallow land (2012)
From agriculture (2009) to Semi-natural and Natural areas not in use (2012)
From hunting (2009) to Semi-natural and Natural areas not in use (2012)
From unused (2006) to hunting (2009) and than to forestry (2012)
From hunting (2009) to Semi-natural and Natural areas not in use (2012)
From hunting (2009) to Semi-natural and Natural areas not in use (2012)
From unused (2009) to agriculture (2012)
From unused (2006) to forestry (2009,2012)
From unused (2006) to hunting (2009) and than to forestry (2012)
From unused (2006) to agriculture (2009,2012)
From unused (2006) to agriculture (2009,2012)
From unused (2006) to hunting (2009)
From unused (2006) to agriculture (2012)
From sport (2006) to hunting (2009)
From unused (2006) to agriculture (2009,2012)
From sport (2006) to agriculture (2009) and than to forestry (2012)
From unused (2006) to agriculture (2009,2012)
From unused (2006) to agriculture (2009,2012)
From unused (2006) to agriculture (2009,2012)
From unused (2006) to agriculture (2009,2012)
From unused (2006) to agriculture (2009) and than fallow land (2012)
From unused (2006) to agriculture (2009) and than fallow land (2012)
From unused (2006) to agriculture (2009,2012)
From unused (2006) to agriculture (2009)
From unused (2006) to agriculture (2009,2012)
From unused (2006) to agriculture (2009,2012)
From sport (2006,2009) to residential (2012)
From unused (2006) to sport (2009) and than residential (2012)
From unused (2006) to agriculture (2009,2012)
From unused (2006) to agriculture (2009,2012)
From unused (2006) to agriculture (2009,2012)
From unused (2006) to agriculture (2009)
From sport (2006) to agriculture (2009,2012)
From unused (2009) to agriculture (2012)
From agriculture (2006) to unused (2009) and than fallow land (2012)
From unused (2006,2009) to storage (2012)
From unused (2006) to agriculture (2009,2012)
From sport (2006,2009) to residential (2012)
From unused (2006) to sport (2009) and than residential (2012)
From unused (2006) to agriculture (2009,2012)
From unused (2006) to agriculture (2009,2012)
From unused (2006) to agriculture (2009,2012)
From unused (2006) to agriculture (2009)
From sport (2006) to agriculture (2009,2012)
From unused (2009) to agriculture (2012)
From agriculture (2006) to unused (2009) and than fallow land (2012)
From unused (2006,2009) to storage (2012)

Fig. 28 - Table summarizing land use changes with LUCAS microdata 2006-2012, [data: EUROSTAT, Land Cover and Use Area Survey LUCAS, created by Author]

A In Magdeburg, Szczecin, Moselle and Salamanca, there is a strange phenomenon happening; from one use in 2006, to another use in 2009 and than back the original use in 2012. For instance: from roads (2006), to agriculture (2009) and back to roads (2012).

This is explained by the fact that the surveyor must have considered a slightly different point in 2009 or that the interpretation of the main use on field varied in the different years.

B Mostly in Innsbruck and in one case in Moselle and York, the changes are from « unused » to « semi-natural and natural areas not in use »; this is clearly a result of change in categories. Whereas in 2006 and 2009 the classification only contained "unused areas U400" in 2012, this category was divided into two subcategories: "abandoned areas U410" and "semi-natural and natural areas not in use U420". In almost all cases, U400 in 2006 was replaced by U420 in 2009 or/and 2012. The same anomaly happens in Szczecin but even more bizarre is the category “nature reserves U364” that only appears in the classification in 2009 and but does not exist for the years 2006 and 2012.

C In Moselle, a surprisingly high number of points changed from a certain use (e.g. amenities, museum & leisure, agriculture, residential or forestry) to semi-natural and natural areas not in use. Although there is a tendency to enhance biodiversity in and around cities, whether it is due to carelessness or leaving nature to grow without interventions, this cannot be the reason for such a high number of areas that suddenly are unused although they were used three to five years back.

D In Salamanca, almost half of the points (28 out of 61) indicate a change in land use from unused to agriculture. This proportion seems too high to be accurate, we can assume that this is biased in the survey.

E Another thing to note in Salamanca is that more than 20% of the points (13 points) are land use "hunting" and only in the year 2009. There is no hunting use in 2006 or 2012. Many explanations can be imagined for that strange fact, such as for instance a coding error, but we will not speculate on that.

F The third remark about the points in Salamanca is that although the city is probably the most touristy of the 6 considered not only in terms of the number of visitors but also in terms of infrastructures as the entire city center is historical (protected by UNESCO world heritage), it is bizarre to see that out of 61, no point was recorded in the category "amenities, museum & leisure U361". The explanation for that is simple: the core city of Salamanca (in yellow) is so small that only two points are located in it. What is more, they are not located in the historical center but rather in the second “metropolitan” ring. The two points in purple show a residential use (Fig. 29).

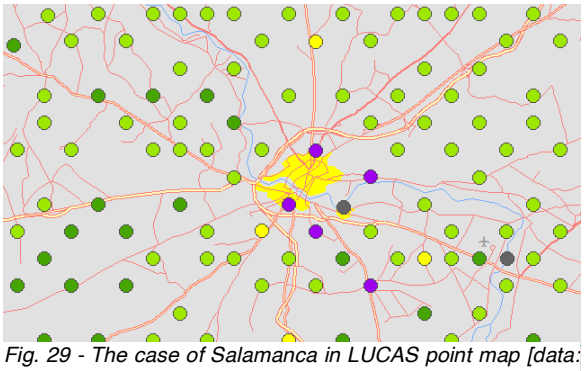

Fig. 29 - The case of Salamanca in LUCAS point map [data: EUROSTAT, Land Cover and Use Area Survey LUCAS]

These remarks show that the LUCAS dataset has imperfections. We could not test and evaluate on field the reasons why these « particularities » described above occurred. Nevertheless, we can assume that the surveyor's subjective interpretation and small variations in the location of the point measured from one survey period to another, are at least partly responsible for the strange land use changes outlined. Misinterpretations or divergent observations are more likely to happen when there are numerous classification categories. Moreover, it is difficult to analyze the changes and compare the land use points in time when we see that the classification is not stable: categories are appearing and disappearing in each measurement year, such as the example mentioned above (b) in which the category « nature reserve » only existed in 2009.

4.2.4 Comparison of CLC and LUCAS classification methods

One main difference between CLC and LUCAS classification is that in CLC a certain land use is automatically connected to one same land cover type (Fig. 30). The table shows that, in CLC classification, the land uses « urban green areas » and « sport & leisure facilities » are both in the main cover « Artificial surfaces ». On the other hand, LUCAS land use categories do not directly relate to one unique type of cover. Indeed, the same use can exist in multiple types of land cover. As represented in the Figure 30, there is a large range of possible combinations or "links" between land cover and land use type, enabling a more detailed description of the uses. (See detailed table in Appendix VI)

There is also a difference in the number of categories. There are 43 subcategories for land use in CLC but only 33 in LUCAS. The reverse is true for land cover LUCAS has many more categories for land cover than the CLC classification. This is particularly interesting, because logic would suggest the opposite because CLC is usually defined as more oriented in the cover and LUCAS in the use, but the number of categories suggest the contrary. Nevertheless, when comparing the two hierarchical classifications in details, we actually note that the entire CLC classification for both cover and use equals the LUCAS classification only for cover; the one for use constituting an additional set of categories not existing in CLC. In other words, LUCAS land uses are much more precisely defined than in the CLC.

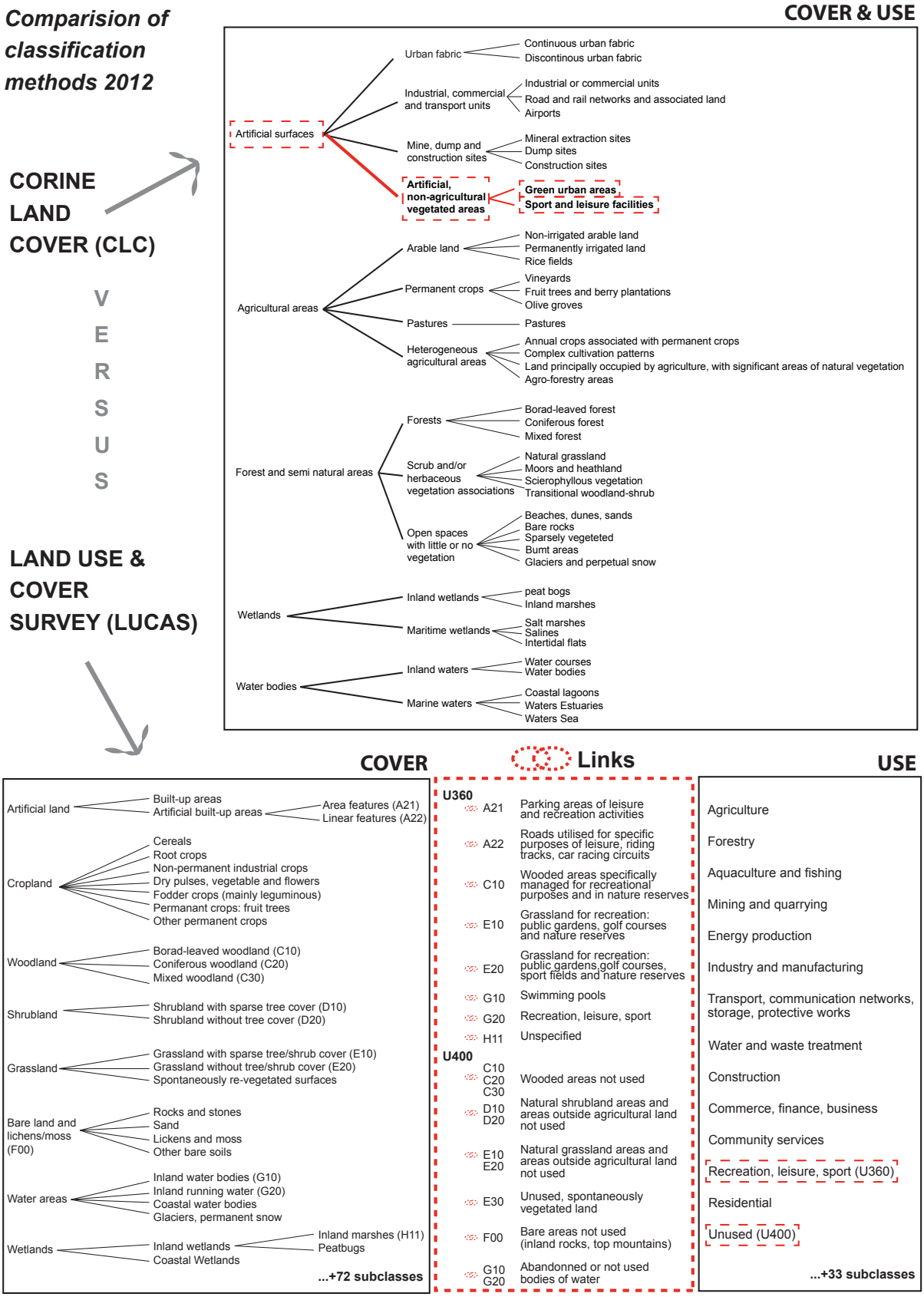

Fig. 30 - Comparison of CLC and LUCAS classification logics [data: EEA, Corine Land Cover (CLC) & EUROSTAT, Land Cover and Use Area Survey (LUCAS), created by Author]

To summarize, both datasets have advantages and disadvantages some of their features were taken up in this chapter. They both have defects but their weaknesses are at different scales. Whereas CLC lacks a detailed interpretation of areas or contains defects in the delineation accuracy, LUCAS, because of its measurement scale, can be too detailed and is not always representative of territorial characterization. Both are based on interpretation: CLC interprets remotely sensed images using computer assistance and LUCAS interprets observations made in-situ by different surveyors. Concerning the usage of these datasets, since CLC measurement units are surfaces it is adapted for quantitative methods. On the other hand, LUCAS is more suitable for qualitative methods because it uses points units and also because there are numerous diverse categories in the classification – making the quantification and comparison difficult.

Although LUCAS is not appropriate to look at the land use change at the regional scale, given that it does not account for the whole territorial surface, it can – in some cases – reflect reality better than CLC data. For example abandoned land is often dissimulated or largely reduced in land cover classification based on remote sensed pictures (Verburg *et al.*, 2009). This is why we can argue that CLC and LUCAS complementarity is positive, especially when considering a holistic approach to the land system. After having discussed the changes in cover and in use, the last step of this research is to look at the changes in land functions. This is the objective of the next section.

