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The peri-urbanization of Europe: A systematic review of a multifaceted process

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A B S T R A C T

Urbanisation patterns in Europe since the 1950s have resulted in a swath of low-density discontinuous development, commonly called peri-urban areas. These areas are characterised by a mixed rural-urban character, are highly dynamic in nature, and are expected to continue growing rapidly in the next few decades. This paper presents a systematic review of the literature on changes in peri-urban areas in Europe. We analysed 142 cases from 121 studies that are spread across Europe, representing a wide range of peri-urban processes. Land cover changes were the most reported changes, followed by socioeconomic changes, land use changes, planning process changes, land management changes, and environmental changes. Over half of the cases reported co-occurring land-cover and socioeconomic processes of change. In addition, we analysed sequential and causal relations between these processes. In this analysis we found that peri-urbanization cannot be conceptualized as driver – land change – impact, because often relations between processes pointed in different directions. Therefore, we characterize peri-urbanization as a multifaceted process that can manifest itself differently in different case study areas. In addition, we found that planning precedes land change processes about as often as it follows these processes, illustrating the specific challenge for planners and policy makers in managing peri-urban areas.

1. Introduction

Changing lifestyles, infrastructure development, increased mobility, and a growing economy have led to an expansion of low-density discontinuous urban development in many areas of the world. In different areas of the world this development has different character, ranging from new sub-urban development at the edge of large cities (Theobald, 2005) to the infill of rural areas due to the expansion of villages and towns surrounding cities (Schneider, Chang, & Paulsen, 2015). As a consequence, large parts of Europe cannot be described as strictly urban or strictly rural (van Vliet, Verburg, Grădinaru, & Hersperger, 2019). These territories-in-between, often called peri-urban areas (PUA), combine elements of both urban and rural land (Wandl, Nadin, Zonneveld, & Rooij, 2014) and are characterized as emergent, dynamic, socially heterogeneous, and areas associated with often competing land use practices and demands (Hedblom, Andersson, & Borgström, 2017). To meet these multiple competing demands, landscapes in Europe often provide multiple functions and services at the same time, such as the production of food, recreation, and biodiversity habitat (Willemen, Verburg, Hein, & van Mensvoort, 2008). The importance of peri-urban areas is among others reflected by their projected growth rate, which in Europe is higher than for urban areas, expecting to double in size in the next 30–50 years (Piorr, Ravetz, & Tosics, 2011).

Peri-urban areas have been described as a grey area whose definition cannot avoid a degree of arbitrariness (Iaquinta & Drescher, 2000), and therefore present a challenge for environmental planning and management (Allen, 2003). Consistently, developments in peri-urban areas have been described by a range of terms that are not necessarily all synonymous, but relate to different aspects of peri-urbanization, including sprawl, urban fringe, functional urban region, and exurbs (Antrop, 2013; Griffiths, Hostert, Gruebner, & van der Linden, 2010; Janečková, Skřivanová, Kalivoda, & Sklenička, 2017; Mabin, Butcher, & Bloch, 2013). Meeus and Gulinck (2008) find that it mainly refers to a land use type, or a land use function, both of which acts as a divide between urban and rural areas, hence forming its own landscape. However, Antrop (2004) indicates that alongside land cover and land use changes, such as the development of low density housing or commercial infrastructure, socio-cultural transitions also occur as rural dwellers increasingly adopt urban lifestyles. Due to the complexity and multifaceted characteristics of PUAs, studies have addressed multiple dimensions of spatial change, mobility, identity and economic activities (Gonçalves, Gomes, Ezequiel, Moreira, & Loupa-Ramos, 2017).

