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ABSTRACT

Urbanisation, urban growth and planning in the Copenhagen Metropolitan Region with reference studies from Europe and the USA

87 % of the Danish population lives in urban areas and thus urbanisation in Denmark may have come to an end, but urban growth has not. We are continuously using more and more urban land per capita, and the pace is increasing. Every year, around 15 km^2, the size of the city of Ringsted, become transformed from natural to urban land in Denmark. A driving force behind this is the emergence of metropolitan regions, which integrate vast parts of rural areas into the urban system. Peri-urban areas are one of the hot spots of change. Agricultural and nature areas are under significant transformation pressure. Growth management strategies are necessary to secure future balanced and sustainable development throughout the whole urban region.

The analysis of urbanisation and urban growth in peri-urban areas is at the core of this study, including socio-demographic and functional dynamics, land use impacts and options for spatial planning. The main case was the metropolitan region of Copenhagen, Denmark. Other cases from Europe and the USA were used as reference studies. The methods included quantitative analyses of register and land use data as well as general case study work to investigate options for spatial planning.

The study shows that, while the most visible impacts of land use changes can be found at the close urban fringe, many other dynamics have a much longer reach into the rural-urban region. In the Copenhagen metropolitan region, we can observe migration to peri-urban areas and to the urban core in parallel, but dominated by different social groups. Peri-urban agriculture is adapting to this through multifunctional practices including non-productive activities as well as urban-oriented services. Nature areas are, in many cases, well protected. However, the areas closest to cities are still threatened, and urban sprawl remains a problem. The recent economic crisis has slowed down urbanisation in the most distant areas of the Copenhagen metropolitan region, which is consolidating.

This project was funded by the Centre for Strategic Urban Research (Realdania Research) and the EU-FP6 integrated research project "PLUREL - Peri-urban land use relationships -Strategies and Sustainability Assessment Tools for Urban-Rural Linkages" (EC FP6 036921).

RESUMÉ (DANISH ABSTRACT)

Urbanisering, byvækst og planlægning i Storkøbenhavn samt referencestudier fra Europa og USA

87% af den danske befolkning bor i byområder - urbanisering i Danmark har nået et højdepunkt. Samtidig vokser byerne videre: Hvert år bliver 15 km^2 – et areal på størrelse med Ringsted – omdannet til byformål i Danmark. Tidligere perifere landdistrikter påvirkes af urbaniseringen som følge af dannelsen af metropolregioner, hvoraf de bynære (peri-urbane) områder er et af forandringens brændpunkter. Landbrugs- og naturområder er under stærkt transformationspres. Planlægningsstrategier er nødvendige for at sikre en fremtidig afbalanceret og bæredygtig udvikling i hele byregionen.

Analyse af urbanisering og byvækst i bynære områder er kernen i denne undersøgelse, herunder socio-demografisk og funktionel dynamik, konsekvenser for arealanvendelsen og muligheder for fysisk planlægning. Hovedstadsområdet er hovedcasestudiet, men andre europæiske byregioner og byer fra USA er brugt som referenceundersøgelser. Metoderne omfatter kvantitative analyser af register- og arealanvendelsesdata samt en kvalitativ analyse af planlægningsværktøjer.

Undersøgelsen viser, at selvom de fleste ændringer i arealanvendelse kan findes tæt på byerne, så er der mange andre faktorer, som påvirker udviklingen i et langt større geografisk område. I hovedstadsområdet kan vi se tilflytning til både peri-urbane områder og til bykernen, men domineret af forskellige sociale grupper. Det peri-urbane landbrug tilpasser sig i form af multifunktionelle og ikke-produktionsrelaterede aktiviteter, samt byorienterede aktiviteter. Naturområder er i mange tilfælde godt beskyttet - dog er de områder, der ligger tættest på byerne stadig truet, og byspredning er et fortsat problem. Den seneste økonomiske krise har bremset urbanisering i nogle af de peri-urbane områder i hovedstadsområdet, og regionen er i en fase af konsolidering.

Projektet er finansieret af Center for Strategisk Byforskning (Realdania Forskning) og EU-FP6 forsknings-projektet "PLUREL - Peri-urban land use relationships - Strategies and Sustainability Assessment Tools for Urban-Rural Linkages" (EC FP6 036921).

ZUSAMMENFASSUNG (GERMAN ABSTRACT)

Verstädterung, Stadtwachstum und Planung in der Stadtregion Kopenhagen mit Referenzstudien aus Europa und den USA

87% der dänischen Bevölkerung leben heute in städtischen Gebieten. Wahrscheinlich hat die Verstädterung in Dänemark ihren Höhepunkt erreicht, gleichzeitg aber wachsen die Städte weiter. Wie in anderen europäischen Ländern steigt der Flächenverbrauch pro Kopf stetig an. Die Entstehung von Metropolregionen hat zu einer Verflechtung von großen Teilen der stadtnahen (peri-urbanen), ländlichen Räume geführt. Peri-urbane Räume sind Brennpunkte der Veränderung, besonders Landwirtschaftsflächen und Naturgebiete stehen unter starkem Druck. Planungsstrategien müssen die Heterogenität von peri-urbanen Räumen berücksichtigen, um eine ausgewogene und nachhaltige Entwicklung in der gesamten Stadtregion zu sichern.

Der Kern dieser Arbeit umfasst die Analyse von Verstädterung und urbaner Flächenexpansion in peri-urbane Räume, mit besonderem Gewicht auf sozio-demographischen und funktionellen Dynamiken, Auswirkungen auf die Flächenutzung und Möglichkeiten der Raumplanung. Die Stadtregion Kopenhagen in Dänemark dient dabei als Beispiel. Weitere Städte aus Europa sowie den USA wurden als Referenzstudien eingebunden. Die Untersuchung enthält quantitative Analysen von Register- und Flächennutzungsdaten sowie qualitative Studien von Planungsinstrumenten.

Die Studie zeigt, dass, während ein Großteil der Flächennutzungsänderungen am Stadtrand stattfindet, andere Dynamiken Einfluss auf einen geographisch wesentlich weiteren Raum haben. Zuwanderung in Kopenhagen findet im Zentrum, als auch in peri-urbanen Räumen statt, jedoch von sehr unterschiedlichen sozialen Gruppen. Landwirtschaft in peri-urbanen Räumen passt sich durch Mulitfunktionalität und einer Zunahme von nicht-produktionsrelevanten, stadt-orientierten Aktivitäten an. Naturgebiete sind in vielen Fällen geschützt. Flächen am direkten Stadtrand sind jedoch weiterhin bedroht, und Zersiedelung bleibt ein Problem. Durch die aktuelle Finanzskrise hat sich der Druck auf die weniger gut angebundene Räume in der Metropolregion Kopenhagen etwas entschärft, welche sich derzeit in einer Phase der Konsolidierung befindet.

Dieses Projekt wurde durch das "Centre for Strategic Urban Research (Realdania Research)" und dem EU-RP6 Forschungsprojekt "PLUREL - Peri-urban land use relationships -Strategies and Sustainability Assessment Tools for Urban-Rural Linkages" (EC FP6 036921) gestützt.

PREFACE

This thesis is the result of my PhD studies commenced in March 2008 at the Danish Centre for Forest, Landscape and Planning, University of Copenhagen. It deals with issues of urbanisation and urban growth within the subjects of human geography and spatial planning. It consists of four research articles, one research note and this synthesis. But doing a PhD (in Denmark) is much more than writing a thesis or submitting papers. It incorporates taking courses, participating in conferences, visiting other institutions and being engaged in teaching as well as other research projects at the host institution. These activities contribute essentially to one's professional development and were a great motivation for me to conduct such a study. Some of these activities are documented in my CV and the list of publications at the end of this thesis. I also started a research blog in November 2009 (landblend.wordpress.com) to publish "by-products" of my work; draft results or things which do not get published other places.

Writing a dissertation is a 'one-person' project. However, I had the pleasure to join-up with several colleagues to work on research projects and write papers related to this PhD in the last four years and I am thankful for that experience. I would like to express my gratitude to my supervisors Gertrud Jørgensen, Thomas Sick Nielsen and Stephan Pauleit for their engagement in the project, their valuable comments on many drafts and their general support during the time. Thanks to Mette Fabricius Madsen, Søren Bech Pilgaard Kristensen, Anne Gravsholt Busck, Gertrud Jørgensen, Ingo Zasada, Annette Piorr, Thomas Sick Nielsen, Lise Herslund, Julien Grunfelder and Joe Ravetz for sharing their knowledge with me in one of the research papers or other articles related to this PhD.

I want to thank my colleagues Antje Backhaus, Ole Fryd and Per Bjerager who I shared the office with most of my time as PhD student, for being supportive, good discussion partners and colleagues to have a laugh with. Finally, I want to thank my wife Mette for covering my back during the final phase and for being a loving partner. You can count on me when you finish your PhD in a few years!

This project was funded by the Centre for Strategic Urban Research (Realdania Research) and the EU-FP6 integrated research project "PLUREL - Peri-urban land use relationships -Strategies and Sustainability Assessment Tools for Urban-Rural Linkages" (EC FP6 036921).

Christian Fertner
June 2012

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1 INTRODUCTION

The emergence of large urban regions has been the most prominent manifestation of urbanisation in Europe over the past decades. In urban regions, one or several urban cores are surrounded by peri-urban areas, which facilitate important urban services, and which are at the same time under strong pressure from urban development. This inflicts pressure on peri-urban agricultural and natural areas, which are important elements for future balanced and sustainable development throughout the whole urban region. In Denmark, similar trends have been observed. Within the research project "Cities without limits" (2004-2011, co-ordinated by the Centre for Strategic Urban Research in Denmark, www.byforskning.dk – of which this PhD is also a part), the diverse pattern of urban transformation in the vicinity of cities was investigated, including new patterns of infrastructure, leisure activities, commuting, migration, and business location. The results show the ongoing expansion of the urban field and the urban-rural relationship.

Against this background, the objective of this PhD project is to analyse urbanisation and urban growth in peri-urban areas. This includes an analysis of contemporary issues of urbanisation as the heterogeneity of urban areas, socio-demographic and functional dynamics, land use impacts and the options there are for spatial planning. Four research questions were defined to be investigated in the project:

(1) How can peri-urban areas be **determined**?
(2) What are the **pressures and demands** of urban development in peri-urban areas?
(3) What **impact** has the ongoing urbanisation on land use in peri-urban areas?
(4) How can spatial **planning respond** to these challenges?

The main case is the metropolitan region of Copenhagen, Denmark. Other cases from Denmark, Europe and the US are used as reference studies. The thesis is based on 5 papers. Each of the papers deals with one or more of the above research questions (see section 3). Besides the project "City without Limits", this study was also linked to and co-funded by the EU-FP6 integrated research project "PLUREL - Peri-urban land use relationships - Strategies and Sustainability Assessment Tools for Urban-Rural Linkages" (EC FP6 036921)".

The thesis consists of four research articles (Paper I and III-V), a shorter research note (II) and this synthesis. Papers I, II and III focus on the dynamics of urbanisation in peri-urban areas including the socio-economic changes and patterns of migration, but they do not take specific land use changes into account. Paper IV discusses the impact of these dynamics on the traditional

agricultural structure in peri-urban areas. Paper V discusses the growth of urban areas in terms of land use change, and deals with planning instruments and tools developed to steer urban growth. The methods include quantitative analyses of register and land use data as well as general case study work to investigate options for spatial planning. In this synthesis, I introduce the theoretical and empirical background, explain my research methodology, introduce the papers and summarise their results. I finish with a discussion on the project's setup and contribution followed by conclusions.

2 BACKGROUND

In this section, I provide an overview of the theoretical concepts and actual development in contemporary urbanisation (2.1 and 2.2), planning and growth management (2.3) as well as present my major case study, the Copenhagen metropolitan region (2.4)

2.1 Contemporary urbanisation

The world is becoming more urban. From 1950 to 2012, the population living in cities increased from 29% to 51% worldwide. In Europe this corresponded to an increase from 51% to 73%, and in Denmark, one of the most urbanised countries in the world, numbers increased from 63% to 87% (UN 2009)[1]. The UN projects a further increase over the coming decades. However, in highly urbanised countries such as Denmark, the curve has flattened out since the 1980s, as shown in Figure 1. Is this the end of urbanisation in Denmark as Andersen et al. (2011) put it? Seeing the ongoing spatial growth of cities, the emergence of metropolitan areas and functional urban regions, and the renewal of inner cities, we can negate this with a clear conscience (just as Andersen et al. do). Rather can we see new forms of urbanisation, e.g. the evolution of the *Zwischenstadt* (Sieverts 1999), which are not mirrored in traditional analyses.