4.3 Part III – Urban green functions

As explained in chapter 3, NUTS 3 are regions between 150,000 and 800,000 inhabitants. This range is not always accurate because NUTS 3 regions are often based on existing national statistics in order to ease the process by benefiting from structures in place and their data. The varying NUTS 3 delimitations make the comparison in densities very difficult at the European scale. Further, the correlation test between population density and soil sealing also showed the discrepancy between the

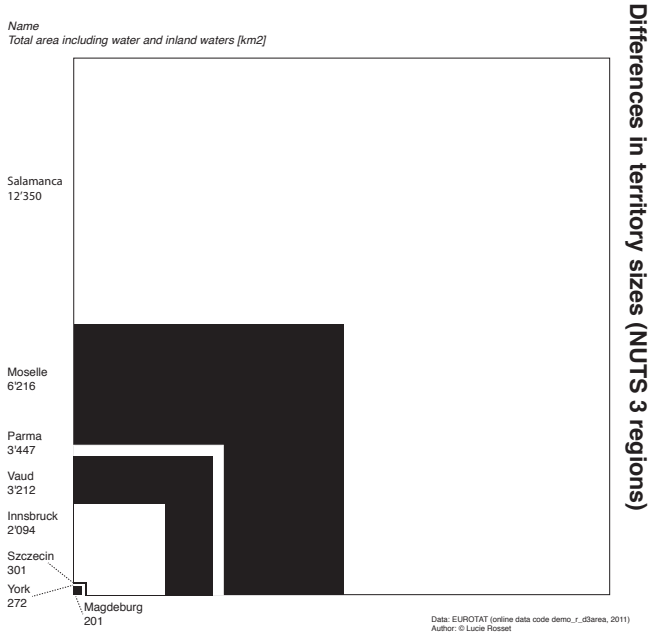

Fig. 31 - Differences in NUTS 3 sizes [EUROSTAT, created by Author]

NUTS 3 sizes. As shown in Figure 31, for the 8 selected regions, the density is directly related to the territorial size of the region. Indeed, all regions classified as “highly dense” are the smallest ones, but it does not describe the density within the main urban center and its fabric. Available data at the regional European level do not address density in a satisfactory manner to further test the validity of the 4-class Typology Model. Therefore, a small shift in the direction of this work had to be undertaken. The last part leaves out density and NUTS 3 regions; it focuses on urban green in cores cities of the following shrinking regions: Salamanca, Metz[9], Magdeburg and Szczecin. Based on their strategic plans and on interviews with 16 stakeholders[10] of these cities, the aim is to discuss urban green functions by outlining some particularities that appeared while comparing the four cities.

4.3.1 Study cases: 4 shrinking cities

One important clarification has to be made – the four cities selected as shrinking are defined so on the basis of the 4-class typology presented in *Part I*. It is built on a composite indicator that considers Growth Domestic Product in Purchasing Power Parity (GDP-PPP), unemployment rate and population change. Although the regions are defined as shrinking, for the period 2004-2014, only Salamanca and Szczecin experienced depopulation strictly speaking (Fig. 32). The great decline in Szczecin is explained by the fact that the NUTS 3 region encompasses only the very center and that strong suburbanization is still occurring in the region. The population in Magdeburg and Moselle is slightly growing, but still less than most of other regions classified as growing in *Part I*.

Although they face similar problems due to weak socio-demographic dynamics, the strategic planning they adopt for the future and their perception of urban green are different. This section is organized as follows: first, a short description of the general characteristics of each region; second, a summary of the arguments in favor and against the comparative approach in this context; third, a comparison of the vision for urban green in the four cities; fourth, two urban green functions – branding and social cohesion – will be discussed; fifth and last, a focus on the relation between traditional allotments (*kleingarten, ogrody dzielkowe, huertos urbanos, jardins-familiaux*) and urban gardening.

[9] Metz is the core city of the Moselle (FR413) NUTS 3 region.
[10] For interviewee list see Appendix V

Population change 2004-2014 / NUTS 3

Data: EUROSTAT
(demo_r_pjanaggr3)

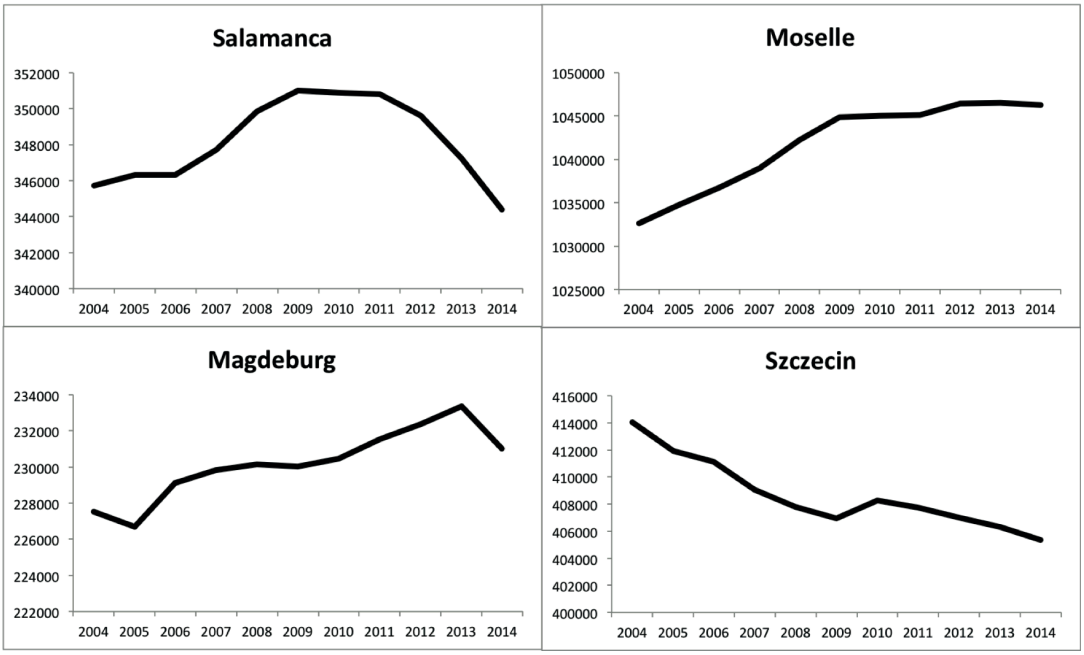

Fig. 32 - Population changes in 4 "shrinking" regions [data: EUROSTAT, created by Author]

Salamanca

Salamanca is an old medieval city with a dense urban fabric. The major economic activity is education as Salamanca universities host about 26,000 students. These students are a particular type of citizens for two main reasons: first because they are usually only staying for 3 to 5 years and second because during the year they leave for long periods of time provoking big variations in population between semesters and during holidays. Concerning urban green, there is a large green heritage with numerous parks especially compared to other cities in Spain. The development of these green spaces followed the model of Southern European countries with the late introduction of urban green only in the middle of the 20th century. In the seventies, gardens and allotments belonging to various religious orders were converted into public parks (Gómez-Gonçalves, 2013b). According the latter cited research, the city has only about 6.5 m² available for urban green[11] per inhabitant.

Metz

Located at the border between France and Germany, ownership of the city was disputed and shifted from one to another. Whereas most of the center is medieval, there are also some very large buildings that demonstrate its Germanic heritage, such as the train station or the Imperial Quarter in general. In the history of Metz, they were two very important landlords, the military and the church. There are numerous green spaces in and

[11] By « available urban green » are considered only green areas that can be used by a majority of the citizens, excluding private gardens and inaccessible spaces.

around the city thanks to the fact that strategic zones were left unbuilt for military purposes. According to the municipality, all green areas cover the city with 580 ha, or about 45 m² per inhabitant. This contributes to Metz winning its nickname of *Metz, ville jardin* (garden city). Metz was never touristy until lately; it has an industrial past that explains its prosperity until 40 years ago, when the economy started to go down. Today they are about 80,000 commuters everyday taking the A31 motorway to go to work in Luxembourg or in Germany.

Magdeburg

Magdeburg was erected in the 9th century but it was heavily destroyed during the Second World War. It appearance and structure today is inherited from the Soviet past. It is organized in a grid structure, with large and oversized streets as well as imposing residential blocks. According to Magdeburg Strategic plan "Magdeburg 2030", the city suffers from numerous overbuilt and in poorly conditioned areas. The strategy presented in the report is to actively undertake a land compensation policy. Magdeburg has a high proportion of land covered by allotments (*Kleingarten)* when compared to other areas nationally. Because of abundance of allotment supply, since 1994, the city converted 6% of the allotments to other uses. Like Salamanca but to a lesser extent, a large part of the population are students. The rest of the people living in Magdeburg are traditionally workers with rather low education.

Szczecin

Szczecin is a Baltic city located in the border between Poland and Germany. The population is peculiar because people living there before the Second World War left and new inhabitants from all over Poland came, mostly from the countryside. This historic fact gives the population of Szczecin a unique character; a rural-urbanized population with little attachment to the place as there are no multigenerational benchmarks. Contrary to Metz, in Szczecin, commuters live in Germany (in villages next to the region) and come to work in Szczecin. Indeed, for the past decade German villages on the border of Poland tried to attract new citizens as their own inhabitants moved west. Concerning green, Szczecin has large and numerous green areas. According to the city guide published by the municipality, green areas represent more than 41.8% of the total surface.

4.3.2 Interest and limits of the comparative approach

What these cities have in common is that they are core cities of shrinking MSUA, and they are relatively rich in green spaces within their urban fabric. These similarities are a good start for comparing how the functions of urban green evolve in such singular socio-

demographic settings. On the other hand, there are many ways in which these cities are dissimilar, which limits the comparative approach. We will not name all of the differences between these four cities, but some points can be raised.

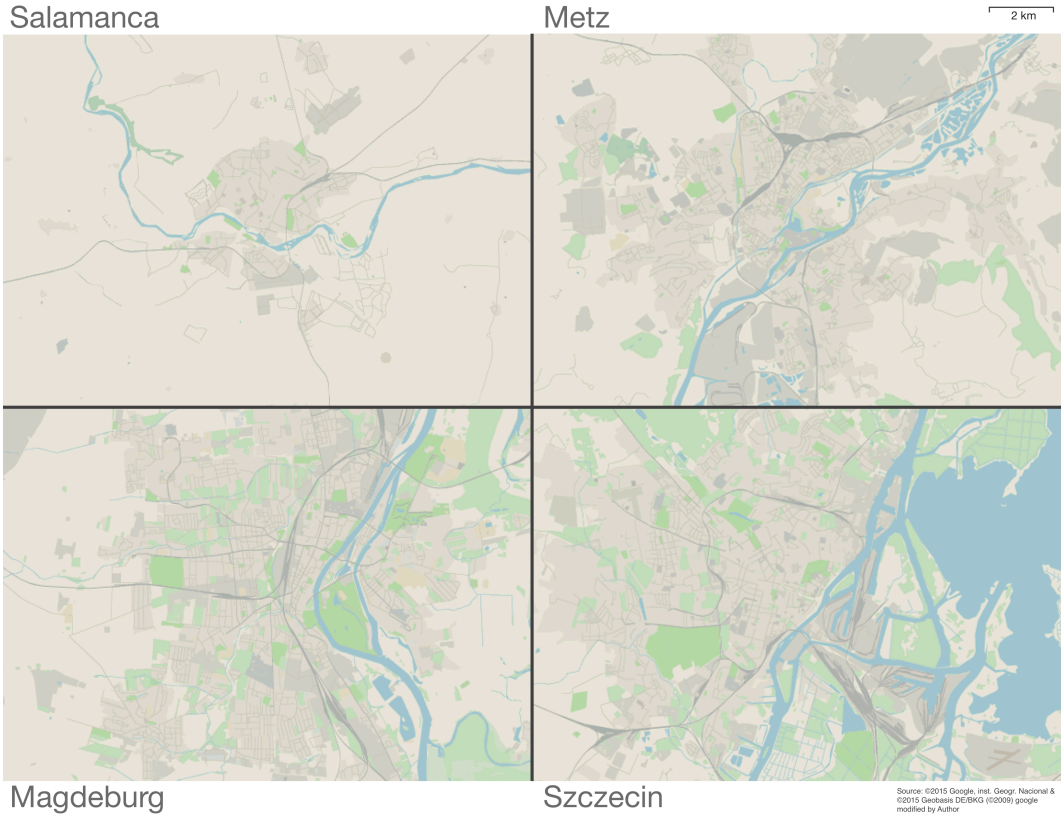

Fig. 33 – Maps outlining green areas of the cities core of the 4 shrinking regions [data: Google 2015, instituto Geografico Nacional & Geobasis DE/BKG (2009), created by Author]

The 4 cities were all established in the medieval period but the history of Europe during the 20th Century imposed different patterns of development: on the one hand, Salamanca and Metz are the western capitalist cities, on the other Magdeburg and Szczecin are the eastern communist cities (Fig. 33). Whereas Salamanca and Metz have circular urban form and a rather compact shape, Magdeburg and Szczecin follow a grid-pattern and have a rather dispersed shape. The dispersion of the two latter cities explains the presence of very large green areas with the urban fabric. Such large urban green does not exist in Salamanca or Metz; large green areas are found further outside the cities, but these areas are used for agriculture purposes rather than for urban leisure use. Finally, today they are all evolving in a European context where national peculiarities are strong, not only in terms of cultures and structures but also in terms of know-how and of a singular way of developing things.