Land change is often conceptualized as drivers that lead to land use changes that subsequently lead to socioeconomic and biophysical impacts (Turner, Lambin, & Reenberg, 2007). A combination of demographic, socio-economic, political, biophysical and technological drivers, have been found underlying peri-urbanization (EEA, 2016; Hersperger & Bürgi, 2009; Nilsson, Pauleit, Bell, Aalbers, & Nielsen,

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2013; Plieninger et al., 2016). These processes of change are also understood as social responses to increasingly globalised economic conditions, which are mediated by institutions at different scales (Lambin et al., 2001). However, the manifestation of peri-urbanization has been described in terms of multiple different dimensions, including land use changes themselves, but also the socioeconomic and environmental impacts that are normally considered land use change impacts. Therefore, the directionality and causality of the multiple different peri-urbanization processes is not clear.

The aim of this study is to provide a comprehensive overview of processes that characterize peri-urbanization in Europe, based on a systematic review of case-study evidence. Contrary to most other systematic reviews of land change, which focus on driving forces (e.g. Geist & Lambin, 2002; Plieninger et al., 2016; van Vliet, de Groot, Rietveld, & Verburg, 2015; van Vliet et al., 2016), the main focus of this paper is on the identification of the manifestation of change processes themselves and the relation between multiple different change processes occurring within peri-urban areas. Specifically, we ask 1) what processes of change in peri-urbanization are described in the literature, and 2) what are the general patterns of co-occurrence between these processes, and 3) what is the sequential or even causal relation between these processes. In addition, we provide an inventory of the methodological approaches that have been used for studying peri-urbanization in case-studies, as well as the bibliographic characteristics of the publications they have been presented in, in order to contextualize our findings and characterize the case-study literature in this field.

2. Materials and methods

2.1. Systematic literature search and analysis

We systematically searched for publications reporting on change processes in peri-urban areas in Europe. To help develop an inclusive search string, we first collected a sample of 18 publications that represent to our knowledge the breadth of studies reporting on these processes (Table S.1). This sample was subsequently used to refine the search string in ISI Web of Science in such a way that it returned all publications in our sample, in order to ensure that the search covered the whole breadth of publications reporting on peri-urbanization processes.

Results of the systematic search were screened by title and abstract, and subsequently assessed for eligibility based on the full text (the full selection process was documented according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) and can be found in Supplementary material S1). Publications were considered eligible when the following two criteria were met:

1. The case(s) described in the publication must be situated in a peri-urban area. This criterion can be satisfied by one or more of the following three characteristics: a) the article situates the case(s) explicitly in a peri-urban area; b) the article situates the case(s) in a peri-urban area, for example using terms related to peri-urban (e.g. sprawl, urban fringe, urbanization, rural gentrification, exurbanization, peri-urban, commuter town); c) the publication describes the case(s) with characteristics associated with peri-urban areas, i.e., the places are described as a combination of rural and urban land uses or landscapes, or, there is the indication of urban lifestyles (such as employment predominantly in tertiary sector) in a rural landscape.
2. The article must describe two or more processes associated with peri-urbanization. This criterion allows us to understand the relationship between multiple processes that are characteristic for PUA. Processes can relate to changes in land use, land cover, environmental or socioeconomic change described in the case study area. Planning changes are also considered as processes, as we assume they are either a catalyst for or a response to expected or undesired outcomes. This criterion allowed us to exclude cases that are only reporting remote-sensing based expansion of built-up area without any further analysis.

Eligible articles can contain one or more cases. A case is defined by a case study area for which the processes are analysed or described separately. Cases are further restricted by the following criteria: no minimum or maximum timeframe; space-time substitutions are included; areas larger than national are not included; no minimum area; case study locations are limited to geographic Europe; where cases described changes both before and after 1945, only those after were coded.

We used ISI Web of Science as a search database because this database includes only peer-reviewed publications, thus ensuring a quality control on the evidence included in this review. Consistently, we did not include conference proceedings and grey literature, as these often present work in progress, while completed studies are typically published as journal articles.