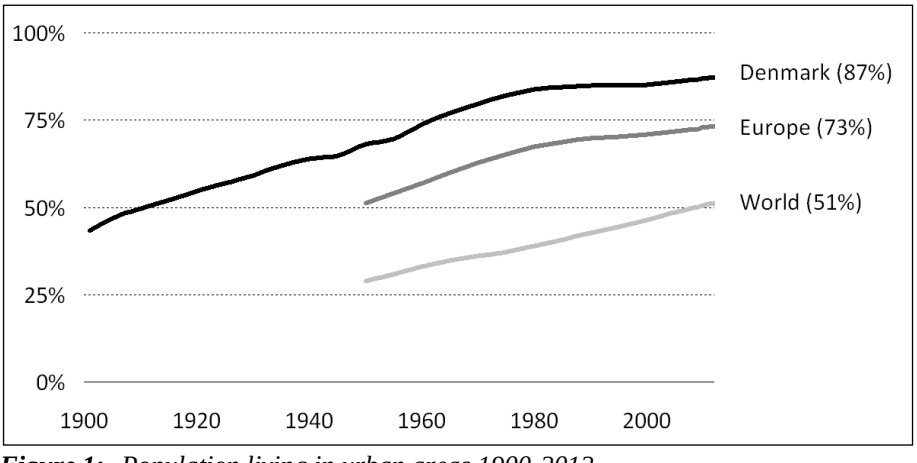

Figure 1: *Population living in urban areas 1900-2012*
Data source: UN (2009)

[1] There is no common definition of urban and rural areas; instead the UN uses the national definitions. In Denmark, rather small settlements of 200 inhabitants already count as urban. However, if the threshold was put at 1,000 inhabitants, still 80% of Danes would live in urban areas (see also *Paper II* for a discussion of the issue).

Another important issue regarding urbanisation is the decoupling of population growth and the growth of urban area. Angel et al. (2011) showed that cities currently expand in terms of land twice as fast as their population rate globally. In countries of the developed world, this is not new however, as it has been an ongoing trend for decades (EEA 2006). In Europe, where many countries have only experienced minor population increase in recent decades, this gap is even wider. From 1990 to 2006, urban areas in Europe grew by 15,000 km^2 (based on Nilsson & Nielsen 2010 and EEA 2011). This is equal to half the size of Belgium and means an increase in urban areas of about 37% within 16 years[2]. During the same period, the population in Europe only increased by about 7%. So the urban area expanded more than five times as much as the population growth rate. The resulting land use changes are clearly visible at the fringes of our cities. Much of it can be called *urban sprawl*, a term which has been widely used since the 1950s (Soule 2006). Typically former agricultural land became converted to low density housing, large commercial areas or spacious new transport infrastructure.

However, contemporary urbanisation is much more than the physical expansion of urban areas. The emergence of *functional urban regions* as a widely accepted concept (Nordregio et al. 2005) had a crucial impact on how we understand cities today. The contemporary city is increasingly becoming a network of urban areas which are physically separated, but functionally integrated. This process includes the integration of even relatively peripheral areas into the urban system, the connection of neighbouring cities to form polycentric networks and the formation of large-scale metropolitan regions. *Functional urbanisation* is established by different urban-rural flows of human activities, including migration, commuting, trade, shopping, private relationships or recreation. Many of these flows are not manifested in physical urban growth, but rather in functional changes of the existing land use. This phenomenon is also called *hidden urbanisation* (Lewan 1969;van den Vaart 1991). The integration of vast rural areas into the system of an urban region is also an important reason for the high rates of urban population in Europe (Figure 1), i.e. the definition of the city growing and only to a lesser extent the city itself. Out of ongoing urban population growth, the physical expansion of urban areas and the emergence of integrated urban-rural regions, it is the latter which challenges contemporary spatial planning the most. The complexity and uncertainty of the ongoing processes in an urban region – as well as the lack of adequate definitions and indicators – make urban planning and growth management a difficult task.

Though urban regions are becoming more and more integrated, there are hotspots of change. Besides inner-city redevelopment areas, peri-urban areas are especially affected by urbanisation. Land prices are usually lower than in

[2] The calculation is based on CORINE Land cover data (EEA 2011). As the 1990-2000 change-layer covers less countries than the 2000-2006 change layer, the numbers are not entirely comparable, but they provide a rough indication.

the inner city and there is more open space available in peri-urban areas, which makes them very attractive to various kinds of urban development. In Europe, peri-urban areas are expected to experience an increase in built-up areas which is four times greater than urban areas (Piorr et al. 2011;Ravetz et al. 2012). Moreover, peri-urban areas are, by definition, not located within the strong policy frameworks of a dense urban area or a deeply rural area, but on the edge of them.

The knowledge about these dynamics and the possible answers in planning are therefore crucial elements in securing the sustainable development of our cities. With this study, I contribute to the empirical basis and strive to determine which dynamics and forms of urbanisation that peri-urban areas are experiencing. The rather loose definitions of *peri-urban areas* or *peri-urbanisation* require a thorough elaboration of applicable conceptualisations as a first step, which is followed by an analysis of dynamics and impacts. Finally, the study focuses on the options for spatial planning to contribute to sustainable development.

2.2 Peri-urban areas: Concepts and dynamics

As is apparent from the previous descriptions, urbanisation is a very diverse phenomenon, which consists of several interrelated drivers and results in various outcomes. Establishing a theoretical framework which covers all these aspects is almost impossible. However, there are some concepts which I would like to introduce here because they influenced my empirical work[3].

To start with, I would like to discuss the terms *peri-urban* and *peri-urbanisation* as they are at the centre of my study, describing the heterogeneous pattern of settlements at the urban-rural interface, replacing the former model of an urban-rural dichotomy (Errington 1994). *Peri-urban* has been used in the English and French languages since the 1950s, *peri-urbanisation* since the 1980s[4]. However, the theoretical discussion of the terms started only recently. This might also be an explanation for the overlap of the terms with many other terms and concepts, as *peri-urban* seems to have been more shaped by the cultural context than by the general scientific discussion. Analyses of urbanisation processes in developing countries coined the term the *peri-urban interface* (Adell 1999;McGregor et al. 2006). From a European perspective, *peri-urban areas* are often understood to be mixed areas under urban influence, but with a rural morphology (Caruso 2001). The Council of Europe (CEMAT 2007) defines peri-urban as a transitional area between strictly rural and completely urban, which is characterised by high pressure for urban development (Bertrand 2007). Conversely, peri-urban areas are from ephemeral, but rather form a new kind of permanent landscape.

[3] Besides drawing from the 5 papers, this is partly based on my contribution to Ravetz et al. (2012).
[4] Derived from Google's Ngram Viewer (http://books.google.com/ngrams, accessed May 2012), see also Michel et al. (2011)

Furthermore, the development is not necessarily limited to purely physical development with urban characteristics, but is often marked by the emergence of urban activities in rural areas like hobby farms and second homes (Briquel & Collicard 2005;Caruso 2001). The fact that the residents can be considered urbanised, even though they do not live in a strictly urban spatial type, because of their lifestyles and social focus on the urban, for example, emphasises the uniqueness of the zone. I summarise these urban transformations which take place outside the urban cores and which do not necessarily lead to the emergence of a physical urban area by the term *peri-urbanisation*.

At the core of the emergence of peri-urban areas lies the dissolution of the historical *dichotomy of urban and rural* space. In Europe, this dichotomy started to blur with the formation of nation states, industrialisation and the liberalisation of the economy in the 19th century (ESPON 2005). However, firstly with the introduction of mass commuter transport systems such as suburban railways, and finally with the increased affordability of the car, the countryside close to towns became a potential place for living, recreation and sometimes also work for former urbanites. This development led to the expansion of cities, not only in physical terms with low density housing, but also in terms of functional relationships, thereby creating an area of urban influence around cities, also called the urban field (Friedmann & Miller 1965). In this urban field, a variety of places developed, characterised by a mixture of urban and rural features.

The blurring of the urban-rural boundary inspired research into the idea of an *urban-rural continuum*. Bryant et al. (1982) illustrated this with a model where the *urban-rural region* ranges from core city through inner and outer fringe, a zone of an urban shadow and out to the rural hinterland. However, in reality, while this model works in general, the complex pattern of actual cities and their surroundings, with all their different spatial structures that have emerged through geographical and historical as well as political precursors, is often difficult to fit completely if at all. This is the case regardless of the fact that the idea of the continuum includes several dimensions (or several continua) of urbanisation in the urban-rural space, which can result in complex spatial patterns (Robinson 1990). Most recently, the term '*urban-rural interface'* has appeared in research, which emphasises the mixed character of these areas without fixing them on a single, simple gradient.

A major factor which shapes peri-urban space is *migration*, i.e. the relocation of people or households. The influence of migration on urban regions and urban systems led to the idea of *stages of urban development* (van den Berg et al. 1982) and *differentiated urbanisation* (Geyer & Kontuly 1993 and later). Van den Berg et al.'s model describes the spatial variations in intra-regional population change by a 4-stage model (Figure 2). When they developed the concept, the last stage of "reurbanisation" was only theoretical

and was not apparent from their empirical analysis of European cities. Later however, other authors took up the concept (Cheshire 1995;Kabisch & Haase 2009), and established the existence of this last stage, although the different stages do not always follow the original order in reality. Also, the changes between states occur at shorter time periods than propsed by van den Berg et al.

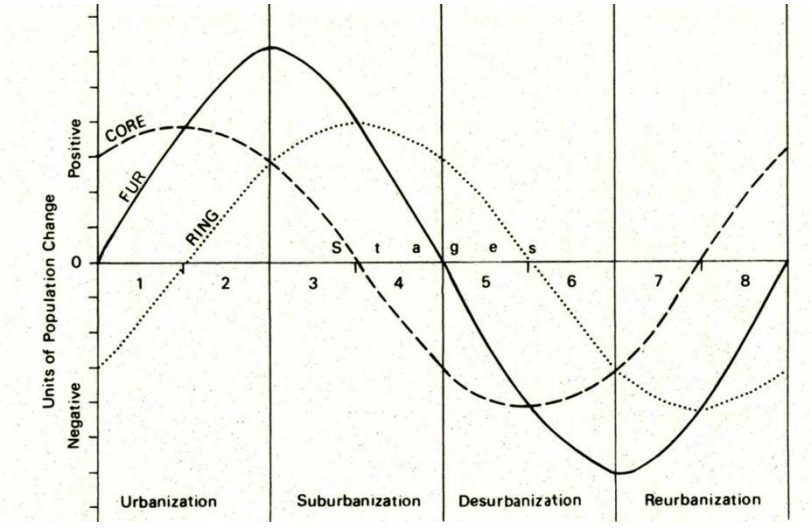

Figure 2: *Stages of urban development*
Source: Van den Berg et al. (1982: 38)

Geyer & Kontuly (1993) proposed a similar phase-model, but referred to the urban system in general. Instead of intra-regional population change, they looked at migration between cities and towns of different sizes. Three phases, *urbanisation, polarisation reversal* and *counterurbanisation*, and various sub-stages were identified. These phases,, as well as van den Berg et al.'s stages, refer to particular migration behaviour in urban-rural settings.

Regarding *peri-urban areas*, a widely seen phenomenon – though not mentioned explicitly in the two models introduced above – is *ex-urbanisation*. The term was originally coined by Spectorsky (1955), who described the development of a ring of wealthy rural communities around New York City, characterised by urban professionals – exurbanites – who lived there but commuted to the urban core for work. Today, many of these areas could also be called *suburban*, and Nelson and Sanchez (1999: 689) have argued that ex-urbanisation does not differ from suburbanisation, but that ex-urbia "is simply the latest incarnation of the continued suburbanisation of American cities."

Another closely related concept is *counter-urbanisation,* which is also mentioned in Geyer & Kontuly's model and is analogous to "desurbaniza-

tion" in van den Berg et al's model. Counter-urbanisation implies an opposite trend to *urbanisation*, i.e. an increase in migration away from the city to the countryside, which was observed in the 1960s and 1970s in the United States and Western Europe (Robinson 1990). Counter-urbanisation can be based on different motivations including pull factors, such as a search for green space and country life in the outskirts of towns/cities or various forms of landscape amenities, as well as push factors, such as housing prices or employment opportunities (Mitchell 2004). However, counter-urbanisation is not limited to migration dynamics, but also includes the relocation of services and industry to rural areas, the development of part-time farming or second homes. Champion et al. (1989) emphasised that it is not a unidirectional movement, but a tendency towards de-concentration, resulting from a complex pattern of flows.

Although migration dynamics do not necessarily have an effect on the built-up structure – see, e.g. *hidden urbanisation* (Lewan 1969 and Paper I) – it is nevertheless an important driver of land use change. Together with firm location strategies, transport accessibility, economic or demographic development, migration patterns shape urban development. In peri-urban areas, this led to the emergence of *urban sprawl*. Urban sprawl can be traced back to the emergence of a substantial middle class in the first half of the 19th century in Britain, which started to acquire weekend houses, thereby creating the first suburbia (Couch *et al.* 2008). In the USA sprawl emerged with the expansion of metropolitan public transport systems in the beginning of the 20th century. Various definitions of sprawl were put forward, based on form, land use, impacts or densities, although no accepted common definition is in use today, which reflects how sprawl is a matter of degree, and is not an absolute form (Batty *et al.* 2002). The fact is that areas close to cities have historically been subject to high developmental pressures strongly linked to an increasing per capita consumption of urban land. Urban sprawl, in the form of low density, discontinuous and dispersed urban development, is now a common phenomenon throughout Europe (EEA 2006). Although new planning paradigms such as *compact urban development* and *polycentric development* have been propagated for some time, e.g. by the European Spatial Development Perspective (ESDP 1999) or even earlier by the Brundtland report (WCED 1987), urban sprawl remains a major challenge in Europe (Nielsen 2009). Both reports also point out that spatial planning can play a key role in guiding urban development in a more sustainable direction.