Bearing in mind these differences we will follow this analysis by examining the perceived changes in green areas over the part decade and how such areas may change in the

future. Based on both interviews with 16 stakeholders and strategic planning documents, it is presented in the form of a discussion.

4.3.3 How do you perceive urban green changes over the last decade?

In terms of surface, according to the stakeholders interviewed the balance of urban green is the following: in Metz, it increased but only slightly, in Salamanca it remained stable, in Szczecin and Magdeburg it is decreasing. In Metz, there are cases of greening zones that were not affected and have been converted into green areas. This only happened with non-affected zones but no construction zones were converted into green. In Salamanca, the people interviewed said that there is no real change in terms of surface but a general greater attention to green from both politicians and citizens. On the other hand, they also stressed that if the economy had been better and if possible investments had been envisaged, urban green would have probably decreased. In Magdeburg, no exact number was given but various people interviewed said that urban green decreased slightly. In Szczecin region, the number was stated more precisely by one interviewee, during the period 2002-2015, green areas decreased about 370.6 ha; this is more than the entire surface of central park in New York. Szczecin is a perfect empirical example of what Kabisch & Haase (2013) affirm: “a decrease in population does not automatically lead to a decline in residential areas and a subsequent increase in urban green space on a large scale.” (113) A decrease of both population and urban green occurs in many cities in Central and Eastern Europe. Further, according to one of the city agents interviewed, the general state and quality of the green spaces has improved not because of direct intervention but mainly because certain industries disappeared which led to a decrease in air pollution.

In terms of quality, all stakeholders spontaneously mentioned the fact that the way to care about green has changed. Not only from a societal perspective but also simply how urban green spaces are being managed. Traditionally, urban green in cities is the epitome of the control of nature by humankind. Nature is sequenced by man, rather than being hostile and uncontrolled. Today this vision is changing, as there is a tendency to intentionally care less about green spaces. Indeed, there is an emphasis on biodiversity having two impacts on urban planning: the creation of green corridors and the reduction of traditional parks with intense management in favor of green spaces left to grow “wild”. This new vision is exemplified in the case of the park created in 2012 in the redevelopment of the *Quartier du Sansonnet* in Metz, but according to the city representative on this project, locals are not used to having these kinds of parks. They complain because from their point of view, when a park is not mowed, it is not pleasant to use. Some of the city

representatives found that this trend of letting the nature grow with minimum intervention is very favorable especially because they do not have the financial means to care for green spaces. In all cities, stakeholders complained about the lack of public financial resources to maintain the green spaces. For example, in Metz, the shrinkage is experienced not only in the urban planning sector but also in the green sector which will have to cut its budget of 500,000 euros in 2016.

4.3.4 Strategic planning

Whereas Metz, Magdeburg and Szczecin recently established strategic plans for the city, Salamanca does not have one. Only the southern part of the city is part of a project that is similar to a strategic plan: Tormes+. Indeed, the last revision of the City Master Plan (*Plan General de Ordenación urbana*) was in 2007, with major areas of intervention. This plan is obsolete insofar as it was created prior to the recent economic crisis – especially severe in Spain – and contains oversized urban developments, such as the construction of a very large bridge. Another interesting element is that for Salamanca and Szczecin[12], doing strategic planning is mainly a financial interest as it helps get funding for the projects[13]; in Metz and Magdeburg it is already more anchored in the culture and is considered necessary for effective planning.

In all cities except Salamanca, their strategic documents clearly mention their difficult economic and demographic situation, also the ones published for a wide audience. They take this fact as a starting point for rationalizing their future developments. Whereas Metz and Magdeburg are planning small-scale housing units in order to maintain their population, Szczecin is in another logic seeking for international investors to develop large-scale urban developments. Surprisingly and contrary to current urban planning trends, Magdeburg aims to develop more single houses in the future. They are revising their zoning plan, because they realized that although they have a very high vacancy rate, the existing dwellings[14] are not fitting the potential demand in the real estate market. Indeed, the city agent of Magdeburg explained that according to their own research, the city would have greater potential to attract new comers by building more individual housing with private gardens. This follows Müller & Siedentop (2004) prognostics about shrinking cities: “The fall in population could make it easier for cities to provide an attractive stock of larger dwellings in a pleasant residential environment.”

[12] The first Strategic planning for Szczecin was published in 2004.
[13] They both mentioned the goal of applying to European Regional Development Funds (ERDF).
[14] According to one stakeholder interviewed, about 40% of the urban fabric in Magdeburg are large development (*großsiedlung*) with more than 2,500 housing units.

4.3.5 Urban green functions

[Branding Tool]

At the neighborhood scale

In Metz and Salamanca there are two urban development projects *Quartier du Sansonnet* and *Tormes+,* which put forward the creation of new allotments. Meeting the people involved in the design and realization of these two projects resulted in a very interesting and unexpected conclusion. In both cases, the creation of these allotments is central as they use it as one of their main branding tools. In reality these allotments are not new. In both projects, the pieces of land where "new" allotments are planned were already used as allotments or agricultural land prior to the development of the project. The motivation for developing these projects is similar; they are both in vulnerable areas, not renewed for a long time and breaking with the continuity of the urban fabric but the processes are very different.

In the case of Metz, it is an area of 12 ha that belonged to 22 different landowners. This is a widespread spatial configuration that is difficult to develop because of the complexity of putting together such an important number of landowners. Nevertheless, in the context of French law, in which public institutions have a the strong expropriation power, the municipality of Metz was able to play a role and create a cohesive urban redevelopment including housing units and a large public park surrounded by these "new" allotments. To do so, they had to destroy existing gardens (*jardins-familiaux*) and rebuild them anew. According to the public agent interviewed, out of 40 existing allotments, about half were functioning, about a quarter used in a savage way (without valid permission of use) and the last quarter was unused. The park and the allotments were completed in 2012. Planning them first is a way to enhance the rest of the project by attracting real estate investors to come, buy the land and build housing units. This attraction factor, and more broadly the creation of added value is an interesting intrinsic function of urban green.

In the case of Salamanca, the nature of the project is different as it concerns a larger surface: the entire southern part of the city situated further from the city center, on the other side of the Tormes River. It is still at the concept development stage and it is a strategic plan (*Estrategia de desarollo urbano sostenible 2015-2020*) with goals and actions and only a few physical interventions. One of the latter is the creation of 1000[15]

[15] This is the number stated in the only document published in September 2014 available to the public so far (August 2015). In reality after the conversation with a person working for the contracted agency for that project, another number came out. Indeed, originally

urban gardens. They would be located in an area mainly publicly owned but of which the main current use is agriculture. In other words, if the project will be carried out, the farmers will be relocated in order to create the gardens. The idea to use land that has a functioning socio-economic activity in a shrinking city with numerous vacant and unused spaces seems strange. According to an employee of the company that designed the project, there were two main reasons for planning urban gardens on that site. First, the urban garden projects initiated in small municipalities (Santa Marta de Tormes and Carabajosa de la Sagrada) surrounding the city of Salamanca are very successful. Second, just next to the site being designed, gardening activity already exists in the form of a social enterprise aiming to help handicapped people enter the labor market. These two reasons for planning urban gardening on that site seem to show that no proper spatial analysis was carried-out but that it was designed by looking at what works elsewhere. Moreover, the promotional slogan for the project is that it will be one of the largest development of that kind in Spain. According to an interviewee from a group of young researchers, there is no demand for so many allotments; this project is just part of a political play before the city elections. In this case, urban green is not only used for project branding but also as a political tool to keep the electorates happy.

At the city scale

In Szczecin there is a strong emphasis on city branding, as the city website clearly attests:
"Miast na świecie jest mnóstwo i każde oferuje podobne funkcje. Miasta ze sobą konkurują, a wygrywają te, które potrafią zaprezentować swoja wyjątkowość. Wygrywają np. to, że mieszkańcy nie opuszczają miasta- wręcz przeciwnie chcą w nim żyć. Miasto, które wygrało konkurencje z innymi rozwija się. Dzięki marce pokazujemy innym swoją wyjątkowość, a to przekłada się na rozwój." (City of Szczecin (2011) online Szczecin.eu)

"There are plenty of cities in the World and they each offer similar features. Cities compete, those who win are those that are able to present their uniqueness. They win for example when the people do not leave the cities. On the contrary they want to live in it. Cities winning the competition with others are developing. With the brand we show others our uniqueness, and this translates into growth." (translated by Author)

1000 urban garden of 50 square meters were panned. This number was reduced to 600 during the participation process. Indeed, fruit and vegetable sellers lobbied against, afraid of losing their market. The gardens will be divided into different aims of use: about 100 for research, 300 for social economy and the rest for the municipality to be used further.

Fig. 34 - Branding logo in the City of Szczecin (Poland) [Source: City of Szczecin]

The brand logo "Szczecin, floating gardens 2050" (Fig. 34) is visible not only online but everywhere in the city, at the train station, in the bus, printed on transport tickets, etc. As we know from the interviewees, Szczecin uses existing green features to promote itself but is not really planning to focus particularly on green space. This is enough to conclude that green is used here only as a branding strategy and not in urban development strategy.

[Social tool]

At the neighborhood or city scale

In Salamanca, there is *Asprodes* association that aims to integrate handicapped people into the labor market. In Magdeburg, there is IKuGa – *Interkulturales Garten* that aims to promote tolerance towards different migrant groups. In Metz, there are for instance groups of friends in association, like the case of *Carré d'air,* (Air square) an association of 10 members that started gardening in their leisure time just because they like to spend time together. These three examples are representative of the variety of possible social functions at the neighborhood or city scale.

At the inter-city scale

Through its different networks and projects, urban gardening also has the social function of increasing collaborations between cities. In Magdeburg, one of the stakeholders involved in urban gardening talked about the fact that he and his colleagues are active through the Transition Network that is defines on their website as: "a charitable organisation whose role is to inspire, encourage, connect, support and train communities as they self-organise around the Transition model, creating initiatives that rebuild resilience and reduce CO2 emissions. ". As of 2013, this network had 1,700 various initiatives in 43 different countries. Another example of "inter-city social function" but of another kind is the collaboration between Szczecin and Berlin-Kreuzberg. There are two

types of urban green initiatives created through this collaboration. First, based on the model of *Grüner Hof* (green courtyards), in 2008, Szczecin created the same project that aimed at encouraging residents to revitalize neglected backyards. Second, in 2013, the members of the *Prinzessinnengarten* [16] in Berlin-Kreuzberg came to Szczecin to provide their expertise on launching an urban gardening projet. Unfortunately, after a year the project stopped because of lack of funding but also back of active citizens in this field.

4.3.6 Allotment versus urban gardening

On-site observations and discussions with the 16 stakeholders allow us to argue that there is no direct relationship between the amount of available green spaces and the urban gardening initiatives. Indeed, the best way to illustrate this argument is by comparing of Metz and Magdeburg. Whereas in Metz there are not enough allotments (about 300 people are on a waiting list), in Magdeburg there are too many allotments (a surplus compared to the demand). Metz is promoting urban gardening initiatives by offering help in finding a plot, connecting it to the water system, and providing fences as well as helping administratively in the creation of an association. Magdeburg does not play such a supportive role in the development of urban gardening initiatives, only some large long-lasting projects can get funding. Nevertheless, Metz counts much less urban gardening initiatives than Magdeburg. In other words, whereas in Metz there is a lack of allotments and support by the city to enhance urban gardening, only a few initiatives exist. The reverse is true of Magdeburg: there are more allotments than the people interested in having them and there is no explicit support for urban greening initiatives, but there are many initiatives happening.