2.2. Case coding and analysis

For each case, we recorded a unique ID, descriptive characteristics such as location, country, size of case study area, and time period, where given, and the methodological approach of each study. Alongside case characteristics, processes of peri-urbanization, relationships between these processes, and their underlying drivers were recorded. Consistent with our research question, we employed a holistic understanding of peri-urbanization processes, including spatial, social, and institutional changes.

From the eligible articles, we coded all peri-urbanization processes that were reported. These processes describe the change processes as they are manifested in the case study area. Examples of these include the development of infrastructure elements, the change in use of (former) agricultural buildings, and an increase in hobby farmers. Although we started from a number of possible peri-urbanization processes this list was extended during the coding process when other, unanticipated, processes were reported. In order to facilitate the analysis and interpretation, the reported peri-urbanization processes were aggregated into groups of similar processes. This aggregation of processes followed an hierarchical structure consisting of three levels: the original description of processes as presented in case study literature (level 3), an intermediate level of aggregation (level 2), and a higher level of aggregation (level 1). For example, the level 3 processes *Infrastructure development* and *Increase in residential area* are both included in the level 2 process *Urban development*. *Urban development*, together with level 2 processes *Changes in agricultural land* and *Changes in natural land* are then grouped in the level 1 category *Land cover changes*. In each aggregation the number of processes in the higher level is the sum of all processes at the lower level belonging to this higher level. Consistently, the total number of processes reported at each level is the same, and the *Infrastructure development* in the example will also be included as *Urban development* at level 2 and *Land cover change* at level 1. A detailed list of all level 3 processes coded, as well as their aggregation into level 2 and level 1 processes, can be found in Supplementary material S2, while a more detailed description of each process is included in S4, in the tab named “Key”. Results reported here refer to level 1 and level 2 processes only. To ensure consistency, all cases were coded by the first author. However, to verify the coding scheme, ten sample papers were also coded by the second author and differences between coding results were discussed to improve the coding criteria and reproducibility.

At level 1 we included six types of change processes: land cover changes, land use changes, land management changes, planning processes, socioeconomic changes, and environmental changes. These categories are based on the prevalent conceptualization in land change science, where land cover changes refer to the changes in the physical properties of the land surface, while land use refers to the human use of