2.3 Planning and urban growth

Urban growth can occur without planning, but the development of *spatial planning* is closely linked to urban growth and expansion. It is the ambition to steer urban development in a particular direction. According to this view, spatial planning is a tool which can influence development (Pallagst 2007).

However, it can just as easily be part of the cause of a problem as it can be part of the solution. For example, with the expansion of auto-dependent infrastructure and low density zoning, planning contributed considerably to the dispersion of cities. On the other hand, planning can also support the opposite by planning for transit-oriented development or the densification and renewal of existing neighbourhoods. Another example is the fragmentation of planning authorities inside an urban region which have competing agendas, resulting in the excessive supply of urban land.

The examples also show that planning is highly dependent on contemporary societal values. Regarding urban sprawl as well as many other planning-related issues, a major shift in planning values has been underway since the 1980s. The emergence (or comeback) of notions of urban density, sustainability or integrated and holistic problem understanding is a consequence of new challenges faced by cities and the incapability of traditional planning methods and public authorities to deal with them in a satisfactory way (Jørgensen & Ærø 2008). In many Scandinavian countries, *urban sprawl* and *compact urban development* rose to the top of the agenda in the 1990s. In the previous section, I mentioned the European Spatial Planning Perspective (ESDP 1999), which was the first European document to contain a jointly agreed spatial strategy, and, although it was not a legally binding document, it is a clear example of this paradigm shift. The ESDP underlines the importance of balanced, sustainable spatial development and recognises the complexity of the theme and the importance of local and regional solutions.

The possibilities of local and regional planning are, however, strongly context dependent and based on the national planning system and legislation. Three contextual factors play a fundamental role in a country's spatial planning system: Constitutional law, government structure & responsibilities for spatial planning and the legal framework (European Commission 1997). The means which a city or region has to deal with the challenges of urbanisation can therefore be very different. Furthermore, the historical and geographical context produces very case specific forms of urbanisation. Still, most cities are subject to the same global drivers and face similar challenges.

An example from Denmark shows that urbanisation can result in quite different land use changes even within the same planning system. Around Copenhagen much less area was acquired for new urban land in recent years than in the urban conurbation of East Jutland, Denmark, although both regions experienced the same increase of housing and commercial units (Hartoft-Nielsen 2010). Hartoft-Nielsen interprets this as a result of the relatively strict regional plan in the Copenhagen region, the *Fingerplan 2007*, while no similar plan exists in East Jutland. There is a need to highlight such developments and discuss the transferability of the related policies to other cases.

2.4 Urban change around Copenhagen

The metropolitan area of Copenhagen, Denmark, is the main case study in this thesis. Copenhagen has undergone considerable suburban growth since the 1960s (Matthiessen 1980; see Figure 3). The pace of suburbanisation slowed down in the 1980s because of slower economic and population growth. However, since the 1990s, the region has experienced significant population and economic growth, which has been accompanied by the migration of many households to the urban fringe, peri-urban areas and the rural countryside (Aner 2009;Herslund & Fertner 2011).

This growth is expected to continue with an increase of 300,000 inhabitants and an additional 5000 ha of urban area (Fertner et al. 2012) over the next 30 years (see Figure 4). The functional relationships extend far beyond the morphological urban area, transforming the whole island of Zealand (up to a distance of about 100 km) into one functional urban region (Nielsen & Hovgesen 2005;OECD 2009). Some functional relationships go even beyond the national border onto the Swedish side of the Øresund region (Fertner 2006). These dynamics in the peri-urban space make Copenhagen an interesting case for my research questions.

The region's urban development has been influenced by a range of regional plans and visions, which have attempted to contain urban growth and preserve regional green space. The classic guiding document is the first Fingerplan from 1947 (Egensplankontoret 1947), which proposed that urban development of the metropolitan area of Copenhagen should proceed along five suburban railroads to support easy access between suburban dwellings and work places in the city centre, while the areas between should be kept free of buildings to form green wedges, thereby supplying the urban population with recreational areas. Although the plan was only a report and was in no way legally binding, it had a great influence on subsequent regional plans and infrastructure development in the region (Primdahl et al. 2009;Vejre et al. 2007). Still, compared with other European cities, Copenhagen is characterised by a high proportion of low-density residential areas (EEA 2006).

The latest regional plan, Fingerplan 2007 (Miljøministeriet 2007), refers directly to the original plan in an extended regional context. The plan is a national directive based on the current planning act and is therefore a legally binding and spatially explicit document. However, it has been much discussed, and the wisdom of this steering tool has been questioned. Currently, the ministry has opened up a debate on an adaptation of the plan which should result in a new directive in 2012.

Besides the specific dynamics and planning regulations in the region, Copenhagen is also a typical European capital region, which enables a comparison with other cities and regions in Europe and elsewhere. A significant proportion of the national population and economy is based in Copenhagen

and it is subject to ongoing in-migration from the rest of Denmark and from outside. The city has an old urban core and a belt of suburban areas, and, just

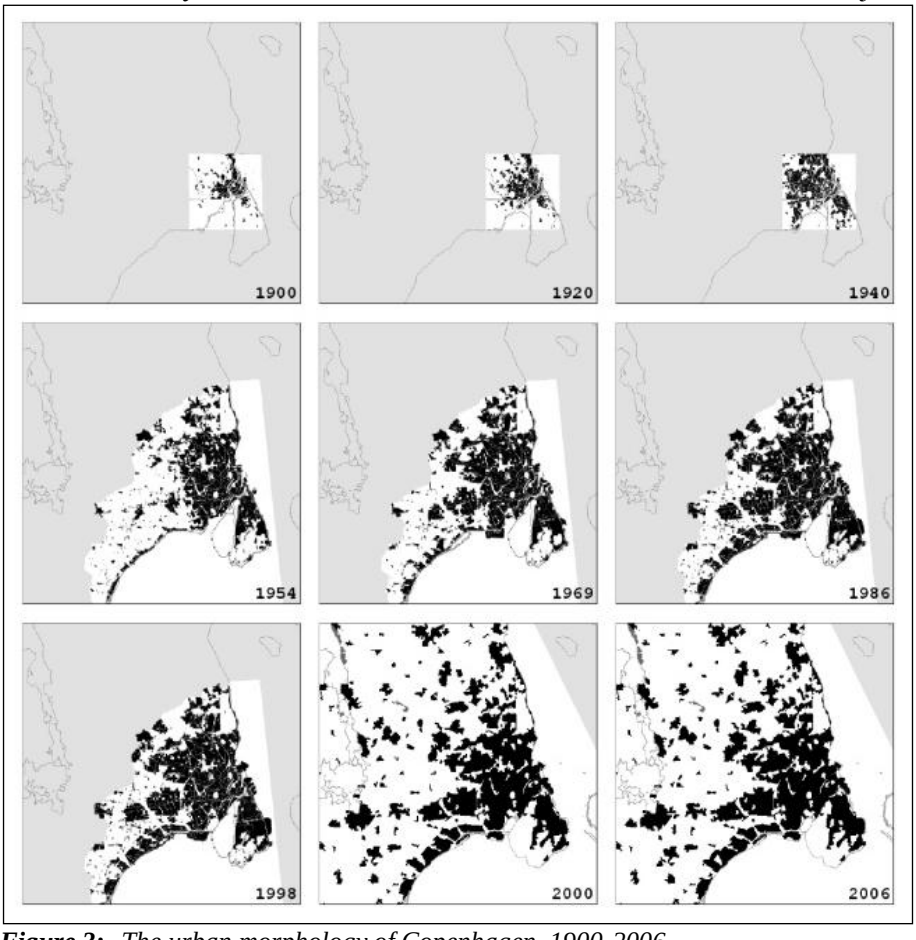

Figure 3: *The urban morphology of Copenhagen, 1900-2006*
Data sources: Holm & Johansen (1941), MOLAND (Barredo et al. 2003), CORINE (EEA 2011)

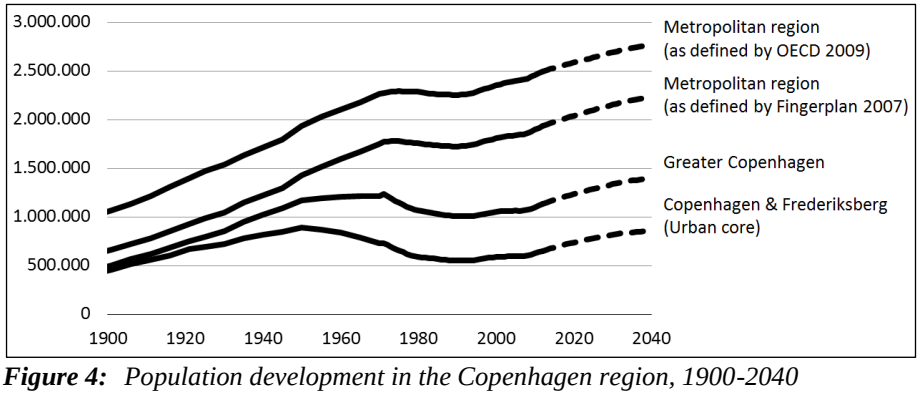

Figure 4: *Population development in the Copenhagen region, 1900-2040*

Data source: Statistics Denmark (2012)

like many other European cities, it experienced a decade of restructuring in the 1980s. This was replaced by a new focus on economic development in the 1990s (Swyngedouw et al. 2002), which took the form of major investments in infrastructure and urban renewal projects as well as the return of private investment to the city (Andersen et al. 2000;Andersen & Winther 2010).

The new urban growth also affected the open countryside, which underwent substantial transformation including the diversification of farming activities (Praestholm & Kristensen 2007) and an increase in part-time, hobby and retirement farming (Busck et al. 2008;Primdahl et al. 2009). The traditional green structure of the Copenhagen area with its green wedges was again under pressure for development (Caspersen et al. 2006). So, although the city has a relatively small population compared to other European capitals, its influence reaches far out into the region and one could say it has developed into a city without limits.

3 RESEARCH DESIGN

3.1 Project structure

The project was organised in several parts in line with the research questions outlined in the introduction. The intention was that each part would result in the publication of a scientific paper. The research questions have a sequential order, which means that in principle they build on each other. However, not all the results of the preceding steps needed to be ready to proceed to the next. Also, the findings from one step resulted in an adaptation of the study approach and the methods of the previous step, as described in the introduction to the papers. The structure and the relationship between the parts was more of a spiral than a straight line.

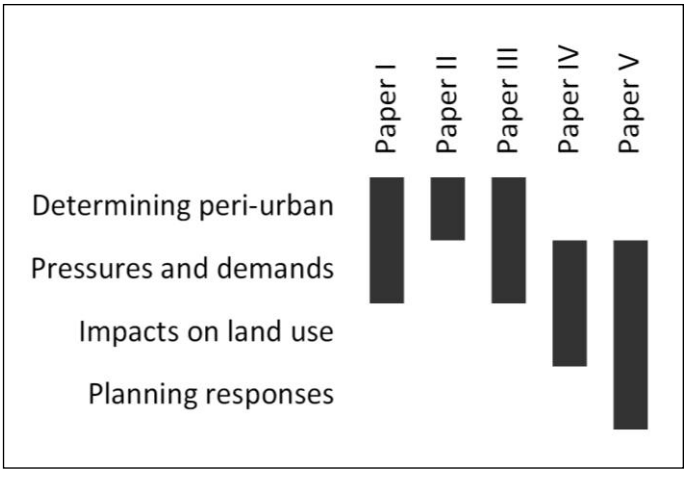

Figure 5: *The five papers in relation to the four research questions*

Figure 5 illustrates the relationship between the papers and the research questions. The issues touched upon in the research questions – definition, pressures, demands, impacts, responses – are deeply interrelated. For example, the chosen definition of peri-urban areas influences which pressures or impacts can be observed in them, while the different dynamics in peri-urban areas influence how we define such areas. In the scientific papers, it was therefore not useful to look at the questions in isolation, but instead to consider several of them at the same time.