Many reasons contribute to the fact that urban gardening initiatives happen in some places more than others, and this is not related to the existing green available. Also, even if the general activity “gardening” is the same, the motivations and the goals of each urban gardening project are unique. What we can state is that urban gardening fulfills a variety of functions especially social ones. In the previous section, we touched on a sample of functions that appeared in the comparison of the focus cities but entering into more details would go beyond this study. There is just one very last point that was recurred during numerous discussions with the stakeholders, the question of the urban milieu. For many stakeholders, the fact that people get involved in urban green depends a lot on the given milieu. The description of comments made during the interviews attest the importance of the social context.

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[16] It is often cited as a very successful example of urban gardening in Europe. The *Prinzessinnengarten* is an ecological and social landscape garden at *Moritzplatz* in Berlin. The 6000 m² large area remained unused for 60 years until the summer of 2009. The project of the nonprofit organization Nomadic Green converted the former brownfield into a wearing surface.

In Salamanca, no urban gardening initiatives were found in the process of this research. One possible reason for that, besides the fact that generally such initiatives are less popular in Spain compared to other countries in Europe, is the fact that the population counts numerous students, who are only staying for classes and are not able to get involved in demanding projects as they leave the city during holidays. Further, different representative from the civil society underlined that they believe the project of urban gardening *Tormes+* proposed by the city is weak and will have no success. The reason why they see a potential failure of the project is that the 1000 urban gardens are planned in a neighborhood where the population will not be interested in urban gardening. Further, they speculate that people living in wealthier areas who would be good candidates for urban gardening will not come because of the distance and the neighborhood's bad reputation. This comment implicitly suggests that there is a certain milieu for urban gardening in Salamanca.

When the representative of the city responsible for green areas in Metz was asked about the relatively low number of urban gardening initiatives, he answered that it is related to the context of the city, in which people are not used to being active. Traditionally, right wing politician were not enhancing any kind of associative civil movements. For the past 8 years, there had been leftist mayor who is in favor of bottom-up initiatives and tries to promote them. The interviewee believes that it will take time until the associative spirit takes hold in Metz.

Despite the fact that for several years the number of new allotment leases is lower than the number that are cancelled. Magdeburg has numerous urban gardening initiatives, but politicians and public institutions at large are not really supporting them. One of the interviewees explained that in his opinion it comes from the urban milieu in Magdeburg. On one side there are young progressive people inspired by the general movement of urban gardening in Germany and elsewhere. On the other, politicians and people employed in public institutions are rather conservative and not open to these kinds of initiatives especially after 40 years of centralized and bureaucratic communism.

In Szczecin the allotments stem from a long tradition and are usually used by elderly people. There are many factors that could explain why only the elderly use allotments. One explanation posed by the city agent interviewed is that because of its history the population is composed of people from all over Poland and mostly people from the countryside. Therefore, traditionally the users are people that come from the countryside and that value the land as a resource. They would care for allotments with the idea of

growing food to reduce their expenses or to even sell some of their surplus. This follows the logic of "the allotments for the poor" of the 19th Century[17]. According to the same interviewee, younger age groups in Szczecin are not interested in gardening at all; this might also explain why the urban gardening project initiated with the collaboration of *Prinzessinnengarten* in 2013 was not successful.

4.3.7 Summary

Although needed, no methodological innovation in analyzing changes in land functions could be created in the frame of this research, but results were presented in the form of a discussion. Taking a qualitative comparative approach allowed us to focus on certain points that the 4 cities experienced similarly and/or differently. In general, because of financial constraints, shrinking cities are welcoming the new way urban green in being managed today: with less care letting it grow in a more "natural" way. After presenting the perception of the changes of urban green in the past decade and for the future, two main land functions were discussed at various scales: urban green as a branding tool and as a social tool. Further, we argued that there is no direct correlation between the amount of available urban green and the number of bottom-up urban gardening initiatives. This argument suggests that the main function of urban gardening is not the green per se. Finally, we acknowledged that in the discourse of the stakeholders interviewed, the question of the urban milieu as an important factor influencing the development of urban gardening initiatives was recurrent. Beyond what was discussed in this chapter, we consider that there is an urgent need to establish methods to collect, to map or/and to display in another way the functions of urban green in order to evaluate their utility in urban environments and develop them in an intelligible way. Moreover, comparing the different practices is important not only for evaluating the benefits and threats of urban green but also to enhance functioning practices with less effort.

[17] In the industrial city of the 19th Century, urban gardens relieve overcrowding and poverty in working class neighborhoods caused by the process of industrialization and rural-urban migration. To ease the situation existing social conflict governments and church workers provided land for cultivation, they are called "gardens for the poor".

5. CONCLUSION

This research aimed to look at the way urban green is developing in European MSUA considering particularity two specific elements: density and socio-demographic dynamics. The methodology chosen for dealing with the changes in urban green follows a land system approach considering the cover, use and function of land. Numerous interesting results are presented in this work but because of data constrains they only fulfill partly the established goals.

In the first instance, the 4-class Typology Model was applied to 214 MSUA. The in-depth analysis of the changes of land cover and use show that during the short period of six years (2000-2006) more than half of the 214 MSUA recorded a change of land use concerning sport & leisure facilities and/or green urban areas. As predicted, both categories increased in terms of surface, but sport & leisure facilities increased more than green urban areas. Further, the results show that the initial assumptions based on the 4-class Typology Model could be verified. Indeed, on the one hand, regions with low density, because they have generally less built areas, have more potential for changes of their land-system. On the contrary regions with high density, because they have a low share of non-built areas have limited space in the land system for changes to happen. Additionally, competition for land is greater in growing areas than in shrinking ones. Whereas the initial assumptions are based on population density, they should have considered soil sealing as a more representative indicator for density when looking at land use changes. The correlation test between population density and soil sealing illustrates a methodological limit when using the European regional units (NUTS 3). Indeed, the size of the different regions is disproportionate, leading to biased results. Additionally, research on density at the macro-scale is particularly difficult to carry out because of the significant variations from one residential block to another. All these elements limit the comparative approach on the relation between density and urban green. Leaving out these methodological problems, the relation between density and urban green was never completely tested; we argued without empirical findings that the relation depends on the type of density considered but that initial physical features as well as (past) political decisions and regulations are playing a bigger role than density in the way urban greening is developing.

In a second step, an alternative set of data Land Use and Cover Aras Survey (LUCAS) was analyzed. Although many errors or misclassifications were detected, it breaks with the traditional data based on remote sensed images. LUCAS data collection methods provide detailed information, such as on quality of soils or type of species. What is more, its classification logic is interesting, since unlike Corine Land Cover (CLC), it clearly

divides land cover and land use allowing for a more in-depth understanding of the land system.

The third and last step provides an analysis of land functions in 4 European shrinking cities (Salamanca, Metz, Magdeburg, Szczecin). Based on strategic planning documents and 16 interviews with stakeholders concerning urban green, a discussion about two selected land functions was conducted. Urban green as a branding tool and as a social tool was illustrated at different levels from the neighborhood scale to the inter-city scale. Further, we argued that there is no relation between the number of existing allotments and the number of urban gardening initiatives. Following the interviewee comments, we emphasized the question of the urban milieu as a main factor in the present and future development of urban greening.

One last outcome resulting from this research as a whole is that it illustrates the importance of considering an interdisciplinary approach when analyzing the land system changes. Indeed, the intrinsic nature of the land is that it provides multiple contexts, making different uses possible, of which there are several functions. These functions are diversifying, or better said, they are more valued than ever before: urban green is attracting a greater number and more diverse group of stakeholders. In order to be able to better understand the changes of the land system, innovative approaches in the collection and the transmission of data are needed.

5.1 Discussion

I would like to discuss very briefly a paradox that motivated my interest, in urban green. It impacted the direction of the present research; it goes way beyond it but I am convinced that it constitutes an interesting topic worthy of reflection. The paradox I am inviting you to reflect on is the following: whereas initiatives of urban greening are taking place in urban cores, existing surrounding green plots are disappearing because of suburbanization. Indeed, for example, if the urban system is growing, taking-over built space from the center necessarily implies the need for another space elsewhere to compensate. On the one hand, greening urban centers can have undesirable effects on growing cities: it reduces densification opportunities and therefore increases suburbanization risk. On the other hand, greening urban centers can have positive impacts on shrinking cities; they can enrich the land system – for example, by reusing the urban fringe. Urban green in Europe is not yet replacing built areas to a visible extent but trends suggests that it can occur in the future; therefore, attention to this phenomenon is valuable and necessary.

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7. APPENDIX

I – Cities Sample (study cases)

The cities' sample is based on the OECD classifications of Medium-sized urban areas (MSUA) (see document: http://www.oecd.org/gov/regional-policy/all.pdf) and considers only European cities from the following countries: Austria (3), Belgium (4), Czech Republic (2), Denmark (3), Finland (2), France (26), Germany (49), Greece (1), Hungary (7), Ireland (1), Italy (21), Luxembourg (1), Netherlands (10), Norway (3), Poland (15), Portugal (3), Slovak Republic (1), Slovenia (1), Spain (19), Sweden (1), Switzerland (3) and United Kingdom (38).

For question of data availability, the urban areas had to be translated into NUTS 3 regions, this caused some compatibility issues: from 228 MSUA listed by OECD, the sample has been reduced to 214. Two types of reasons problems had to be faced:

a) 6 MSUA are located too close to a larger urban area and no separated NUTS 3 region exist. This is the case for Sabadell (in the same NUTS 3 as Barcelona); Wigan, Bolton, Oldham, Rochdale (all in the "Greater Manchester North" NUTS 3 region) and Chester (in Cheshire West and Chester Region). All of these 6 MSUA won't be considered in the sample.

b) 15 MSUA are together with at least one other MSUA in the same NUTS 3 region. Some MSUA were merged into one NUTS 3 region that we will be treated as a polycentric MSUA. This is the case for: Valenciennes, Dunerque and Douai ("Nord" NUTS 3 region); Pau and Bayonne ("Pyrénées-Atlantiques" NUTS 3 region); Arnhem and Nijmegen ("Arnhem/Nijmegen" NUTS 3 region); Bydgoszcz and Toruń ("Bydgosko-Toruński" NUTS 3 region); Alicante and Elche ("Alicante" NUTS 3 region) ; Oviedo and Gijón ("Asturias" NUTS 3 region) Doncaster and Bransley ("Barnsley, Doncaster and Rotherham" NUTS 3 region). The 13 MSUA have been reduced to 7 « polynucear » NUTS 3 regions.