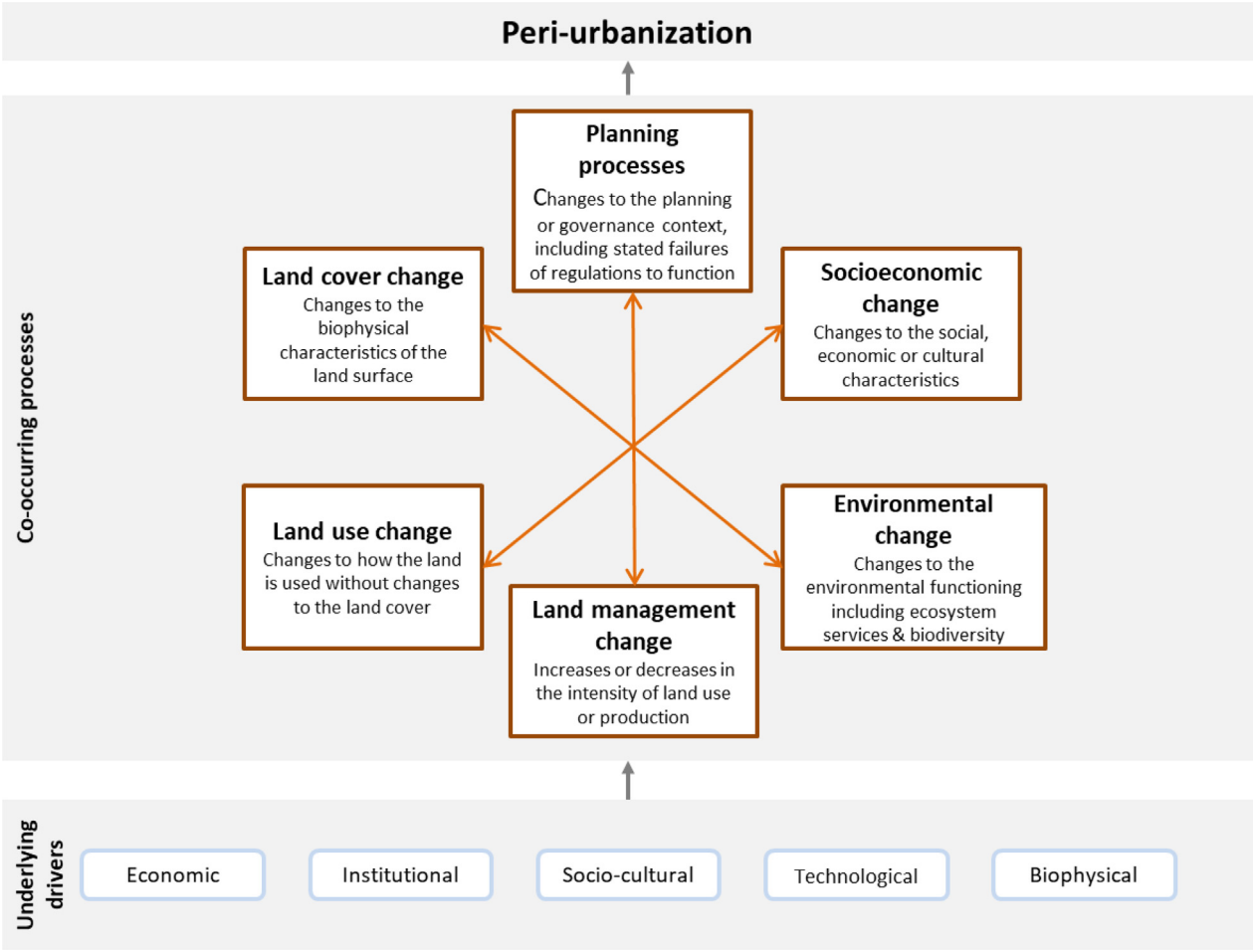

Fig. 1. Conceptual framework for analysing change processes of peri-urban areas.

this surface, and land management refers to the intensity with which this is used (Erb et al., 2013; Turner et al., 2007). In the driver – land change – impact framework commonly used in land change science (Turner et al., 2007), planning is often an underlying driver, while socioeconomic and environmental changes are commonly used to classify a broad range of impacts. Yet, here we deviate from the traditional description of impacts as final outcomes by coding all as processes that are part of peri-urbanization. This allows to analyse the sequential or causal relation between processes of peri-urbanization, acknowledging that outcomes of one process may be drivers of another (Fig. 1). For each case study, relations between multiple level 1 processes were coded as causally related, sequentially related, or merely co-occurring, depending on the description of the case study. Co-occurrence basically indicates the absence of causal or sequential relations.

Where mentioned, underlying drivers of peri-urban processes were also recorded. Following Geist and Lambin (2002), underlying drivers refer to more fundamental societal processes underlying the observed peri-urbanization processes. Drivers were coded following the categories used in other reviews of land change processes and include economic, institutional, sociocultural (including demographic), technological and biophysical (i.e. Geist & Lambin, 2002; van Asselen, Verburg, Vermaat, & Janse, 2013; van Vliet et al., 2015). Drivers were analysed using frequency analysis and this information was used for contextualization of observed peri-urbanization processes as well as comparison of peri-urbanization with other land change processes. An example being where changing transport infrastructure reduces travel distances to nearby urban centres, thereby stimulating demand for and construction of new housing. The development of transport infrastructure and the demand for housing are regarded as drivers, while the construction of housing is the observed peri-urbanization process. Some overlap between drivers and change processes can exist due to the complex mechanisms and feedbacks between them (Geist & Lambin, 2002), so processes and drivers were coded following how they were presented in the case studies.