3.2 Methods and data

One could describe my research approach as pragmatic, i.e. it was not the methods that drove the research, but rather the research questions (Blanco 1994;Creswell 2009). The choice of specific methodologies and variables was guided by the problem area, while each application was founded on rel-

evant theory regarding peri-urbanisation. This a very common approach in research related to spatial planning because of the interdisciplinary character of the field and its close relation to practice (Næss & Saglie 2000). Certainly, questions often lead to the selection of particular methods to answer them, but it would be naive of me to say that my choice of methods was free from any other influences. Previous experience or skills (in my case from urban and regional science) as well as the research environment one works in play naturally an important role for method choice. More practical but no less important is that resource & data availability and previous research results also influenced the choice of methods and cases (see 3.3).

Due to the different nature of my research questions, which on the one hand focus on urbanisation as a measurable phenomenon, and on the other, focus on challenges and options for spatial planning in peri-urban areas, the research design is characterised by *mixed methods*, i.e. the application of quantitative as well as qualitative methods. Peri-urbanisation can be analysed quantitatively (e.g. migration or land use change), but the dynamics are very complex and context-specific (e.g. regarding spatial planning regulations), which demands a qualitative, more in-depth analysis of particular aspects. The application of mixed methods should occur simultaneously, "so that the overall strength of a study is greater than either qualitative or quantitative research." (Creswell 2009: 4). I used the mixed methods both sequentially (e.g. the conceptualisation of peri-urban phenomena in *Paper III* is the basis for the analysis of impacts in agricultural practice in *Paper IV*) and concurrently (e.g. the use of quantitative and qualitative data to provide a comprehensive analysis of urban growth management in *Paper V*). Table 1 presents an overview of the methods and cases used in the articles.

Table 1: *Cases and methods used in the five papers*

Paper	Case	Scale	Literature review	Descriptive statistics	Inferential statistics	Thematic maps	Planning document review and expert interviews
I	Central Jutland Region	Parishes	●		●	●	
II	Denmark	Municipalities		●		●	
III	Copenhagen Region		●	●	●	●	
IV			●		●	●	
V	9 cities in EU & US (incl. Copenhagen)	City-region	●	●		●	●

Grey dots = Methods used in the paper, but without the author's contribution

LITERATURE REVIEW

The literature review was an important part of the study for all the papers (besides the research note) as it was used to frame the problem as well as to derive analytical frameworks, e.g. in terms of indicator choice (*Paper I, III and IV*) and the development of a typology of elements of urban growth management to structure the study (*Paper V*). Literature was mainly acquired through searching for key words in journal indexation platforms[5] and bibliotek.dk (Danish library system) and cross-references.

DESCRIPTIVE AND INFERENTIAL STATISTICS

For the quantitative analyses, both descriptive and inferential statistical methods were applied. Descriptive statistics are an important tool to summarise a data set and to reveal general tendencies as conducted in, e.g. *Paper V* regarding changes in population and urban land uses. In *Paper I, III and IV,* inferential statistics were used to analyse probabilities. For example, in *Paper III*, correlation was used to analyse the probability of location factors such as 'distance to city' influencing migration patterns. In *Paper IV,* an ordinary least squares regression was used to evaluate the interrelations between types of peri-urbanisation and the local agricultural structure.

The data used in the quantitative analyses cover a wide range of themes including population demographics, migration, agriculture and land use. Data were also collected for different points in time (from the 1980s) to analyse shifts in trends (*Paper III*). Some of the data were prepared in GIS as distance and area share indexes (*Paper II, III and IV*). Register data for Danish parishes and municipalities were acquired from Statistics Denmark's online database (Statistics Denmark 2012), or through official statistical publications (Danmarks statistik 1989;Danmarks statistik 2000). Land use data were acquired from the Danish Ministry of the Environment (Miljøministeriet 2011), the European Environment Agency (EEA 2011) and the US National Land Cover (MRLC 2011).

THEMATIC MAPS

A thematic map might not be a distinct research method as such, but it is an explorative approach which facilitates the elaboration of spatial patterns and trends. This was an important element in my work and I used it in all five papers. I did not apply spatial statistical methods – which would represent a quantitative approach to maps – though, in retrospect, that might have been an asset for some of the analyses.

[5] I mainly used Elsevier's ScienceDirect (www.sciencedirect.com), Thomson Reuter's Web of Knowledge (http://apps.webofknowledge.com) and Google Scholar (http://scholar.google.com).

PLANNING DOCUMENT REVIEW AND EXPERT INTERVIEWS

In *Paper V,* the analysis of land use change was combined with a qualitative analysis of planning tools. The comparative case study analysis of 9 cities is based on material provided by the 6 PLUREL case studies. I was myself involved in the elaboration of two further reference studies (Portland and Seattle) where we conducted 18 interviews with academics and planning professionals. Finally, the Copenhagen case is based on the findings from other papers and earlier projects in which the co-authors were involved. Our focus in the interviews, as well as in the collected material, was on various issues related to urban growth management such as legal aspects, implementation in spatial planning, co-operation between jurisdictions, distribution of competences between administrative levels, motivation of stakeholders, acceptance by citizens, design principles, historical development and effects on land use change. Although the review of planning documents and the interviews with experts and professionals were only been used explicitly in *Paper V*, they represented an important means of gaining knowledge during the whole study.[6]

3.3 Cases

The stated research questions are universally valid, but all my studies are based on cases. Some analysis of urban growth is possible on a global level (see e.g. Angel et al. 2011), though for a vague concept such as peri-urban areas, this is difficult to manage without losing a lot of variation, which is one of the key characteristics of peri-urban areas. Also, the very context-dependent aspects of planning could only be studied at a very generic level if a large number of cases were to be used. The use of one or a few cases studies was therefore most appropriate. Figure 6 provides an overview of the cases covered in this thesis. The Copenhagen metropolitan area (as introduced in section 2.4) is the main case study and received the most attention and was included in four of the five papers.

I did not choose the cases randomly to achieve a representative sample. This is not necessarily a disadvantage regarding generalisation. Depending on the form of inquiry, it can also increase the opportunities for generalisation when the cases are chosen strategically (Flyvbjerg 2006). For example, the choice of extreme cases can offer far more information than more representative cases, which often reflect the average. Although Copenhagen may be representative of a range of other metropolitan areas in Europe, it is also an 'extreme' case due to the Fingerplan which has been followed for several decades, the relatively strict Danish planning law and the fact that Copenhagen is the only real metropolitan area in Denmark. Copenhagen is also a

[6] For different purposes I was in contact with planners from the municipalities of Guldborgsund and Køge, both in the Copenhagen metropolitan region, as well as with planners from the Danish Ministry of the Environment.

well-documented case (e.g. regarding data availability), which facilitates the empirical analysis of phenomena in a way that would not be possible in other cases.

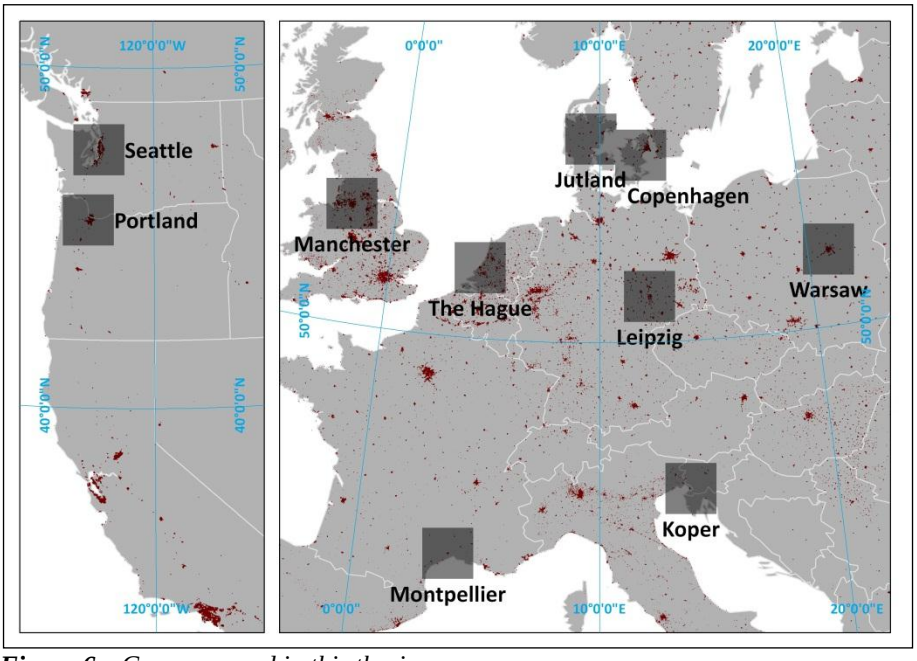

Figure 6: *Cases covered in this thesis*
Background: Urban areas in 2006 (EEA 2011; MRLC 2011)

In contrast to the individual case study approach of *Papers I-IV*, we applied a comparative case study in *Paper V*. However, the 9 selected cities are neither a full sample nor representative of all other cities which experience urban sprawl. However, they also represent extreme cases: From large metropolitan areas (Manchester in the UK) to small cities (Koper in Slovenia), from western planning traditions (The Hague in The Netherlands and Copenhagen in Denmark) to new planning regimes in Eastern Europe (Warsaw in Poland), from cities with high population growth (Montpellier in France) to regions characterised by shrinkage (Leipzig in Germany). The two cases in the USA, Seattle and Portland, differ even more regarding their historical and geographical context or planning traditions and they are 'extreme' regarding urban growth management in the USA as this is not very widely used in other states. Still, Seattle and Portland are facing similar challenges of urban sprawl. A comparison of the different issues and solutions across different contexts can provide new insights.

4 INTRODUCTION TO RESEARCH PAPERS

In this section, I provide an introduction to the five papers, the process of their development and how they are connected and support each other. My main contribution to *Paper I* comprised parts of the background section on urbanisation processes in peri-urban areas and urban-rural classifications. It was a perfect opportunity to dive into the literature and learn from a thoroughly researched Danish case study. The paper contributed considerably to answering my first question on how peri-urban areas can be determined as well as my second question on the kind of dynamics that take place in this space. The review of existing urban-rural classification showed the difficulties in adopting the theoretical concepts on peri-urban areas into an applicable quantification method. In the paper, a new typology was developed, using a cluster analysis on the spatial variation of 23 variables related to urban or rural characteristics. The results show the socio-economic heterogeneity of areas in the Eastern part of Jutland which is closest to the bigger cities. In the Western part, areas are much more homogeneous. This implies that a single delineation of peri-urban areas is difficult because of their heterogeneity; a subject I further discuss in *Paper III*.

The typology used in *Paper I* is very detailed and well-grounded in the literature, though difficult to apply to other cases because of the broad range of different variables used. Although the other typologies reviewed in *Paper I* were extremely simplified compared to the theory on urbanisation of rural areas, they are easily applicable and have a huge impact due to their wide referencing in research and policy, which motivated me to adapt the typologies for my case study. The results can be seen in *Paper II*, in which a method for downscaling four of the most widely referenced European, regional urban-rural typologies to the level of Danish municipalities is presented. Originally I intended to use the typologies as an analysis frame in what became *Paper III*. However, I decided to use a different approach so that a typology was no longer necessary. However, some findings from *Paper III* regarding the shift of population increase towards the urban centres motivated me to finish the paper in the form of a research note[7]. The downscaled typologies showed how different the level of urbanisation can be estimated in Denmark. This is a result of the wide range of "intermediate" areas, which are somewhere between urban and rural densities.

In *Papers III* and *IV*, I focussed on my main case study, the Copenhagen metropolitan region (see Figure 7 and section 2.4), to work on the second and third of my research questions dealing with the dynamics in peri-urban areas. From the literature review conducted in *Paper I*, I learned that urbanisation is more than land use change or population increase, but also includes

[7] Research notes in *Geografisk Tidsskrift-Danish Journal of Geography* are briefer communications (e.g. description of a region, a theme, a method) which are not double blind peer-reviewed, but instead are reviewed by one of the journal's editors.

a range of socio-economic changes which may or may not manifest themselves as physical changes. I became especially interested in different phenomena related to life-style changes in peri-urban areas, as the migration of families or retirees, the emergence of second homes, the shift in agricultural practices or new travel-to-work patterns, etc. (see e.g. Briquel & Collicard 2005;Caruso 2001;Robinson 1990).

Intra-regional migration patterns are an important indicator, which reflect push and pull factors related to the variations within an urban region. *Paper III* shows the diversity of migration behaviour related to different social groups and time periods. The choice of a particular phenomenon as an indicator (i.e. migration of certain social groups) saved me from pre-delineating peri-urban areas. Instead, the phenomenon could be studied across the whole urban-rural region, which was an advantage compared to the conceptual difficulties and large variations connected to delineating peri-urban areas. Generally, in-migration was concentrated in areas located at a medium to long-distance from the Copenhagen city centre from 1996-2005, while in the years since 2006, this trend has been reversed. However, the focus on three migration types related to the concepts of Ex-urbanisation, Displaced urbanisation and Anti-urbanisation (adapted from Mitchell 2004) showed a very diverse and non-linear development, partially unstable over time.