Cities sample list:

Country	City	Code 2006	Code 2010	NUTS3	
Austria	Klagenfurt	AT211	AT211	Klagenfurt-Villach	Polycentric
Austria	Salzburg	AT323	AT323	Salzburg und Umgebung	Code changed
Austria	Innsbruck	AT332	AT332	Innsbruck	
Belgium	Leuven	BE242	BE242	Arr. Leuven	
Belgium	Brugge	BE251	BE251	Arr. Brugge	
Belgium	Charleroi	BE322	BE322	Arr. Charleroi	
Belgium	Namur	BE352	BE352	Arr. Namur	
Switzerland	Lausanne	CH011	CH011	Vaud	
Switzerland	Bern	CH021	CH021	Bern	
Switzerland	Luzern	CH061	CH061	Luzern	
Czech Republic	Plzeň	CZ032	CZ032	Plzeňský kraj	
Czech Republic	Olomouc	CZ071	CZ071	Olomoucký kraj	
Germany	Sindelfingen	DE112	DE112	Böblingen	
Germany	Heilbronn	DE117	DE117	Heilbronn, Stadtkreis	
Germany	Heidelberg	DE125	DE125	Heidelberg, Stadtkreis	
Germany	Pforzheim	DE129	DE129	Pforzheim, Stadtkreis	
Germany	Reutlingen	DE141	DE141	Reutlingen	
Germany	Ulm	DE144	DE144	Ulm, Stadtkreis	
Germany	Ingolstadt	DE211	DE211	Ingolstadt, Kreisfreie Stadt	
Germany	Regensburg	DE232	DE232	Regensburg, Kreisfreie Stadt	
Germany	Bamberg	DE241	DE241	Bamberg, Kreisfreie Stadt	
Germany	Erlangen	DE252	DE252	Erlangen, Kreisfreie Stadt	
Germany	Aschaffenburg	DE261	DE261	Aschaffenburg, Kreisfreie Stadt	
Germany	Schweinfurt	DE262	DE262	Schweinfurt, Kreisfreie Stadt	
Germany	Würzburg	DE263	DE263	Würzburg, Kreisfreie Stadt	
Germany	Cottbus	DE422	DE422	Cottbus, Kreisfreie Stadt	
Germany	Bremerhaven	DE502	DE502	Bremerhaven, Kreisfreie Stadt	
Germany	Darmstadt	DE711	DE711	Darmstadt, Kreisfreie Stadt	
Germany	Wiesbaden	DE714	DE714	Wiesbaden, Kreisfreie Stadt	
Germany	Gießen	DE721	DE721	Gießen, Landkreis	
Germany	Kassel	DE731	DE731	Kassel, Kreisfreie Stadt	
Germany	Fulda	DE732	DE732	Fulda	
Germany	Rostock	DE803	DE803	Rostock, Kreisfreie Stadt	
Germany	Braunschweig	DE911	DE911	Braunschweig, Kreisfreie Stadt	
Germany	Wolfsburg	DE913	DE913	Wolfsburg, Kreisfreie Stadt	
Germany	Göttingen	DE915	DE915	Göttingen	
Germany	Hildesheim	DE925	DE925	Hildesheim	
Germany	Oldenburg (Olde	DE943	DE943	Oldenburg (Oldenburg), Kreisfreie Stadt	
Germany	Osnabrück	DE944	DE944	Osnabrück, Kreisfreie Stadt	
Germany	Krefeld	DEA14	DEA14	Krefeld, Kreisfreie Stadt	
Germany	Mönchengladbac	DEA15	DEA15	Mönchengladbach, Kreisfreie Stadt	
Germany	Oberhausen	DEA17	DEA17	Oberhausen, Kreisfreie Stadt	
Germany	Wuppertal	DEA1A	DEA1A	Wuppertal, Kreisfreie Stadt	

Germany	Leverkusen	DEA24	DEA24	Leverkusen, Kreisfreie Stadt
Germany	Gelsenkirchen	DEA32	DEA32	Gelsenkirchen, Kreisfreie Stadt
Germany	Bielefeld	DEA41	DEA41	Bielefeld, Kreisfreie Stadt
Germany	Paderborn	DEA47	DEA47	Paderborn
Germany	Hagen	DEA53	DEA53	Hagen, Kreisfreie Stadt
Germany	Hamm	DEA54	DEA54	Hamm, Kreisfreie Stadt
Germany	Siegen	DEA5A	DEA5A	Siegen-Wittgenstein
Germany	Koblenz	DEB11	DEB11	Koblenz, Kreisfreie Stadt
Germany	Trier	DEB21	DEB21	Trier, Kreisfreie Stadt
Germany	Kaiserslautern	DEB32	DEB32	Kaiserslautern, Kreisfreie Stadt
Germany	Mainz	DEB35	DEB35	Mainz, Kreisfreie Stadt
Germany	Chemnitz	DED11	DED41	Chemnitz, Kreisfreie Stadt
Germany	Zwickau	DED13	DED45	Zwickau
Germany	Halle an der Saal	DEE02	DEE02	Halle (Saale), Kreisfreie Stadt
Germany	Magdeburg	DEE03	DEE03	Magdeburg, Kreisfreie Stadt
Germany	Kiel	DEF02	DEF02	Kiel, Kreisfreie Stadt
Germany	Lübeck	DEF03	DEF03	Lübeck, Kreisfreie Stadt
Germany	Erfurt	DEG01	DEG01	Erfurt, Kreisfreie Stadt
Denmark	Odense	DK031	DK031	Fyn
Denmark	Århus	DK042	DK042	Østjylland
Denmark	Aalborg	DK050	DK050	Nordjylland
Greece	Patra	EL232	EL232	Αχαΐα (Achaia)
Spain	A Coruña	ES111	ES111	A Coruña
Spain	Vigo	ES114	ES114	Pontevedra
Spain	Oviedo/Gijón	ES120	ES120	Asturias
Spain	Santander	ES130	ES130	Cantabria
Spain	Vitoria/Gasteiz	ES211	ES211	Álava
Spain	San Sebastián/Dc	ES212	ES212	Guipúzcoa
Spain	Pamplona/Iruña	ES220	ES220	Navarra
Spain	Burgos	ES412	ES412	Burgos
Spain	León	ES413	ES413	León
Spain	Salamanca	ES415	ES415	Salamanca
Spain	Valladolid	ES418	ES418	Valladolid
Spain	Alicante/Alacant-	ES521	ES521	Alicante / Alacant
Spain	Palma de Mallorc	ES532	ES532	Mallorca
Spain	Almería	ES611	ES611	Almería
Spain	Cádiz	ES612	ES612	Cádiz
Spain	Córdoba	ES613	ES613	Córdoba
Spain	Granada	ES614	ES614	Granada
Spain	Murcia	ES620	ES620	Murcia
Spain	Santa Cruz de Ter	ES709	ES709	Tenerife
Finland	Turku	FI183	FI183	Varsinais-Suomi
Finland	Tampere	FI197	FI197	Pirkanmaa
France	Reims	FR213	FR213	Marne
France	Amiens	FR223	FR223	Somme
France	Le Havre	FR232	FR232	Seine-Maritime

France	Tours	FR244	FR244	Indre-et-Loire
France	Orléans	FR246	FR246	Loiret
France	Caen	FR251	FR251	Calvados
France	Dijon	FR261	FR261	Côte-d'Or
France	Valenciennes/Du	FR301	FR301	Nord
France	Lens - Liévin	FR302	FR302	Pas-de-Calais
France	Nancy	FR411	FR411	Meurthe-et-Moselle
France	Metz	FR413	FR413	Moselle
France	Mulhouse	FR422	FR422	Haut-Rhin
France	Besançon	FR431	FR431	Doubs
France	Saint-Nazaire	FR511	FR511	Loire-Atlantique
France	Angers	FR512	FR512	Maine-et-Loire
France	Le Mans	FR514	FR514	Sarthe
France	Brest	FR522	FR522	Finistère
France	Lorient	FR524	FR524	Morbihan
France	Poitiers	FR534	FR534	Vienne
France	Pau/Bayonne	FR615	FR615	Pyrénées-Atlantiques
France	Limoges	FR633	FR633	Haute-Vienne
France	Annecy	FR718	FR718	Haute-Savoie
France	Clermont-Ferran	FR724	FR724	Puy-de-Dôme
France	Nimes	FR812	FR812	Gard
France	Perpignan	FR815	FR815	Pyrénées-Orientales
France	Avignon	FR826	FR826	Vaucluse
Hungary	Székesfehérvár	HU211	HU211	Fejér
Hungary	Győr	HU221	HU221	Győr-Moson-Sopron
Hungary	Pécs	HU231	HU231	Baranya
Hungary	Miskolc	HU311	HU311	Borsod-Abaúj-Zemplén
Hungary	Debrecen	HU321	HU321	Hajdú-Bihar
Hungary	Nyíregyháza	HU323	HU323	Szabolcs-Szatmár-Bereg
Hungary	Szeged	HU333	HU333	Csongrád
Ireland	Cork	IE025	IE025	South-West (IE)
Italy	Bergamo	ITC46	ITC46	Bergamo
Italy	Brescia	ITC47	ITC47	Brescia
Italy	Pescara	ITF13	ITF13	Pescara
Italy	Salerno	ITF35	ITF35	Salerno
Italy	Taranto	ITF43	ITF43	Taranto
Italy	Lecce	ITF45	ITF45	Lecce
Italy	Cosenza	ITF61	ITF61	Cosenza
Italy	Reggio di Calabri	ITF65	ITF65	Reggio di Calabria
Italy	Messina	ITG13	ITG13	Messina
Italy	Sassari	ITG25	ITG25	Sassari
Italy	Cagliari	ITG27	ITG27	Cagliari
Italy	Verona	ITD31	ITH31	Verona
Italy	Vicenza	ITD32	ITH32	Vicenza
Italy	Padova	ITD36	ITH36	Padova
Italy	Udine	ITD42	ITH42	Udine

Italy	Trieste	ITD44	ITH44	Trieste
Italy	Parma	ITD52	ITH52	Parma
Italy	Reggio nell Emilia	ITD53	ITH53	Reggio nell'Emilia
Italy	Modena	ITD54	ITH54	Modena
Italy	Prato	ITE15	ITI15	Prato
Italy	Perugia	ITE21	ITI21	Perugia
Luxembourg	Luxembourg	LU000	LU000	Luxembourg
Netherlands	Groningen	NL113	NL113	Overig Groningen
Netherlands	Leeuwarden	NL121	NL121	Noord-Friesland
Netherlands	Zwolle	NL211	NL211	Noord-Overijssel
Netherlands	Enschede	NL213	NL213	Twente
Netherlands	Apeldoorn	NL221	NL221	Veluwe
Netherlands	Arnhem/Nijmege	NL226	NL226	Arnhem/Nijmegen
Netherlands	Breda	NL411	NL411	West-Noord-Brabant
Netherlands	Tilburg	NL412	NL412	Midden-Noord-Brabant
Netherlands	's-Hertogenbosch	NL413	NL413	Noordoost-Noord-Brabant
Netherlands	Heerlen	NL423	NL423	Zuid-Limburg
Norway	Stavanger	NO043	NO043	Rogaland
Norway	Bergen	NO051	NO051	Hordaland
Norway	Trondheim	NO061	NO061	Sør-Trøndelag
Poland	Płock	PL121	PL121	Ciechanowsko-płocki
Poland	Radom	PL128	PL128	Radomski
Poland	Nowy Sącz	PL215	PL215	Nowosądecki
Poland	Tarnów	PL217	PL217	Tarnowski
Poland	Częstochowa	PL224	PL224	Częstochowski
Poland	Bielsko-Biała	PL225	PL225	Bielski
Poland	Rzeszów	PL325	PL325	Rzeszowski
Poland	Kielce	PL331	PL331	Kielecki
Poland	Białystok	PL343	PL343	Białostocki
Poland	Kalisz	PL416	PL416	Kaliski
Poland	Szczecin	PL424	PL424	Miasto Szczecin
Poland	Zielona Góra	PL432	PL432	Zielonogórski
Poland	Opole	PL522	PL522	Opolski
Poland	Bydgoszcz/Toruń	PL613	PL613	Bydgosko-Toruński
Poland	Olsztyn	PL622	PL622	Olsztyński
Portugal	Braga	PT112	PT112	Cávado
Portugal	Coimbra	PT162	PT162	Baixo Mondego
Portugal	Funchal	PT300	PT300	Região Autónoma da Madeira
Sweden	Uppsala	SE121	SE121	Uppsala län
Slovenia	Maribor	SI012	SI012	Podravska
Slovak Republic	Košice	SK042	SK042	Košický kraj
United Kingdom	Middlesbrough	UKC12	UKC12	South Teesside
United Kingdom	Sunderland	UKC23	UKC23	Sunderland
United Kingdom	Blackburn	UKD41	UKD41	Blackburn with Darwen
United Kingdom	Blackpool	UKD42	UKD42	Blackpool
United Kingdom	Preston	UKD43	UKD43	Lancashire CC

United Kingdom	The Wirral	UKD54	UKD74	Wirral
United Kingdom	Kingston Upon H	UKE11	UKE11	Kingston upon Hull, City of
United Kingdom	York	UKE21	UKE21	York
United Kingdom	Doncaster/Brans	UKE31	UKE31	Barnsley, Doncaster and Rotherham
United Kingdom	Huddersfield	UKE43	UKE44	Calderdale and Kirklees
United Kingdom	Derby	UKF11	UKF11	Derby
United Kingdom	Northampton	UKF23	UKF24	West Northamptonshire
United Kingdom	Stoke-on-trent	UKG23	UKG23	Stoke-on-Trent
United Kingdom	Coventry	UKG33	UKG33	Coventry
United Kingdom	Dudley	UKG34	UKG36	Dudley
United Kingdom	Walsall	UKG35	UKG38	Walsall
United Kingdom	Wolverhampton	UKG35	UKG39	Wolverhampton
United Kingdom	Peterborough	UKH11	UKH11	Peterborough
United Kingdom	Cambridge	UKH12	UKH12	Cambridgeshire CC
United Kingdom	Norwich	UKH13	UKH13	Norfolk
United Kingdom	Ipswich	UKH14	UKH14	Suffolk
United Kingdom	Luton	UKH21	UKH21	Luton
United Kingdom	Colchester	UKH33	UKH33	Essex CC
United Kingdom	Wokingham	UKJ11	UKJ11	Berkshire
United Kingdom	Milton Keynes	UKJ12	UKJ12	Milton Keynes
United Kingdom	Oxford	UKJ14	UKJ14	Oxfordshire
United Kingdom	Brighton	UKJ21	UKJ21	Brighton and Hove
United Kingdom	Southampton	UKJ32	UKJ32	Southampton
United Kingdom	Rochester	UKJ41	UKJ41	Medway
United Kingdom	Bath	UKK12	UKK12	Bath and North East Somerset, North Somerset and South Gloucestershire
United Kingdom	Swindon	UKK14	UKK14	Swindon
United Kingdom	Poole	UKK21	UKK21	Bournemouth and Poole
United Kingdom	Plymouth	UKK41	UKK41	Plymouth
United Kingdom	Exeter	UKK43	UKK43	Devon CC
United Kingdom	Swansea	UKL18	UKL18	Swansea
United Kingdom	Newport	UKL21	UKL21	Monmouthshire and Newport
United Kingdom	Motherwell	UKM36	UKM36	North Lanarkshire
United Kingdom	Aberdeen	UKM50	UKM50	Aberdeen City and Aberdeenshire

141 Green urban areas

Areas with vegetation within urban fabric, includes parks and cemeteries with vegetation, and mansions and their grounds.