Figure 7: *The case study area of Paper III and IV in grey*

The idea of *Paper IV* was to focus on the impacts of urbanisation in peri-urban areas, as outlined in my third research question. Together with colleagues from ZALF,[8] I chose to analyse the transformation of agriculture close to cities. Agriculture is usually the main land use in peri-urban areas and is often under significant pressure from urban expansion (see also *Paper*

[8] Leibniz Centre for Agricultural Landscape Research (ZALF) in Müncheberg close to Berlin, Germany.

V). Adaptation pathways in agricultural practices encompass specialisation into horticulture as well as an enhanced environmental and lifestyle orientation of farming – typical elements of multifunctional agriculture. However, due to the heterogeneity of urbanisation processes (*Paper I* and *III*), we also expected differences in farming transition. By applying regression analyses, we studied the relation between peri-urbanisation (slightly different variables than those used in *Paper III*) and the adaptation of agricultural practices to cope with it. We found particular relationships between leisure and environmentally oriented farm practices and peri-urbanisation. Although there are many other factors which influence change in farming practices in around Copenhagen, such as the EU Common Agricultural Policy, the urbanisation and transformation of peri-urban areas had some influence on particular practices.

Finally, in *Paper V,* the focus shifted towards the options for spatial planning, the fourth question. Together with my co-authors, I chose a comparative case study approach to account for the context-dependency of planning and urban growth. The paper was based on material from 9 cities in Europe and the USA which had been studied during the PLUREL project. Although I was not directly involved in the case study work, I obtained good insights through my participation in PLUREL. I also participated in a study trip to Seattle and Portland and visited most of the other case studies. The paper combined an analysis of land use change with an exploration of urban growth management practices. This approach provided a comprehensive view of the case studies, showing the wide diversity of urban growth pressures, applied planning tools and resulting land use patterns. We could not identify a general pattern regarding drivers, applied policies and effects. Strong population or economic growth does not necessarily lead to (relative) dispersion (Copenhagen, Portland, Koper), neither is urban growth management a guarantee that dispersion will be avoided (Montpellier, The Hague, Seattle). Also, urban sprawl does not automatically trigger the establishment of strong growth management, even if the problems are recognised (Warsaw). On the other hand, Copenhagen, Portland, Koper and Manchester seem to successfully condemn urban dispersion and their urban growth management policies are deemed to make an important contribution to this.

All the papers in their full length are presented in the Annex.

5 SUMMARY OF RESULTS

A few of the results have already been presented in the previous section. In this section, I summarise the results according to my four research questions stated in the introduction. As each research question was dealt with in several papers, this section also includes some elements of a cross-paper discussion. In the actual discussion sections, I instead focus on the more general implications and contributions of this study to the field and reflect on the methods and cases.

5.1 RQ1: Determining peri-urban

My first research question deals with the application of theoretical concepts related to *peri-urban areas* or *peri-urbanisation* in an empirical model to determine and analyse peri-urban space. The literature review as presented in section 2.2 forms the contextual basis. Together with the empirical applications, it also provides some implications, which I address in the discussion section. In *Paper I*, *II* and *III* three different approaches were developed and applied to determine peri-urban areas:

1. Complex and case specific typology
2. Urban-rural typologies based on a few key indicators
3. Dynamics based approach

COMPLEX AND CASE SPECIFIC TYPOLOGY

The literature review showed that the urbanisation of rural areas is followed by a range of other changes than land use. In *Paper I* we used a wide range of indicators related to socio-economic changes to draw a detailed picture of the status of urbanisation in Central Jutland. A cluster analysis resulted in 5 types of parishes related to their urban-rural characteristics. Although an urban-rural gradient from east to west is still obvious, the region around the conurbation of East Jutland consists of a mix of the types 'ex-urban', 'counter-urban' and 'peri-urban'. Only the part of the region furthest to the west still presents a rather uniform picture with mainly parishes of the type 'agricultural'.

The analysis illustrates that any generalisation of peri-urban space, e.g. along a simple urban-rural gradient (as also done in *Paper II*), will aggregate many dynamics which do not necessarily follow this gradient. For example, the two cluster group, 'ex-urban' and 'peri-urban,' were defined from different variables – the one by high income and commuting, the other by hobby farming and accessibility respectively – but they are both present at similar distances from the urban cores.

URBAN-RURAL TYPOLOGIES BASED ON A FEW KEY INDICATORS

In *Paper II*, four existing urban-rural typologies were used to determine peri-urban areas, but they were adapted and downscaled to the level of Danish municipalities. The general picture stays the same in that there are predominantly urban areas around Copenhagen and East Jutland and predominantly rural areas in the Northwest and on the smaller islands. The rest of the country resembles a mosaic pattern (especially in the ESPON typology) as can be seen in the maps *Paper II*. In contrast to the previous approach, peri-urban areas are predefined by the typologies, mainly based on population density. These typologies give an overview of the extent of peri-urban areas. Table 2 shows the account for the Copenhagen metropolitan region: A third to over half of the area and about a fifth to a quarter of the population are encompassed in peri-urban areas (see Table 2). However, the typologies do hide inner variations, found with the previous method.

Table 2: *Peri-urban areas in the Copenhagen metropolitan region: population and area, according to three downscaled urban-rural typologies for 2011*

Typology	Category name	Municipalities	Area share	Population share
OECD	Intermediate	9 (out of 45)	35%	19%
Eurostat	Intermediate	11 (out of 45)	31%	22%
ESPON	Medium categories[9]	15 (out of 45)	77%	28%

Source: Adapted from Paper II

DYNAMICS BASED APPROACH

A third approach focused on the dynamics related to peri-urbanisation and was used in *Paper III* and *IV*. The literature review provided a range of phenomena which are relevant to this process. A prior delineation of peri-urban areas (as with the urban-rural typologies) would have limited the results geographically. Instead dynamics – migration in the case of *Paper III* – were analysed across the whole region. The insight from *Paper I*, that peri-urban areas are very diverse, was therefore considered as well as the hypothesis that peri-urbanisation occurs far beyond the 'usual' urban fringe. In contrast to the method used in *Paper I*, this approach can also be used to compare variations across time. The developed, empirically applicable, typology is therefore also a result of the analysis (see RQ2) and not just a framework for it. The disadvantage, however, is that it does not provide a coherent delineation of peri-urban areas. Instead it shows the hot spots of peri-urbanisation and how they shift over time.

[9] The ESPON typology (ESPON 2005) uses 6 categories. The 4 'middle' categories represent intermediate areas. They are called "High urban influence and Medium human intervention", "High urban influence and Low human intervention", "Low urban influence and High human intervention" and "Low urban influence and Medium human intervention". See *Paper II* for a detailed description of the categories and thresholds.

The application of this approach in *Paper III* and *IV* is theory driven. Three migration-related dynamics – Ex-urbanisation, Displaced urbanisation and Anti-urbanisation (Table 3) – were considered to be important phenomena of peri-urbanisation. In *Paper IV,* we also included the process of Hidden urbanisation which relates to socio-economic changes to the original local population due to peri-urbanisation. As such, Hidden urbanisation can also be understood as an impact of peri-urbanisation. All four dynamics were analysed by way of proxy indicators (see also RQ2), which does not show all aspects related to theory, but on the other hand, provides a comprehensible result.

Table 3: *Peri-urbanisation processes (used in Paper III & IV)*

Type	Theoretical background
Ex-urbanisation	Wealthy urbanites moving to the near countryside (Mitchell 2004;Spectorsky 1955)
Displaced-urbanisation	Migration due to a need (employment, lower living costs, housing availability, quality of living) (Mitchell 2004)
Anti-urbanisation	Self-sufficient lifestyle, smaller communities, amenity-driven retirement migration (Halliday & Coombes 1995;Herslund 2012;Mitchell 2004;Robinson 1990)
Hidden urbanisation (only used in Paper IV)	Non-agricultural activities, conversion of farmsteads, commuting due to economic reasons (Lewan 1969;van den Vaart 1991)

CONCLUSION

Each of the three approaches to determine peri-urban areas are theoretically valid, but all have problems related to empirical comparability, simplicity or fuzziness. However, within their limits, they are valuable tools to determine peri-urban areas and to analyse the dynamics in peri-urban spaces.

5.2 RQ2: Pressures of urban development in peri-urban areas

The second research question deals with the pressures related to urbanisation in peri-urban areas. Pressure is understood as a phenomenon which drives or demands some transformation, e.g. of land use. The question partially overlaps with the first one, as determining peri-urban areas was, at least in the third approach, directly related to pressures (in that case of various kinds of migration). *Paper I, III, IV* and *V* contribute to answering that question and mainly focus on two issues: Population change and intra-regional migration. Both issues were analysed in a 'development over time' perspective, which revealed considerable divergence between different years.

POPULATION CHANGE

Population increase puts pressure on urban development by increasing demand for housing, jobs, transport needs, etc. However, as shown in *Paper V*,

this can result in very different land use changes (see RQ 3). Just like many other European cities (see e.g. Swyngedouw et al. 2002), the Copenhagen metropolitan region[10] experienced a stagnation in population growth during a phase of economic restructuring in the 1980s. Since then, however, its population has increased relatively significantly by about 15,000 new inhabitants each year. The areas which are growing the most are however changing over time. Figure 8 shows that in the period 1996-2006 there was strong growth in areas close to the centre as well as those further away. Only the most remote areas experienced a decline in population. In the last six years, however, this changed and almost all population growth is now concentrated in the urban centre.

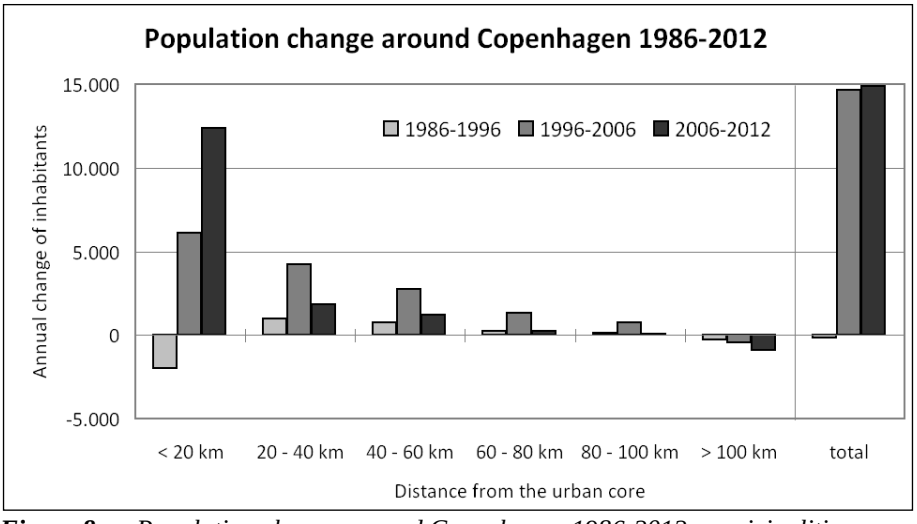

Figure 8: *Population change around Copenhagen 1986-2012, municipalities grouped by distance from Copenhagen*

The population increase in areas at a medium distance (approx. 40-80 km) from the urban core, until 2006, was one of the developments which were at the core of this study. The pressure on peri-urban areas from population growth might decrease around Copenhagen. Still, the city is continuing to grow and so will its surroundings. Statistics Denmark (2012) projects an increase of about 300,000 inhabitants in the region over the next three decades. Also, Figure 8 does not say who these people are, or the reasons why they are moving [11] to the particular area. People who migrate to peri-urban areas might do so for a lot of different reasons, which result in different pressures.

[10] For the delineation see Figure 7 in the previous section.

[11] The increase in population also includes natural growth but the major part is caused from national or international in-migration. From 2006 to 2011 the region grew by ca. 100 000 inhabitants, whereas 30 % was natural growth and 70 % migration (Statistics Denmark 2012).

Therefore, intra-regional migration according to different types of migrants was analysed in *Paper III*.

DIFFERENTIATED INTRA-REGIONAL MIGRATION

For *Paper III* and *IV* a definition of counter-urbanisation by Mitchell (2004) was adapted to analyse the dynamics related to *peri-urbanisation*. Mitchell differentiates between three types motives for migration from urban to rural (or peri-urban) areas: Ex-urbanisation, Displaced urbanisation and Anti-urbanisation. Figure 9 shows spatial patterns of in-migration of the three types of migrants around Copenhagen, based on proxy indicators. While Ex-urbanisation was mainly located relatively close to the city centre, Displaced urbanisation was strongest in areas located at a medium distance from the urban core. Anti-urbanisation mainly occurred in areas far away from the centre and in areas with high natural values such as coastlines. These differences were more or less the same in the three analysed time periods (1986-1995, 1996-2005 and 2006-2011) although the general picture changed.