Extension:
This class includes cemeteries with important vegetation coverage.

Green urban areas concern all vegetated areas greater than 25 ha which are either situated within or in contact with urban fabrics. Greenery with strips of lanes and paths may be found within these areas created for recreational use.

This heading includes:
- parks, park basins, lawns, flower beds in settlements;
- ornamental gardens;
- botanical and zoological gardens situated in settlement (urban fabric - 112) or in contact-peripheral zone of settlement;
- city squares;
- inner spaces of city blocks;
- cemeteries with vegetation in settlements;
- vegetated areas which can be used for recreational purpose even if it is not their main utilisation such as woods in urban fabric.

This heading excludes:
- city gardens (class 242);
- vegetated cemeteries outside urban fabric (class 142);
- unvegetated cemeteries inside urban fabric (class 11x).

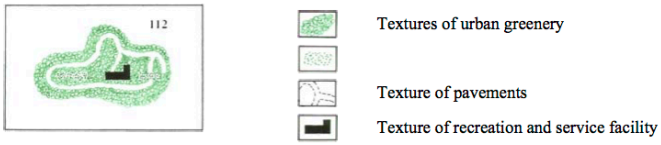

Fig. 27 A generalised pattern of the class 141

Fig. 28 Representative demonstration of the quoted class on example of the Freedom Square in Bratislava (Slovakia)

No particularity was identified in this class.

142 Sport and leisure facilities

Camping grounds, sports grounds, leisure parks, golf courses, race-courses, etc. Includes formal parks not surrounded by urban areas.

This heading includes:

- areas of sport compounds (football stadiums with the corresponding infrastructure, hockey halls, swimming pools and tennis courts, cycling stadiums, athletic halls and stadiums, etc.) within settlements and out of them;
- sport shooting-ranges;
- cemeteries with vegetation situated out of the settlements;
- camping sites;
- cottage (tourist) communities used for recreation and leisure activities outside the settlements only for temporary residence;
- zoological and botanical gardens out of settlements;
- compounds of disclosed/open archaeological sites;
- golf courses;
- racecourses;
- ski resorts (except ski pistes);
- motor – racing circuit;
- forest-parks in the periphery of settlements;
- small sport airports with non concreted or asphalted runways.

This heading excludes:

- motor-racing circuits inside industrial unit areas used for test purposes (class 121);
- caravaning parking used for commercial activities (class 121);
- beaches (class 331);
- camping areas within forests that are not specially prepared for the purpose (class 31x);
- stud farms (class 121).

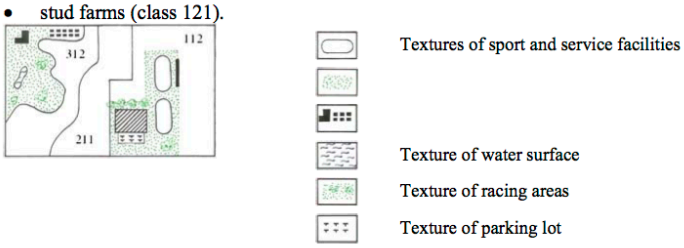

Fig. 29 A generalised pattern of the class 142

Fig. 30 Representative demonstration of the quoted class on example of sport area in Bratislava (Slovakia)

Density

Population density – [demo_r_d3dens]: the ratio of the (annual average) population of a region to the (land) area of the region; total area (including inland waters) is used when land area is not available.

Year: 2012 (except for DE803 Rostock Kreisfreiestadt, data missing completed with 2011) EUROSTAT

Dynamic (3 variables)

1) DGP-PPP (Evo2004-2008) – [MD4_GDPPPS_20120523] : Gross domestic product (GDP) in Purchasing Power Standards (PPS) at current market prices

Year: Difference between year 2004 and 2008

ESPON-MD4 Project

2) Unemployment – [INTERCO_Unemployment_rate_20121002]

Unemployment rate

Year: 2009

3) Population (Evo2007-2011) – [MD4_poptot1990-2011_20120522]

Total population, both sexes

Year: Difference between year 2004 and 2008

The classification was contrasted with:

Soil sealing – [INTERCO_Soil_sealing_20120207]

Soil sealing per capita

Year : 2006 (except for CH11 Vaud, CH21 Bern, CH61 Luzern 2009)

The data for Norway and Switzerland is missing. For Switzerland data completed from the National Statistic Office : *Office fédéral de la Statistique* (OFS)

Here are the four possible typologies according to density and socio-demographic dynamics.

1) High density and Dynamic (48 regions)
2) Low density and Dynamic (59 regions)
3) High density and Shrinking (59 regions)
4) Low density and Shrinking (48 regions)

The classes were defined according to the median value of two above-mentioned indicators. The table below shows the regions completed classification with all 214 regions.

LOW DENSITY & DYNAMIC

UKJ14	Oxfordshire	AT332	Innsbruck	GR232	Achaia
NL211	Noord-Overijssel	FR522	Finistère	FR615	Pyrénées-Atlantiques
ES532	Mallorca	ES620	Murcia	PL121	Ciechanowsko-plocki
ITD53	Reggio nell'Emilia	ITD52	Parma	PL432	Zielonogórski
UKH12	Cambridgeshire CC	FR251	Calvados	ES611	Almería
AT323	Salzburg und Umgebung	CZ071	Olomoucký kraj	CZ032	Plzenský kraj
LU000	Luxembourg	SK042	Kosický kraj	UKM50	Aberdeen City and Aberdeenshire
NL121	Noord-Friesland	PL416	Kaliski	FR633	Haute-Vienne
FR511	Loire-Atlantique	UKK43	Devon CC	ES418	Valladolid
UKH14	Suffolk	ITD42	Udine	ES220	Navarra
PL217	Tarnowski	ES130	Cantabria	FR534	Vienne
PL325	Rzeszowski	FR512	Maine-et-Loire	PL622	Olsztynski
FR718	Haute-Savoie	FR815	Pyrénées-Orientales	IE025	South-West (IE)
CH021	Bern	FR524	Morbihan	NO043	Rogaland
UKH13	Norfolk	ITE21	Perugia	FI183	Varsinais-Suomi
SI012	Podravska	ES211	Álava	SE121	Uppsala län
ES111	A Coruña	HU221	Gyor-Moson-Sopron	FI197	Pirkanmaa
DK042	Østjylland	PL343	Bialostocki	NO051	Hordaland
PL215	Nowosadecki	FR246	Loiret	NO061	Sør-Trøndelag
AT211	Klagenfurt-Villach	FR244	Indre-et-Loire		

HIGH DENSITY & DYNAMIC

UKJ32	Southampton	NL226	Arnhem/Nijmegen	NL221	Veluwe
UKH21	Luton	UKE21	York	ES212	Guipúzcoa
UKJ21	Brighton and Hove	UKM36	North Lanarkshire	PT300	Região Autónoma da Madeira (PT)
UKK41	Plymouth	UKJ11	Berkshire	ES521	Alicante / Alacant
UKK21	Bournemouth and Poole	UKL18	Swansea	ITD32	Vicenza
DE232	Regensburg, Kreisfreie Stadt	UKH11	Peterborough	ITD31	Verona
DE943	Oldenburg, Kreisfreie Stadt	UKK12	Bath and North East Somerset	NL113	Overig Groningen
DE252	Erlangen, Kreisfreie Stadt	NL412	Midden-Noord-Brabant	PL225	Bielski
DE125	Heidelberg, Stadtkreis	NL411	West-Noord-Brabant	ITC47	Brescia
DE711	Darmstadt, Kreisfreie Stadt	NL413	Noordoost-Noord-Brabant	UKF23	West Northamptonshire
ITD44	Trieste	ITD36	Padova	ITF13	Pescara
DE144	Ulm, Stadtkreis	BE251	Arr. Brugge	CH061	Luzern
DE211	Ingolstadt, Kreisfreie Stadt	BE242	Arr. Leuven	BE352	Arr. Namur
UKK14	Swindon	NL213	Twente	PL613	Bydgosko-Torunski
DEB21	Trier, Kreisfreie Stadt	ITC46	Bergamo	ITD54	Modena
UKJ12	Milton Keynes	UKH33	Essex CC	CH011	Vaud

LOW DENSITY & SHRINKING

DEA5A	Siegen-Wittgenstein	PT162	Baixo Mondego	HU323	Szabolcs-Szatmár-Bereg
DEA47	Paderborn	DE732	Fulda	HU311	Borsod-Abaúj-Zemplén
ITF43	Taranto	PL331	Kielecki	FR223	Somme
DE925	Hildesheim	FR826	Vaucluse	FR514	Sarthe
DE915	Göttingen	DE731	Kassel	HU321	Hajdú-Bihar
UKL21	Monmouthshire and Newport	FR411	Meurthe-et-Moselle	HU231	Baranya
ITF35	Salerno	DK031	Fyn	FR724	Puy-de-Dôme
FR302	Pas-de-Calais	FR812	Gard	ITG25	Sassari
FR422	Haut-Rhin	ITG27	Cagliari	DK050	Nordjylland
ES114	Pontevedra	PL522	Opolski	ES614	Granada
ITG13	Messina	ITF61	Cosenza	FR213	Marne
FR232	Seine-Maritime	PL128	Radomski	FR261	Côte-d'Or
ITF65	Reggio di Calabria	FR431	Doubs	ES613	Córdoba
ES612	Cádiz	ES120	Asturias	ES413	León
PL224	Czestochowski	HU211	Fejér	ES415	Salamanca
FR413	Moselle	HU333	Csongrád	ES412	Burgos