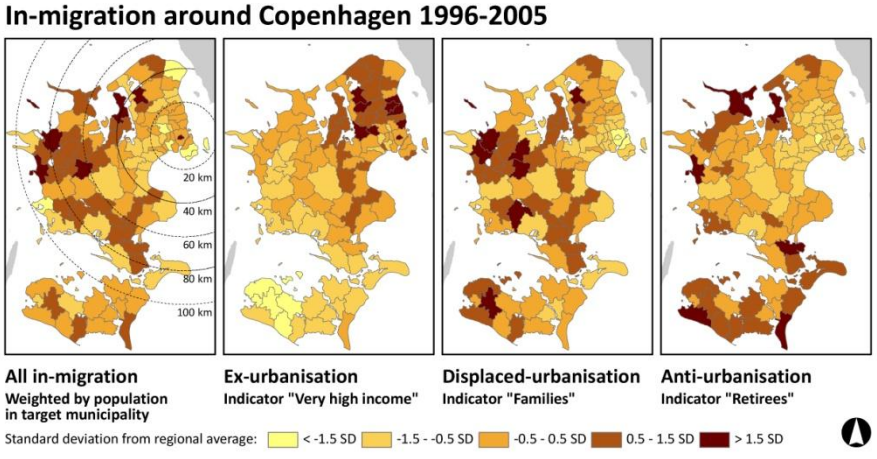

Figure 9: *In-migration around Copenhagen, weighted by population, 1996-2005*
(For a description of the indicators see *Paper III*.)

Up to 2005, in-migration occurred in areas which were located increasingly further away from the city centre, driven by strong economic growth and a booming housing market. Recently, this trend has been reversed, following stagnation in the housing market due to the current financial crisis. The present phase of population redistribution in the region therefore points to the consolidation of the extent of the urban-rural region. There has been a decline in the share of all groups in remote municipalities in recent years. However, areas located at a medium distance (40-80 km) experienced weaker decline, or still gained. Anti-urbanisation, in particular, remained strong at

medium distances. Furthermore, despite decreasing, Anti-urbanisation as well as Displaced urbanisation, represented by families, still accounts for a high share of relative in-migration in municipalities located at a medium to long distance from the city centre. In general, the three types showed stronger growth in distant areas than the general in-migration during the period 1996-2005. However, in the subsequent period, 2006-2011, more significant reductions were also observed.

Differentiating between the general migration patterns adds a complementary view to the diverse migration processes, which are even antipodal in some respect, e.g. between Ex-urbanisation and Anti-urbanisation. The maps in Figure 9 show the uneven distribution, which also results in uneven pressure on peri-urban land. They are not clear linear gradients, i.e. increasing or decreasing with the distance from town, neither do the three types have the same regional focus. The figure also shows that there is quite a lot of pressure in areas beyond the borders of traditional regional planning, which usually covers an area about 50 km from the core of Copenhagen.

OTHER PRESSURES

There are other pressures relevant to peri-urban areas such as economic development or traffic which were not, or only marginally, tackled in this thesis. In *Paper IV,* we looked at a process called Hidden urbanisation. Hidden urbanisation, represented by the commuting of former locally employed people in an area, is positively correlated with population density and is strong in areas in which the other three processes do not typically occur to any significant extent. The prevalence of Hidden urbanisation in regional centres outside the urban core shows the ongoing physical expansion and integration of the regional labour market, which supports the hypothesis of an interrelated urban-rural region. In *Paper V,* we also looked at the relationship between economic and urban development, which is discussed in the next section.

5.3 RQ3: Impacts on the land use in peri-urban areas

The impacts of urbanisation on land use in peri-urban areas were tackled mainly in *Paper IV* and *V*. In Paper IV the transformation of agricultural practice in relation to peri-urbanisation around Copenhagen was analysed. In Paper V a comparative analysis of land use change in terms of growth of urban area in 9 cities was conducted.

AGRICULTURAL TRANSFORMATION

Agriculture is usually the dominant land use in peri-urban areas[12] and the main source for new urban land. Between 2000 and 2006, 86 % of all new urban areas around Copenhagen were established on former agricultural land (see Figure 4 in *Paper V*). At the same time, agriculture is under pressure from international competition. Many farmers in peri-urban areas adapt their practice, focusing more on urban services. In *Paper IV* we analysed three types of adaptation strategies: Environmental farming, specialisation on high-value crops, and farming related to lifestyle and recreation. Because of issues of data availability and data reliability only cross-sectional analysis of the agricultural practices could be done, and not the development over time, as with for the pressures in RQ2.

The results of *Paper IV* show that peri-urbanisation, represented by the four dynamics presented in Table 3, accounts for a substantial influence on farm adaptation strategies towards multifunctionality. Especially environmental farming and farming related to lifestyle and recreation are closely related to Ex-urbanisation and Displaced urbanisation. This is not surprising, considering that the in-migration of younger families, but also affluent residents, contributes to a growing consumer potential combined with an appreciation for rural life attributes and products. However, we have to consider that farming in general, and multifunctional adaptation in particular, as we saw around Copenhagen, is strongly dependent on political framework conditions, such as the European Common Agricultural Policy.

GROWTH OF URBAN AREA

In *Paper V,* we analysed the impact of urban development on land use change more generally, i.e. related to the whole city-region, not focusing on peri-urban areas in particular. In all nine case cities, the urban area increased from 2000/2001 to 2006, even in the area of Leipzig which experienced a decline in population at the same time. The consumption of urban land per new resident was very different in each case. Although in general in Europe (Nilsson & Nielsen 2010), as well as globally (Angel et al. 2011a), more and more urban land is used per inhabitant, some of the case cities used less area per inhabitant than previously. Figure 10 shows the urban area consumption per inhabitant in 2000 as well as the incremental change, i.e. the additional urban land use per additional inhabitant. Manchester, Montpellier, Seattle and Portland became denser. The other cities, including Leipzig, became less dense and used more urban land per inhabitant in 2006 than in 2000. But density does not necessarily mean concentration. Although Copenhagen became less efficient regarding population per urban area, all (100 %) new urban areas were adjacent to existing urban areas, which can potentially in-

[12] Copenhagen, agriculture becomes the main single land cover type about 15 km from the urban centre of Copenhagen with 30 % of the area. About 20-25 km from the centre, agriculture fills 70 % of the area and stays at this level also at longer distances; own calculation based on CORINE land cover data (EEA 2011)

crease the efficiency of infrastructure. On the other hand, in Warsaw or Seattle, between 80 and 90 % of all new urban areas were adjacent to existing urban areas and the patches were considerably smaller in size than in Copenhagen.

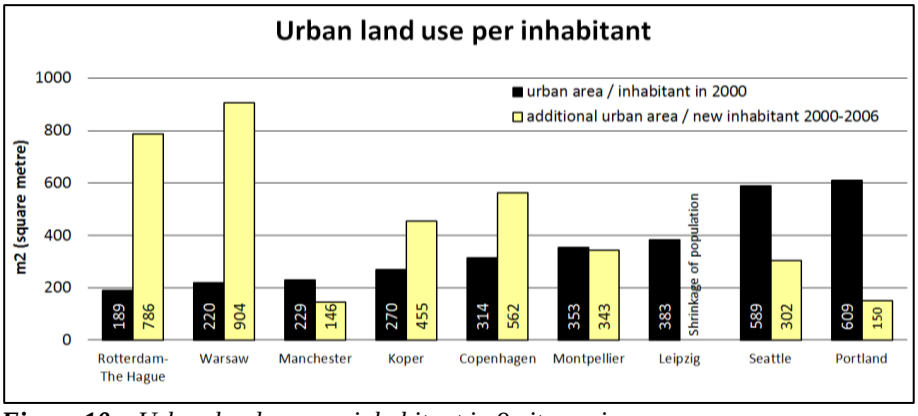

Figure 10: *Urban land use per inhabitant in 9 city-regions*

Data sources: Eurostat, CORINE (EEA 2011), U.S. Census Bureau, NLCD (MRLC 2011)
For Seattle and Portland the initial year is 2001.

The latest available land use data for that study was from 2006. For Copenhagen we can expect that the shift of population increase towards the urban centre (see RQ 2) can also be seen in less new urban land use in peri-urban areas. According to an expert from the Danish Ministry of Environment[13], the built-up area is currently only increasing by 100 ha annually. Related to the population increase of about 14,000 persons in the metropolitan region annually, this would mean an urban land use increase of only 70 m^2 per new inhabitant – compared to 562 m^2 from 2000-2006. However, it is unclear what these 100 ha includes (or does not include) compared to the data used in *Paper V*. Still, it shows that urban growth occurs to a certain degree independently from population growth, and that cities can considerably change path with regards to urban structure. Still, even if Portland continues densification at the current speed, it would, hypothetically, take another 30 years to reach the density of Copenhagen has.

5.4 RQ4: Spatial planning options

The fourth research question, how spatial planning can deal with peri-urbanisation and steer the development in a desired direction, was mainly dealt with in *Paper V* by comparing urban growth management in 9 cities. The term growth management originates from planning in the USA in the

[13] Discussion with Peter Hartoft-Nielsen from the Nature Agency (Ministry of Environment) in May 2011.

1970s, although the idea of controlling urban growth to optimise land use is as old as spatial planning itself. The basis for growth management in all cases, besides Warsaw, is some kind of urban containment plan or simplified vision. Several of them only deal with a few ideas and distinctions, such as Koper dealing with three types of land, Copenhagen with four themes for the planning, and Portland with only one distinction: urban or non-urban. The Hague's vision deals more specifically with place-related problems and priorities. Policies are more complex and perhaps more useful for prioritisation. On the other hand they are less iconic, and might rather be seen as a registration of current problems and values than as a vision for the future of the region. In this case, it might be more difficult to gather political will and the citizens' commitment to support the plan.

Besides the common element of a containment strategy, the cases use a variety of other policies to support the general goals of their growth management. Policies which support urban attraction are among the most frequently used. Although these policies fulfil a lot of other goals, they should be considered as important parts of urban growth management. By making inner-cities more attractive, these policies lessen pressure from the peri-urban areas. Rural policies are in particular used to preserve cultural heritage and provide recreational functions.

A major issue for growth management policies in the nine cities is to find a balance between a firm delineation of urban areas and flexibility for future development. Some cities therefore only implement general guidelines for urban growth at the regional level, keeping some flexibility for the local level. Portland determined urban reserves to increase the flexibility of its containment boundary. A crucial basis for this is a common vision for future development. Simple and iconic spatial visions, such as the Fingerplan in Copenhagen or the green belts of Manchester and Leipzig, are possibilities to gain support from stakeholders and citizens, though place-specific regulations should be used to anchor and implement the vision locally. Co-operation within and between levels seems to be effective in the implementation of regional visions.

However, we could not find a clear relation between growth management and the manifestation of urban growth. Furthermore, strong population or economic growth does not necessarily lead to (relative) dispersion (Copenhagen, Portland, Koper), while urban growth management is no guarantee that dispersion will be avoided (Montpellier, The Hague, Seattle). Also, urban sprawl does not automatically trigger the establishment of strong growth management, even if the problems are recognised (Warsaw). Many other factors which are context-specific play an important role, not least the national policy and legal framework for spatial planning. On the other hand, Copenhagen, Portland, Koper and Manchester seem to successfully condemn urban dispersion and it is deemed that their urban growth management policies make an important contribution to this.

6 DISCUSSION

The research issue of urbanisation in peri-urban areas has been illuminated by different methods and in different case studies. In this discussion, I discuss the overall development of peri-urban areas and its implications for planning, the use of the concept of peri-urban space for further research and policy and the methodological limitations of this study.

6.1 Peri-urban megatrend and planning

Since the end of the 1990s, an increasing out-migration to peri-urban areas and a strong expansion of urban land use has been observed around Copenhagen and other cities. Urban growth in Europe until 2025 has been modelled in the EU-FP6 project, PLUREL. In all four scenarios, built-up area is projected to grow fastest in peri-urban areas, 3 – 4 times faster than urban areas (Ravetz et al. 2012). The current rate of urban growth might not be comparable to that of previous decades [14], but it is far from reversing. Some might call this a new wave of suburbanisation (e.g. Nelson & Sanchez 1999), but there are two important differences to the developments we saw with earlier suburbanisation:

(1) Peri-urban areas are growing in parallel with the urban core and
(2) urbanisation in peri-urban areas is very heterogeneous and can include the conversion of farmsteads, a change in activity patterns of the local population, the development of recreational landscapes, traditional low density residential and commercial development, etc.

Both matters contribute to the difficulties of grasping this phenomenon in a conceptual or even empirical way. However, all three approaches to determine peri-urban areas (see section 5.1) show that a considerable number of areas are concerned by phenomena related to peri-urbanisation, including the diffusion of population and activities to rural areas. Even if we are currently witnessing a pause in the development due to the financial crisis and some consolidation of the development of recent years, urban-rural regions will become further integrated, a process in which peri-urban areas will play an important role.