HIGH DENSITY & SHRINKING

UKD42	Blackpool	DE262	Schweinfurt, Kreisfreie Stadt	UKC12	South Teesside
UKG35	Wolverhampton	UKJ41	Medway	UKE43	Calderdale and Kirklees
UKE11	Kingston upon Hull, City of	DE944	Osnabrück, Kreisfreie Stadt	DEA54	Hamm, Kreisfreie Stadt
UKG33	Coventry	DE714	Wiesbaden, Kreisfreie Stadt	BE322	Arr. Charleroi
UKF11	Derby	PL424	Miasto Szczecin	DEG01	Erfurt, Kreisfreie Stadt
UKG34	Dudley	DE911	Braunschweig, Kreisfreie Stadt	DEB32	Kaiserslautern, Kreisfreie Stadt
DEA17	Oberhausen, Kreisfreie Stadt	DE241	Bamberg, Kreisfreie Stadt	ITE15	Prato
UKG23	Stoke-on-Trent	DEA41	Bielefeld, Kreisfreie Stadt	UKE31	Barnsley, Doncaster and Rotherham
UKG35	Walsall	DE117	Heilbronn, Stadtkreis	DE422	Cottbus, Kreisfreie Stadt
DEA32	Gelsenkirchen, Kreisfreie Stadt	DE129	Pforzheim, Stadtkreis	DE112	Böblingen
DEA1A	Wuppertal, Kreisfreie Stadt	DE502	Bremerhaven, Kreisfreie Stadt	DE913	Wolfsburg, Kreisfreie Stadt
DEB35	Mainz, Kreisfreie Stadt	DEA53	Hagen, Kreisfreie Stadt	FR301	Nord (FR)
DEF02	Kiel, Kreisfreie Stadt	DEE03	Magdeburg, Kreisfreie Stadt	ES709	Tenerife
DEA24	Leverkusen, Kreisfreie Stadt	DE803	Rostock, Kreisfreie Stadt	UKD43	Lancashire CC
UKD54	Wirral	DE261	Aschaffenburg, Kreisfreie Stadt	DED13	Zwickau
UKC23	Sunderland	DED11	Chemnitz, Kreisfreie Stadt	PT112	Cávado
DEE02	Halle (Saale), Kreisfreie Stadt	UKD41	Blackburn with Darwen	DE721	Gießen, Landkreis
DEA14	Krefeld, Kreisfreie Stadt	DEB11	Koblenz, Kreisfreie Stadt	ITF45	Lecce
DE263	Würzburg, Kreisfreie Stadt	DEF03	Lübeck, Kreisfreie Stadt	UKD43	Blackpool
DEA15	Mönchengladbach, Kreisfreie Stadt	NL423	Zuid-Limburg		

Fig. 35 – Detailed list of regions in the applied 4-class typology, Source: Author

Austria:

The three Austrian regions are all classified in the low density and dynamic category. Only in **Innsbruck** land use changes are noted: 5.695543185 ha of sport and leisure facilities were transformed into construction site but the loss have been largely compensated by a total of 172.3620812 ha turned into sport and leisure facilities.

Belgium:

No changes to or from „green urban areas“ and „sport & leisure facilities“.

Switzerland:

The region **Luzern** has no changes. By 2006, **Bern** region increased its territory with sport and leisure facilities by transforming a plot of 117.1107649 ha classified as construction site in 2000. Finally, **Vaud** region, increased its sport and leisure facilities (20.20620194 ha previously marked as construction site) but simultaneously lost 3 plots to green urban area transforming them into both industrial and commercial units (14.77199773 ha) as well as construction sites (12.47819166 ha). Whereas Luzern and Bern are categorized with a low density and dynamic, the region Vaud is highly dense and dynamic.

Czech Republic:

Plzensky Kraj increased its sport and leisure facilities by changing 10 units from different initial uses, mainly agricultural areas (pastures, arable land and land occupied by agriculture with a high share of natural vegetation) and forest totaling a surface of 189.9497165 ha. In contrast, only 5.035408321 ha were changed from sport and leisure facilities to agricultural arable land. **Olomoucky Kraj** indicates only one plot change: 5.035408321 ha were transformed from pasture to sport and leisure facilities. Both regions Plzensky kraj and Olomoucky kraj present a low density and are dynamic.

Germany:

In general little changes in land use concerning green urban and sport leisure facilities are visible in Germany, yet some changes are found in a couple of regions.

In **Reutligen** region one plot of 69.26438233 ha was transformed from arable land to sport and leisure facilities. In **Würzburg**, a small plot of 8.683656115 ha became sport and leisure facilities listed in 2000 as construction site. The figures shows that during the period 2000-2006, **Bremerhaven** region reduced 8.683656115 ha of land dedicated to sport and leisure facilities transforming it to discontinuous urban fabric. **Rostock** region changed 17.74038064 ha of natural grassland to sport and leisure facilities.

Braunschweig region transformed 5.942110579 ha of its arable land to sport and leisure facilities. Interestingly, **Wolfsburg** region changed 5.625596725 ha of its green urban area to sport and leisure facilities. Moreover, Wolfsburg transformed 16.78473572 ha of agriculture area (complex cultivation pattern) and 14.08610693 ha of natural grassland to sport and leisure facilities. **Hildesheim** and **Mönchengladbach** present a similar trend; they transformed plots of arable land to sport and leisure facilities of surfaces respectively 26.33999168 ha and 20.98615803 ha. **Oberhausen** region changed 34.6051210 ha of construction site to sport and leisure facilities. **Leverkusen** also changed its construction site with a surface area of 35.78530412 ha but to green urban areas. Land changes in Hamm region indicate decrease of green urban areas (12.90263592 ha) converted into industrial and commercial units. In **Siegen-Wittgenstein**, an increase of 13.6705262 ha of sport and leisure facilities to the detriment of « Land principally occupied by agriculture, with significant areas of natural vegetation ». **Magdeburg** gained 35.14433078 ha of green urban areas by transforming a dump-site; it also increased its sport & leisure facilities with a surface of 33.50978368 ha listed in 2000 as plots of pastures. **Kiel** lost 33.50978368 ha of green urban areas by converting it into industrial or commercial use. Finally, **Lübeck** and **Erfurt** regions both converted their arable land to sport and leisure facilities with a respective surface of 39.73895787 ha and 20.27329727 ha.

Spain:

In **A Coruña** region, both green urban and sport leisure facilities increased during the period 2000-2006. Concerning the green urban areas, its growth comes mainly from the transformation of « Land principally occupied by agriculture, with significant areas of natural vegetation » (19.29239382 ha) and a small plot of continuous urban fabric (0.801547496 ha). The land dedicated to sport and leisure facilities rise with a total 94.35201603 ha gathering very different land-uses: construction sites, mixed forest, transitional woodland-shrub, agriculture and agro-forestry. **Pontevedra** region increased its green urban facilities with a surface of 8.179098479 ha taken from agricultural areas (complex cultivation patterns) and its sport and leisure facilities with a total surface of 77.01988055 ha earlier listed as: transitional woodland-shrub, construction site and coniferous forest. In contrast to A Coruña and Pontevedra, in **Asturias** a decrease of 7.152900682 ha of green urban areas in favor of a construction site is noted. However, sport and leisure facilities increased with a total of 49.70694298 ha taken from both types of agriculture areas: pastures and transitional woodland-shrub. In **Cantabria** the figures show an increase of 82.40540291 ha dedicated to sport and leisure facilities at the expense of construction sites, pastures and forests. In **Guipúzcoa** region, a construction site has replaced 12.93693734 ha of green urban area. Simultaneously, the surface for sport and leisure facilities increased by 29.70037012 ha listed as pastures, transitional woodland-shrub and forest. In **Navarra**, 28.43119309 ha of green urban areas were lost

in favor of a construction site and 15.31590415 ha in favor of urban fabric. Nevertheless at the same time, the loss was compensated by arable land converted into green urban facilities totaling 49.73146269 ha. The balance of the land changes in Navarra indicates a small increase of green urban areas of 5.984365447 ha. Also a light increase of sport and leisure facilities can be identified: 5.023493967 ha take from arable land.

In **Burgos** (25.34296764 ha), **Leon** (44.9992058 ha), **Salamanca** (56.78601057 ha), **Valladolid** (57.39731214 ha), **Alicante** (205.0980616 ha) and **Almeria** (485.1815346 ha) sport and leisure facilities increased. It is interesting to note the particularly large surfaces in Alicante and Almeria. In **Cadiz,** whereas 49.19304068 ha of green urban areas were lost, 55.66248475 ha converted from transitional woodland-shrub were gained. In sum, the surface of green urban areas increased by 6.469444073 ha. On the other hand, a large number of different plots were converted into sport and leisure facilities totaling 606.2448175 ha. In **Granada** region, 36.97580744 ha of arable land were converted to sport and leisure facilities. In **Murcia** region, a total increase of 1001.977981 ha of sport and leisure facilities from various types of uses, mainly agricultural areas. Finally, **Tenerife** region increased its green urban areas by 30.39883554 ha taken from sclerophyllous vegetation. Sport and leisure facilities also increased in Tenerife with a sum of different plots reaching 272.6566413 ha.

Finland:

In **Varsinais-Suomi** region sport and leisure facilities increased by 350.4678109 ha replacing various type of uses as agricultural and forests. In **Pirkanmaa,** 5.148896002 ha of green urban areas become sport leisure facilities. In total, 169.170572 ha of pasture and forest were transformed to sport and leisure facilities.

France:

In the **Somme** department 43.6507371 ha of pasture were changed into sport and leisure facilities. In Seine-maritime 22.3570915 ha of pasture and 24.48982125 ha of arable land became sport and leisure facilities. In **Calvados**, a decrease of sport and leisure facilities is visible: 24.48982125 ha became construction site and 11.04512315 ha were converted into urban fabric. In parallel to that 6.777713675 ha of arable land were abandoned in favor of sport and leisure facilities. In total, there is a loss of 16.34152013 ha of sport and leisure facilities. In the **Côte-d'Or** department, 12.66779229 ha of green urban areas were listed as construction site in 2006. In **Nord** department, green urban facilities increased its surface by 31.57837311 ha taken from arable land. Sport and leisure facilities also increased (83.70743058 ha) replacing various uses: moors and heathland, transitional woodland-shrub, Beaches, dunes, sands, forest and arable land. In **Pas-de-Calais**, 6.161653524 ha of industrial of commercial area were transformed into green

urban areas and 13.51094421 ha of arable land into sport and leisure facilities. In **Meurthe-et-Moselle**, 12.78695772 ha of sport and leisure facilities were changed into water bodies. In **Haut-Rhin**, 19.11676083 ha of arable land became sport and leisure facilities. In **Doubs**, 7.273094107 ha of green urban areas became construction site. On the other hand, sport and leisure facilities gain surface in the detriment of agricultural land and forest (35.65689006 ha).

In **Loire-Atlantique**, 58.3571314 ha of agricultural land were transformed into sport and leisure facilities. In **Maine-et-Loire**, 69.67306003 ha of arable land were converted into sport and leisure facilities. In **Sarthe**, there is a decrease of sport and leisure facilities totaling a loss of 17.23788374 ha: 8.749013376 ha in favor of industrial or commercial units and 8.488870367 in favor of urban fabric. In **Finistère**, an increase of 11.51868025 ha of sport and leisure facilities taken from both pastures and agriculture areas. In **Haute-Vienne**, sport and leisure facilities gain 33.95799051 ha converted from pastures and forest. In **Haute-Savoie**, 22.68075318 ha of green urban areas were muted into construction sites. In **Puy-de-Dôme**, the surface dedicated to sport and leisure facilities increased by 153.5637513 ha in detriment of pastures, forests and fruit trees and berry plantation. In the **Gard,** whereas 21.89250498 ha of sport and leisure facilities disappeared in favor of urban fabric, 89.52669279 ha were converted to leisure facilities, taken from construction sites, agricultural areas and transitional woodland-shrubs. Finally, in **Pyrénées-Orientales**, sport and leisure facilities gained 26.49987019 ha taken away from agricultural areas and vineyards.

Hungary:

In **Gyor-Moson-Sopron** region, a great loss of sport and leisure activities is visible: 212.7123775 ha were converted to an airport. This loss was partly compensated by the conversion of 140.8695653 ha of mainly arable land and pastures. Nevertheless, the balance indicates an overall decrease of sport and leisure facilities of 71.84281221 ha. In **Baranya** region, 6.853141202 ha of pastures were transformed into sport and leisure facilities. In **Borsod-Abauj-Zemplen** region 8.423620444 ha of green urban areas was muted into urban fabric and 11.29627987 of pasture into sport and leisure facilities. In **Szabolcs-Szatmar-Bereg**, whereas 5.350270506 ha of green urban areas were transformed into urban fabric, 17.42234609 ha listed in 2000 as construction sites became green urban area. Finally, in **Csongard**, 15.72293483 ha of green urban areas were lost in favor of urban fabric and 22.04495176 ha of arable land were converted into sport and leisure facilities.

Ireland:

The **South-West** region lost a large surface of its green urban areas in favor of urban fabric and construction sites totaling a loss of 66.64840408 ha.

Italy:

In **Sassari**, 7.650279434 ha of sclerophyllous vegetation were converted into sport and leisure facilities. In **Taranto**, an increase of 36.12028485 ha of sport and leisure facilities, in detriment of arable land, vineyards and fruit trees and berry plantations.