Therefore, this slow down should be seen as a chance to set the course for future development by recognising the peri-urban in spatial planning and policy making. Therefore, it is important to recognise that peri-urbanisation does not mean the transformation of rural areas into urban areas, although it can lead to this. However, more likely is the development of hybrid forms, where urban and rural lifestyles and landscape transform into new forms of settlements. Traditional urban planning ideals (and ideas) can only be par-

[14] For example the Copenhagen metropolitan region grew, on average, annually by 1.1 % in urban area between 1950 and 1990 (EEA 2002). Between 2000 and 2006 the annual growth rate was 0.6 %.

tially applied because the activity patterns of inhabitants and the interrelations with other areas are different.

Recognising the heterogeneity of these areas is a challenge, but it can also be a big opportunity. Supporting multifunctionality where new forms of agricultural activities, living and working, etc. can coexist and benefit from each other can increase the resilience of peri-urban areas to external changes. However, we have to find ways of concentrating activities to enable an environmentally-friendly and resource-efficient use of the land. Long term visions, including the whole urban-rural region, are necessary as many of the developments are irreversible or are at least long lasting.

6.2 How to use the concept peri-urban

Peri-urban areas and *peri-urbanisation* are central terms in this study. When reflecting on the many similar terms found in the literature (see section 2.2), one might ask if we need any of them, or if they are worth using in the future. In relation to this, I want to note two issues which became apparent:

1) *Peri-urban* is a concept which is used differently from case to case and is context related. The terms *peri-urban* or *peri-urbanisation* emerged from French and English planning terminologies. Although similar dynamics and phenomena appeared in other countries too, different terms were used there (see Caruso 2001).
2) The concept of *peri-urban* emerged from the idea that an urban-rural dichotomy did not exist, or that the 'line' between the urban and the rural was fuzzy. Therefore, it would be misleading to define *peri-urban areas* by way of a new dichotomy (or 'trichotomy' in this case). On the other hand, a definition of *peri-urban areas* can never be exact without defining urban and rural areas at the same time.

Without a doubt, many aspects such population density, economic activity, urban and agricultural land uses, traffic, imply a clear urban-rural gradient. Still, in peri-urban areas, the overlapping of these can result in many different types of areas each with more or less activity regarding the different aspects. In that sense a *peri-urban area* is not phenomenon by itself, but it is just a conceptualisation which can be used to discuss a particular topic.

Peri-urbanisation as an active verb then might offer an additional different perspective. The term could be understood as a process of an area becoming peri-urban. But if this perspective is chosen, it has the same problems as mentioned before regarding delineation. A different perspective is that peri-urbanisation is the process of integration of rural areas into the system of an urban region, whereas integration can mean any kind of functional relationship. With this perspective we can choose particular phenomena, as done in Paper III and IV as the basis for analysis. This has the advantage that

we do not have to apply a dichotomy/trichotomy approach and thereby exclude some areas from the analysis beforehand. As also shown in Paper III and IV, peri-urbanisation is concentrated in particular areas, but the single phenomena are relevant across the whole region, illustrating gradients and flows.

However, also this approach has the disadvantage of not presenting a clear typology. Figure 11 illustrates the trade-off between the three dimensions complexity, comparability and clarity. Each of the three presented approaches is strong in two dimensions to the expense of the third one. So even if a delineation of peri-urban areas by a traditional typology (as shown in *Paper II*) deviates from the complexity of reality, it has the advantage to provide a clear delineation which can have value for policy-making. Peri-urban areas are hardly recognised in spatial policy and a delineation makes them visible and enables a stronger focus on this particular type of area. However, policy-makers should keep this limitation in mind and account for it when developing policies by applying a flexible approach to it.

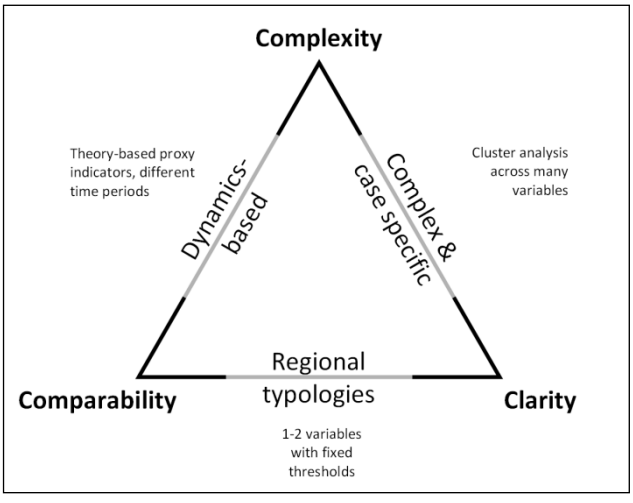

Figure 11: *Determining peri-urban: A trade-off between complexity, comparability and clarity*

6.3 Limitations of this study

This study has several limitations regarding data, case study choice, untreated questions and the general research setup. The first issue is the use of quantitative data, which has the advantage of being very precise, but is a simplification of reality at the same time. The use of proxy indicators (as done in Paper III and IV) makes it difficult to draw conclusions regarding the underlying theoretical concepts. The three described processes of Ex-urbanisation, Displaced urbanisation and Anti-urbanisation provide a useful

and comprehensive framework, while the proxy indicators only depict one aspect. Furthermore, regarding peri-urbanisation, many other issues are relevant, e.g. economic development or traffic, both of which were not, or only marginally, tackled in this thesis. For this study it was important to find a balance between the number of (available) variables and the comprehensibility of the results.

Another methodological issue is the use of aggregated data, as on the level of municipalities. This means that the data represent averages for one municipality, which often contains several cities or towns. Intra-municipal differences might in some cases be larger than inter-municipal. Also, the amalgamation of several municipalities in 2007 complicates data comparison across time. So, in a way, the municipal scale might be too broad, but smaller scales do not necessarily improve the analysis of patterns, while there will always be local variation in social science research. Despite these deficiencies, the data provide overall trends and, in the case of Denmark, the use of municipalities has the advantage that they are political entities subject to policy making.

Regarding the choice of case studies, *Paper V* showed that cities, although subject to the same global drivers, can face very different challenges. Local variations are caused by context specific issues, which make a direct comparative evaluation of urban growth and growth management difficult. A choice of cities of similar size, or in only one country, would certainly have improved comparability. With this method a detailed evaluation of particular policies, differently applied, would be possible. However, the variation found between the cases is also of value and allows a broader discussion of urban development. In Copenhagen, as the main case study, context-specific issues include, e.g. the significant impact of the financial crisis on the housing market, the boom of some inner-city districts or the strict planning regulations. The generalisation of particular phenomena is therefore limited to more general aspects. Instead, the study is characterised by exploring and informing about different development.

There are number of relevant and related issues which were not treated in this study, which leave a number of questions unanswered. As previously discussed, important pressures such as economic development or traffic were not investigated in this study. There are also a number of open questions regarding possible future development. A scenario study to cover the issues of economic regionalisation, energy production, new forms of living and trade could uncover the potential of peri-urban areas. Also, the research had a regional perspective, with only few implications regarding local impacts. A local focus would allow more concrete recommendations to be made for local planning.

Finally, I want to reflect on the general research setup. The study applied different methods and different cases across five different papers. The internal structure of the project was kept flexible enough to allow this variation.

On the one hand, concluding across the different results is, however, difficult and limits opportunities for short statements and summarising recommendations. On the other hand, the inclusion of this variation provides extensive comprehensive picture of the issue. Also, this is a PhD study which, from my point of view, also includes educational aspects. The opportunity to learn different approaches is a real asset of this kind of project, but it can be at the expense of the directness and narrowness of the contribution to the field of research. Furthermore, some knowledge gathered during the study would have been helpful if applied in the study design from the beginning, e.g. a more systematic approach to the literature review or the application of certain methods such as spatial statistics or qualitative case study work.

7 CONCLUSIONS

Peri-urban areas represent a considerable share of contemporary urban regions. In the metropolitan region of Copenhagen, they account for about a third of the area and a fifth of the population. However, delineations of peri-urban areas are difficult due to their heterogeneity. Despite these difficulties, it is clear that peri-urban areas play an important role in the functioning of our cities by accommodating various important functions such as agricultural production, recreational space, transport corridors and space for living and working. Peri-urban areas are becoming more and more integrated into urban regions. Approaches which look at the dynamics of peri-urbanisation, as in this study, can contribute to a better understanding of the pressures and demands in these areas.

Similar challenges of urbanisation can be found in other cities, though with local variation. However, urban sprawl remains a problem in many of them. Containment strategies and visions can provide a useful tool to cope with these challenges, although a clear relation between growth management and the manifestation of urban growth was not found. Strong population or economic growth do not necessarily lead to (relative) dispersion, while urban growth management is not a guarantee that dispersion will be avoided. Also, urban sprawl does not automatically trigger the establishment of strong growth management, even if the problems are recognised. Other factors which are context-specific play an important role, not least national policy and the legal framework for spatial planning.

However, the most recent development in Copenhagen indicates a consolidation of the extent of urban-rural relationships. Migration towards distant areas in the urban region, as was observed a decade ago, has declined. Instead, the urban core and the closest suburbs absorb the major part of the population increase. However, there are indications of a further integration of the urban region. Therefore, this slow down in development should be seen as a chance to set the course for the future development of peri-urban areas. Therefore, it is important to recognise that peri-urbanisation does not only mean a transformation of rural areas into urban areas. More likely is the development of hybrid forms, where urban and rural lifestyles and landscape transform into new forms of settlements. Traditional urban planning ideals (and ideas) can only be partially applied because the activity patterns of inhabitants and the interrelations with other areas are different.

Recognising the heterogeneity of these areas is a challenge, but it can also be a significant opportunity. Supporting multifunctionality, where new forms of agricultural activities, living and working, etc. can coexist and benefit from each other can increase the resilience of peri-urban areas to external changes. However, we have to find ways to concentrate activities to enable an environmentally-friendly and resource-efficient use of the land. Long

term visions, including the whole urban-rural region, are necessary as many of the land use changes are irreversible or are at least long lasting.

8 REFERENCES

Adell, G. 1999, *Theories and models of the peri-urban interface: A changing conceptual landscape*, Strategic Environmental Planning and Management for the Peri-urban Inferface - Research project. Development Planning Unit, University College London.

Andersen, H. S., Andersen, H. T., & Ærø, T. 2000, "Social polarisation in a segmented housing market: Social segregation in Greater Copenhagen", *Geografisk Tidsskrift-Danish Journal of Geography*, vol. 100, no. 1, pp. 71-83.

Andersen, H. T., Møller-Jensen, L., & Engelstoft, S. 2011, "The End of Urbanization? Towards a New Urban Concept or Rethinking Urbanization", *European Planning Studies*, vol. 19, no. 4, pp. 595-611.

Andersen, H. T. & Winther, L. 2010, "Crisis in the Resurgent City? The Rise of Copenhagen", *International Journal of Urban and Regional Research*, vol. 34, no. 3, pp. 693-700.

Aner, L. G. 2009, *Udflytninger fra København. Børnefamiliers udflytninger og bostedvalg i et hverdagslivsperspektiv. PhD dissertation,* Faculty of Natural Sciences, University of Copenhagen.

Angel, S., Parent, J., Civco, D. L., Blei, A., & Potere, D. 2011, "The dimensions of global urban expansion: Estimates and projections for all countries, 2000-2050", *Progress in Planning*, vol. 75, no. 2, pp. 53-107.

Barredo, J. I., Kasanko, M., Lavalle, C., McCormick, N., & Demicheli, L. 2003, *Sustainable Urban and Regional Planning. The MOLAND Activities on Urban Scenario Modelling and Forecast*, European Commission-Joint Research Centre.

Batty, M., Chin, N., & Besussi, E. 2002, *State of the art review of urban sprawl impacts and measurement techniques*, SCATTER Work package 1, Deliverable 1.

Bertrand, N. 2007, "Introduction: ESDP Ideals and the Inheritance of Rural Planning Failures" in *Europe's city-regions competitiveness: Growth regulation and peri-urban land management*, N. Bertrand & V. Kreibich, eds., Van Gorcum, Assen, pp. 1-35.

Blanco, H. 1994, *How to Think About Social Problems: American Pragmatism and the Idea of Planning* Greenwood Press.

Briquel, V. & Collicard, J.-J. 2005, "Diversity in the Rural Hinterlands of European Cities" in *The City's Hinterland - Dynamism and Divergence in Europe's Peri-Urban Territories*, K. Hoggart, ed., Ashgate, Adlershot, pp. 19-40.

Bryant, C. R., Russwurm, L. H., & McLellan, A. G. 1982, *The city's countryside. Land and its management in the rural-urban fringe* Longman Inc., New York.

Busck, A. G., Kristensen, S. P., Præstholm, S., & Primdahl, J. 2008, "Porous landscapes - The case of Greater Copenhagen", *Urban Forestry & Urban Greening*, vol. 7, no. 3, pp. 145-156.

Caruso, G. 2001, *Peri-urbanisation: the situation in Europe. A bibliographical note and survey of studies in the Netherlands, Belgium, Great Britain, Germany, Italy and the Nordic countries*, Report prepared for DATAR, France.

Caspersen, O. H., Konijnendijk, C. C., & Olafsson, A. S. 2006, "Green space planning and land use: An assessment of urban regional and green structure planning in Greater Copenhagen", *Geografisk Tidsskrift-Danish Journal of Geography*, vol. 106, no. 2, pp. 7-20.

CEMAT 2007, *Spatial development glossary* Council of Europe, Strasbourg.

Champion, A. G., Fielding, A. J., & Keeble, D. 1989, "Counterurbanization in Europe", *The Geographical Journal*, vol. 155, no. 1, pp. 52-80.

Cheshire, P. 1995, "A New Phase of Urban Development in Western Europe? The Evidence for the 1980s", *Urban Studies*, vol. 32, no. 7, pp. 1045-1063.

Couch, C., Leontidou, L., & Arnstberg, K.-O. 2008, "Introduction: Definition, Theories and Methods of Comparative Analysis" in *Urban Sprawl in Europe - Landscape, Land-Use Change & Policy*, C. Couch, G. Petschel-Held, & L. Leontidou, eds., Blackwell, Oxford, pp. 3-38.

Creswell, J. W. 2009, *Research design: Qualitative, quantitative, and mixed methods approaches*, Third edn, SAGE, Thousand Oaks.

Danmarks statistik 1989, *Statistiske efterretninger: Arbejdsmarked* Kbh..

Danmarks statistik 2000, *Landbrug 1999: statistik om landbrug, gartneri og skovbrug*.

Danmarks statistik 2012, *Befolkningsfremskrivninger 2012* www.dst.dk/stattabel/184.

EEA 2002, *Towards an urban atlas - Assessment of spatial data on 25 European cities and urban areas*, EEA, Copenhagen, Environmental issue report No 30.

EEA 2006, *Urban Sprawl in Europe - The ignored challenge*, EEA, Copenhagen, 10/2006.

EEA 2011, *Corine Land Cover Data Version 15*, www.eea.europa.eu/data-and-maps, last accessed December 2011, The European Topic Centre on Land Use and Spatial Information.

Egensplankontoret 1947, *Sktiseforslag til egnsplan for Storkøbenhavn* Copenhagen.

Errington, A. 1994, "The Peri-urban Fringe - Europe's Forgotten Rural-Areas", *Journal of Rural Studies*, vol. 10, no. 4, pp. 367-375.

ESDP 1999, *European Spatial Development Perspective*, EC, Luxembourg.

ESPON 2005, *ESPON Project 1.1.2 - Urban-rural relationships in Europe. Final report*.

European Commission 1997, *The EU compendium of spatial planning systems and policies* DG Regional Policy, Luxembourg.
Fertner, C. 2006, "Cooperation and Integration in cross-border regions. The case studies of Copenhagen-Malmö and Vienna-Bratislava", *Der Öffentliche Sektor*, vol. 2/2006, no. 2, pp. 27-40.
Fertner, C., Jørgensen, G., & Nielsen, T. A. S. 2012, "Land use scenarios for greater Copenhagen: Modelling the impact of the Fingerplan", *Journal of Settlements and Spatial Planning*, vol. 3, no. 1, pp. 1-10.
Flyvbjerg, B. 2006, "Five Misunderstandings About Case-Study Research", *Qualitative Inquiry*, vol. 12, no. 2, pp. 219-245.
Friedmann, J. & Miller, J. 1965, "The Urban Field", *Journal of the American Institute of Planners*, vol. 31, no. 4, pp. 312-320.
Geyer, H. & Kontuly, T. 1993, "A theoretical foundation for the concept of differential urbanization", *International Regional Science Review*, vol. 15, no. 2, pp. 157-177.
Halliday, J. & Coombes, M. 1995, "In search of counterurbanisation: Some evidence from Devon on the relationship between patterns of migration and motivation", *Journal of Rural Studies*, vol. 11, no. 4, pp. 433-446.
Hartoft-Nielsen, P. 2010, "Efterskrift: Overordnet planlægning nytter!" in *Det store rum - Debatbog om regional planlægning*, J. Kvorning, K. Skou, & S. M. Christensen, eds., Realdania, Copenhagen, pp. 128-133.
Herslund, L. 2012, "The Rural Creative Class: Counterurbanisation and Entrepreneurship in the Danish Countryside", *Sociologia Ruralis*, vol. 52, no. 2, pp. 235-255.
Herslund, L. B. & Fertner, C. 2011, "Hvem kan udkantskommuner tiltrække?", *byplan*, vol. 63, no. 2, pp. 12-16.
Holm, A. & Johansen, K. 1941, *København 1840-1940: Det københavnske bysamfund og kommunens økonomi* Nyt Nordisk Forlag.
Jørgensen, G. & Ærø, T. 2008, "Urban Policy in the Nordic Countries - National Foci and Strategies for Implementation", *European Planning Studies*, vol. 16, no. 1, pp. 23-41.
Kabisch, N. & Haase, D. 2009, "Diversifying European agglomerations: evidence of urban population trends for the 21st century", *Population, Space and Place*.
Lewan, N. 1969, "Hidden Urbanization in Sweden", *Tijdschrift Voor Economische en Sociale Geografie*, vol. 60, no. 3, pp. 193-197.
Matthiessen, C. W. 1980, "Trends in the urbanization process. The Copenhagen case", *Geografisk Tidsskrift-Danish Journal of Geography*, vol. 80, no. 1, pp. 98-101.
McGregor, D., Simon, D., & Thompson, D. 2006, *The Peri-Urban Interface. Approaches to sustainable natural and human resource use* Earthscan, London.
Michel, J. B., Shen, Y. K., Aiden, A. P., Veres, A., Gray, M. K., The Google Books Team, Pickett, J. P., Hoiberg, D., Clancy, D., Norvig, P., Orwant,

J., Pinker, S., Nowak, M. A., & Aiden, E. L. 2011, "Quantitative Analysis of Culture Using Millions of Digitized Books", *Science*, vol. 331, no. 6014, pp. 176-182.
Miljøministeriet 2007, *Fingerplan 2007 - Landsplandirektiv for hovedstadsområdets planlægning*.
Miljøministeriet 2011, *Danmarks Arealinformation 2.5.1*, http://kort.arealinfo.dk, last accessed December 2011, Danmarks Miljøportal - Data om miljøet i Danmark.
Mitchell, C. J. A. 2004, "Making sense of counterurbanization", *Journal of Rural Studies*, vol. 20, no. 1, pp. 15-34.
MRLC 2011, *National Land Cover Data*, www.mrlc.gov, last accessed December 2011, Multi-Resolution Land Characteristics Consortium.
Næss, P. & Saglie, I. L. 2000, "Surviving Between the Trenches: Planning Research, Methodology and Theory of Science", *European Planning Studies*, vol. 8, no. 6, pp. 729-750.
Nelson, A. C. & Sanchez, T. W. 1999, "Debunking the exurban myth: A comparison of suburban households", *Housing Policy Debate*, vol. 10, no. 3, pp. 689-709.
Nielsen, T. A. S. & Hovgesen, H. H. 2005, "Urban fields in the making: New evidence from a Danish context", *Tijdschrift Voor Economische en Sociale Geografie*, vol. 96, no. 5, pp. 515-528.
Nielsen, T. A. S. 2009, "Sectoral Analysis of urban land use - Analysis of drivers and prediction of urban land use in Europe" in *The SIAT Model Chain - SENSOR Project Deliverable Report 2.2.1*, T. Jansson et al., eds., ZALF, Müncheberg, pp. 29-74.
Nilsson, K. S. B. & Nielsen, T. A. S. 2010, "Towards green urban planning" in *World and European sustainable cities: Insights from EU research*, European Commission, pp. 25-30.
Nordregio et al. 2005, *ESPON 1.1.1: Potentials for polycentric development in Europe, Project report.*, Nordregio/ESPON Monitoring Committee., Stockholm/Luxembourg.
OECD 2009, *OECD Territorial Reviews: Copenhagen, Denmark* OECD Publishing, Paris.
Pallagst, K. M. 2007, *Growth Management in the US. Between Theory and Practice* Ashgate, Aldershot.
Piorr, A., Ravetz, J., & Tosics, I. 2011, *Peri-urbanisation in Europe: Towards a European Policy to Sustain Urban-Rural Futures. A Synthesis Report*, University of Copenhagen, Academic Books Life Sciences, Frederiksberg.
Praestholm, S. & Kristensen, S. P. 2007, "Farmers as initiators and farms as attractors for non-agricultural economic activities in peri-urban areas in Denmark", *Geografisk Tidsskrift-Danish Journal of Geography*, vol. 107, no. 2, pp. 13-27.

Primdahl, J., Vejre, H., Busck, A. G., & Kristensen, L. 2009, "Planning and development of the fringe landscapes: on the outer side of the Copenhagen 'fingers'" in *Regional Planning for Open Space*, A. van der Valk & T. van Dijk, eds., Routledge, Oxon, pp. 21-39.

Ravetz, J., Fertner, C., & Nielsen, T. A. S. 2012, "The dynamics of peri-urbanisation" in *Peri-urban futures: Scenarios and models for land use change in Europe*, K. S. B. Nilsson et al., eds., Springer Verlag, Heidelberg.

Robinson, G. M. 1990, *Conflict and change in the countryside. Rural society, economy and planning in the developed world* Belhaven Press, London.

Sieverts, T. 1999, *Zwischenstadt - zwischen Ort und Welt, Raum und Zeit, Stadt und Land*, 3. edn, reprinted in 2008, Birkhäuser.

Soule, D. C. 2006, "Defining and Managing Sprawl" in *Urban sprawl - a comprehensive reference guide*, D. C. Soule, ed., Greenwood Press, Westport, pp. 3-11.

Spectorsky, A. C. 1955, *The exurbanites* Lippincott, Philadelphia.

Statistics Denmark 2012, *StatBank Denmark, www.dst.dk*.

Swyngedouw, E., Moulaert, F., & Rodriguez, A. 2002, "Neoliberal Urbanization in Europe: LargeΓÇôScale Urban Development Projects and the New Urban Policy", *Antipode*, vol. 34, no. 3, pp. 542-577.

UN 2009, *World Urbanization Prospects: The 2009 Revision Population Database*, http://esa.un.org/unpd/wup/, last accessed January 2012, United Nations, Department of Economic and Social Affairs.

van den Berg, L., Drewett, R., Klaassen, L. H., Rossi, A., & Vijverberg, C. H. T. 1982, *Urban Europe: A Study of Growth and Decline* Pergamon Press.

van den Vaart, J. H. P. 1991, "Conversion of farmsteads: Hidden urbanisation or a changing rural system?" in *Limits to rural land use: proceedings of an international conference organized by the Commission on Changing Rural Systems of the International Geographical Union (IGU), Amsterdam, Netherlands, 1989*, G. M. R. A. van Oort et al., eds., Pudoc, Wageningen, pp. 123-129.

Vejre, H., Primdahl, J., & Brandt, J. 2007, "The Copenhagen Fingerplan: Keeping a green space structure by a simple planning metaphor" in *Europe's living landscapes. Essays on exploring our identity in the countryside*, B. Pedroli et al., eds., Landscape Europe, pp. 311-328.

WCED 1987, *Report of the World Commission on Environment and Development: Our Common Future*, Oxford University Press, Oxford.

LIST OF ORIGINAL PUBLICATIONS

This thesis is a synthesis of the following papers, which are referred to in Roman numerals in the text. Papers I, III and IV are full articles published or under review in peer-reviewed journals. Paper II was published in the shorter format of a research note. Paper V is an unpublished manuscript, intended to be submitted to a peer-reviewed journal. The five papers are not included in this version of the thesis due to copyright.

I Madsen, M. F., Kristensen, S. B. P., Fertner, C., Busck, A. G., & Jørgensen, G. (2010) "Urbanisation of rural areas: A case study form Jutland, Denmark", Geografisk Tidsskrift-Danish Journal of Geography, vol. 110, no. 1, pp. 47-63.

II Fertner, C. (2012) "Downscaling European Urban-rural typologies", Geografisk Tidsskrift-Danish Journal of Geography, vol. 112, no. 1, pp. 77-83.

III Fertner, C. (in review) "The emergence and consolidation of the urban-rural region. Migration patterns around Copenhagen 1986-2011", Tijdschrift Voor Economische en Sociale Geografie-Journal of Economic and Social Geography. Accepted.

IV Zasada, I., Fertner, C., Piorr, A., & Nielsen, T. A. S. (2011) "Peri-urbanisation and multifunctional adaptation of agriculture around Copenhagen", Geografisk Tidsskrift-Danish Journal of Geography, vol. 111, no. 1, pp. 59-72.

V Fertner, C., Nielsen, T. A. S., & Jørgensen, G. (unpublished manuscript) "Urban growth management in 9 cities in Europe and the USA". Not submitted/published yet.

Author's contribution in co-authored publications (I, IV and V)
I: The author contributed mainly to the literature review and participated in writing the manuscript.
IV: The author contributed substantially to the study design, data collection, investigation and analysis and the writing of the manuscript.
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