In **Cosenza**, 62.71963811 ha were transformed into sport and leisure facilities taken away from agricultural areas as well as fruit trees and berry plantations. In **Lecce**, 129.5296739 ha were transformed into sport and leisure facilities in detriment of mainly forest and some agricultural areas. Finally, in **Cagliari** a construction site of 25.07703567 was converted into green urban areas and 112.0896202 ha of mainly arable land and forest became surfaces of sport and leisure facilities.

Luxembourg:

The entire country is one NUTS 3 region called **Luxembourg**. Whereas, 12.57642067 ha listed in the category green urban areas in 2000 became construction sites, in 2006, 6.591852524 ha of pastures and forests were converted in sport and leisure facilities.

Netherlands:

For its territorial size, Netherlands has many land changes in many of its regions belonging to the sample of cities chosen for this research. In **Groningen**, 16.80339582 ha of arable land were converted into green urban areas. Simultaneously, 9.292923886 ha of sport and leisure facilities were reported as construction sites but these were compensated by an increase of 15.45135572 ha in detriment of pastures and agricultural land. In **Noord-Friesland**, there is an increase of 39.27823736 ha of green urban areas; the land was taken from construction sites and transitional woodland-shrub. Sport and leisure facilities lost of 22.42712433 ha in favor of industrial or commercial site, but gained 50.28841385 ha taken from pastures.In **Noord-Overijssel**, 132.7124265 ha of pastures, arable lands and construction sites were converted into sport and leisure facilities.

A lot of changes are observable in **Twente**: 30.2428116 ha of green urban areas were converted into industrial or commercial units; 15.10141247 ha of Land principally occupied by agriculture, with significant areas of natural vegetation was converted into green urban areas; 18.00913695 ha of sport and leisure facilities were converted into urban fabric; and 192.0966278 ha of various uses (mainly pastures and forests) became sport and leisure facilities. To sum up, green urban areas decreased but sport and leisure

facilities increased. In **Veluwe**, 14.62350685 ha of pastures were converted into green urban areas and 14.62350685 ha of pastures into sport and leisure facilities. In **Arnhem/Nijmegen**, 60.85840275 ha of pastures were muted into green urban areas. Sport and leisure facilities lost 70.5287891 ha in favor of construction sites and urban fabric but gained 81.76871875 ha in detriment of pasture and agricultural areas.

In **West-Noord-Brabant**, 57.04532066 ha of land for sport and leisure facilities was transformed into either urban fabric of construction site, but on the reverse 328.7806 ha of various uses (agricultural areas and construction sites) were converted into sport and leisure facilities. In **Midden-Noord-Brabant**, 332.8837306 ha of various uses (construction site, agricultural land and pasture) were converted into sport and leisure facilities. In **Noordoost-Noord-Brabant**, whereas 17.61941828 ha of sport and leisure facilities were converted into industrial or commercial units, on the contrary 136.8154319 ha of arable land, pastures and construction sites were converted into sport and leisure facilities. Finally, **Zuid-Limburg** region many changes occurred: 10.26521566 ha of green urban areas were listed as construction site in 2006; 58.42735279 ha of arable land and agricultural areas were converted into green urban areas; 20.86148749 ha of sport and leisure facilities were transformed into urban fabric; and 139.3540824 ha of mainly agricultural land was converted into sport and leisure facilities. To sum up, during the period 2000-2005, in Zuid-Limburg, both green urban areas and sport and leisure facilities increased.

Poland:

In **Nowosadecki** region, the area dedicated to sport and leisure facilities increased by 44.36582819 ha taken from forests and pastures.In **Czestochowski** region, 73.797988 ha of pastures were converted into sport and leisure facilities. In **Bielski** region 15.79391191 ha of construction site became green urban areas. In **Kaliski,** 9.212380294 ha of green urban areas were muted into industrial or commercial units. In **Szczecinski** region, 108.8811865 of arable land were transformed into sport and leisure facilities. In **Opolski**, 13.48580032 ha of industrial or commercial unit were converted into green urban units and 5.062600833 ha of arable land into sport and leisure facilities. In **Torunsko-wloclawski** region, 9.455343742 ha of green urban areas were listed as construction sites in 2006.

Portugal:

In **Cávado**, many changes occurred, 13.11233813 ha of green urban areas were converted into construction sites and industrial and commercial units; 24.1579841 ha of sport and leisure facilities lost in favor of urban fabric; and 7.942650546 ha of construction site was transformed into sport and leisure facilities. To sum up, in Cávado,

a decrease of surface dedicated to both green urban areas and sport and leisure facilities during the period 2000-2006 is striking. In **Mondego** region, 9.032250493 ha of agricultural area and 4.903960582 ha of construction site were converted into sport and leisure facilities, a change totaling 13.93621108 ha.

Sweden:

In **Uppsala**, on one hand 6.802829755 ha of green urban areas were lost in favor of « roads and rail networks and associated land ». On the other, its surface for sport and leisure facilities has increased with 113.9113598 ha in detriment of arable land, mixed forest and transitional woodland-shrub.

Slovenia:

The only region considered is **Podravska** including Maribor city, no changes in the categories green urban areas neither sport and leisure facilities have been listed during the period 2000-2006

Slovak Republic:

In **Košický kraj**, 33.35482341 ha of agricultural area were converted into sport and leisure facilities

United Kingdom:

In **Lancashire CC**, 118.8143349 ha of mineral extraction site and 6.033894954 ha of pastures were transformed into sport and leisure facilities. In **Barnsley, Doncaster and Rotherham**, 86.13870365 ha of mineral extraction site and 74.93474668 ha of industrial or commercial units were converted into green urban areas. In **Calderdale and Kirklees**, 6.343037955 ha of green urban areas were lost in favor of industrial and commercial units and 155.87346 ha of land principally occupied by agriculture, with significant areas of natural vegetation were converted into sport and leisure facilities. In **Northamptonshire**, 5 small plots of green urban units totaling 39.91783324 ha were listed as construction sites in 2006. In **Coventry**, 61.7376174 ha of green urban areas were lost in favor of urban fabric. In **Cambridgeshire**, 58.09785698 ha of agricultural areas and 35.38947844 ha of construction site became green urban areas. Moreover, 32.8539688 ha of arable land were converted into sport and leisure facilities. In **Norfolk**, in total, 88.24439605 ha of arable land and construction site were transformed into sport and leisure facilities.

In Suffolk, 48.43189492 ha of arable land were lost in favor of sport and leisure facilities. The same scheme occurs in **Luton** region, with 71.86791321 ha of arable land converted into sport and leisure facilities.

In **Berkshire**, 36.66857436 ha of land principally occupied by agriculture, with significant areas of natural vegetation and 10.27675782 ha of forest became sport and leisure facilities. In **Oxfordshire**, 14.00217406 ha of arable land and 13.61366389 ha of industrial or commercial units were converted into sport and leisure facilities. In **Medway**, 12.21492249 ha of green urban units were lost in favor of urban fabric. In **North and North East Somerset, South Gloucestershire**, on one hand 12.15646477 ha of green urban areas and 7.078865956 ha of sport and leisure facilities were lost in favor of urban fabric. On the hand, 100.3647224 ha of pastures were converted into sport and leisure facilities. In **Swindon**, 8.211049147 ha of green urban areas were listed as construction site in 2006. In **Plymouth**, 11.93619692 ha and 6.930803191 ha of green urban areas are lost in favor of respectively industrial or commercial units and urban fabric. In **Devon CC**, whereas 52.3035498 ha of green urban areas are converted into industrial or commercial units, sport and leisure facilities gained 188.0416142 ha from various plots: pastures, arable land, coniferous forest, moors and heathland and transitional woodland-shrub. In **Swansea and Newport**, large areas of pastures have been converted into sport and leisure facilities: respectively 107.9256537 ha and 538.5576667 ha. Finally, in **Lanarkshire** of green urban areas were converted into urban fabric.

V – Interviewee List

RAMON GARACHANA ALONSO (Urban planner, TAU planificacion territorial S.L, Madrid)

JESUS MARIA HERNANDEZ MESANERO (Director, *Ciudadanos por la Defensa del Patrimonio,* Salamanca – Citizens for the defense of patrimony*)*

JESUS DELGADO MESANERO (Representative, *Ciudadanos por la Defensa del Patrimonio,* Salamanca - Citizens for the defense of patrimony*)*

JUAN IGNACIO PLAZA (Director, Geography department in University of Salamanca)

MARCOS MERINO (Member, *Instituto de Investigaciones Cientificas y Ecologicas* – Institute for research in science and ecology)

MARA RUIY LOZANNO (Member, *Instituto de Investigaciones Cientificas y Ecologicas* – Institute for research in science and ecology)

NICOLAS GUILBEAU (Operations manager - *Pôle Urbanisme, habitat et planification urbaine, Metz* – Section urbanism, housing and urban planning)

CHARLES BEISS (Member, *Association Carré d'air, Metz* - Urban gardening)

MICHEL KOENIG (Director, *Pôle Parcs, Jardins et Espaces Naturels, Metz* – Section gardens and natural areas)

STEPHAN HERRMANN (Employee, *Landeshauptstadt Magdeburg Stadtplanungsamt Stadterneuerung / Untere Denkmalschutzbehörde* – Magdeburg city urban planning office, urban renewal and lower monument protection authority)

ERIC REISSIG (Initiator, urban gardening Werk 4)

SCHLOMO HETZEL (Initiator, urban gardening Werk 4)

RALF WEIGT (Social worker, active in urban gardening – transition town network)

STEPHAN WESTERMANN (Urban planner, Büro Stephan Westermann Stadt und Landschaftsplanner – city and landscape planner)

EWA KURJATA (Urban planner, *Biuro Strategii miasta Szczecin* – City strategic office)

KRZYSZTOF MICHALSKI (Director, *Biura Planowania Przestrzennego Miasta Szczecin* – City spatial planning office)

VI – LUCAS linked uses according to the cover

This table shows all the changes affecting U361, U362 or U400/420 that occurred between 2006 and 2012. The links uses according to the cover and the frequency of occurrence are found in that table.

Use type	Cover type	Frequency of occurrence	General use	Linked uses according to cover
U361	A21	1	Non built-up area features	Parking areas of leisure and recreation activities, tennis courts
Amenities. Museum & leisure	A22	1	Non built-up linear features	Roads utilised for specific purposes of leisure, riding tracks, car racing circuits
	E10	4	Grassland with sparse tree/shrub cover	Grassland for recreation: public gardens, golf courses and nature reserves
	E20	6	Grassland without tree/shrub cover	Grassland for recreation: public gardens, golf courses, sports fields and nature reserves
	G10	3	Inland water bodies	Swimming pools
	G20	1	Inland running water	Recreation, leisure, sport
U362	A21	1	Non built-up area features	Parking areas of leisure and recreation activities, tennis courts
Sport	C10	1	Broadleaved woodland	Wooded areas specifically managed for recreational purposes and in nature reserves
	C21	2	Other broadleaved tree land	Wooded areas specifically managed for recreational purposes and in nature reserves
	E10	1	Grassland with sparse tree/shrub cover	Grassland for recreation: public gardens, golf courses and nature reserves
	E20	5	Grassland without tree/shrub cover	Grassland for recreation: public gardens, golf courses, sports fields and nature reserves
	H11	1	Inland marshes	Not specified
400/420	C10 (C11)	14	Broadleaved woodland	Wooded areas not utilized
Unused / Semi-natural & natural areas not in use	C20 (C21)	8	Coniferous woodland	Wooded areas not utilized
	C30 (C13)	3	Mixed woodland	Wooded areas not utilized
	D10 (D01)	16	Shrubland with sparse tree cover	Natural shrubland areas and areas outside agricultural areas not utilized
	D20 (D02)	21	Shrubland without tree cover	Natural shrubland areas and areas outside agricultural land not utilised
	E10 (E01)	10	Grassland with sparse tree/shrub cover	Natural grassland or grassland outside agricultural areas not utilized
	E20 (E02)	14	Grassland without tree/shrub cover	Natural grassland grassland outside agricultural not utilized
	E30	2	Spontaneously re-vegetated surfaces	Unused, spontaneously vegetated land
	F00 (F40)	12	Bare land and lichens/moss	Bare areas not utilised (inland rocks, top mountains)
	G10	2	Inland water bodies	Unutilized bodies of water
	G20 (G02)	4	Inland running water	Not utilized

Fig. 36 – Summary of all changes related the U360 and U400 in LUCAS, data: EUROSTAT, Source: Author