For both drivers and peri-urbanization processes we could not derive from the literature if drivers or processes were simply not reported or not occurring in reality. While working on the assumption that the original authors obtained a thorough understanding of their case study areas and would thus report all relevant processes in their case study area we acknowledge that the different perspectives of looking at the system may have caused authors to overlook processes and drivers that were occurring in the case-study area. This is a common problem in the synthesis of land system case studies.

3. Results

3.1. Case study characteristics

The systematic search yielded 5976 potentially eligible articles. Screening by title and abstract resulted in 1163 articles that were further screened by full text. Of these, 121 articles were found eligible for inclusion, yielding 142 case studies in 27 different countries. Fig. 2a shows there has been a strong but irregular increase in publications on PUAs from 2000 onwards, while no publication in our search before that date matched our criteria. The systematic search was conducted in August 2017, so that year is underrepresented. Fig. 2c shows the geographic distribution of cases. Several clusters of cases are found,

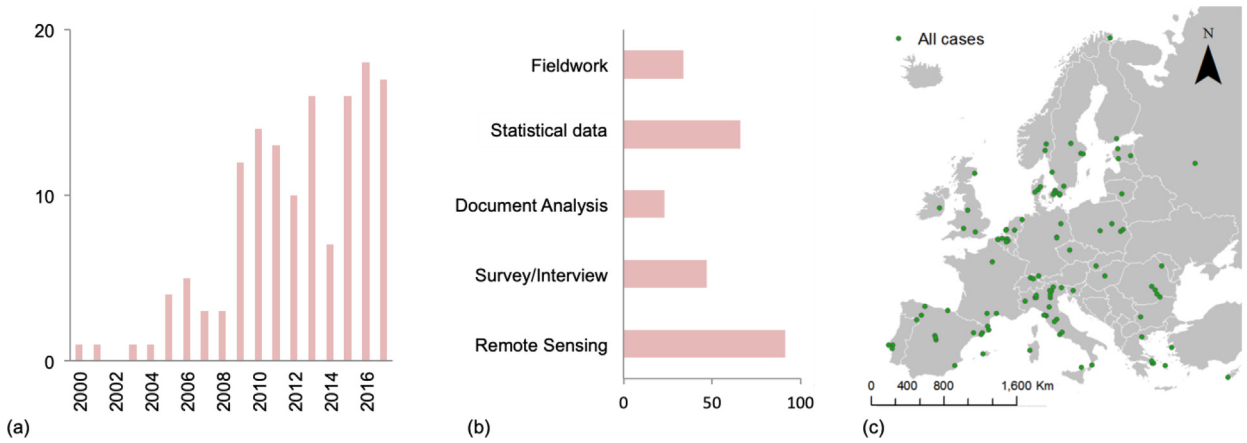

Fig. 2. Distribution of publications by year (a); type of analysis used per case (b); and location of cases (c).

notably around Copenhagen and Malmö, the Benelux countries, Rome and northern Italy, Barcelona, and Athens. A further number of cases are found spread across post-socialist states, mostly concerned with economic restructuring processes. A small number of cases cover peri-urban processes in mountain regions.

Case study areas range from less than 1 km^2 up to 22,000 km^2 with a median of 988 km^2 and a mean of 2762 km^2. The average time period covered by the studies, where given, was 28 years, the longest was 94 years, and the shortest was less than a year. The majority of case studies (91) employed remote sensing, followed by analysis of demographic, agricultural, environmental or other statistics (66), then surveys or interviews (47), fieldwork such as site observations, photo walks, and ecosystem services assessments (34), and document analysis (23) (Fig. 2b). In 63% of all cases, a combination of different approaches was used, which was deemed necessary to analyse the multiple aspects of peri-urban change. One case study used a combination of all five approaches, seven used a combination of four, twelve used three different approaches, seventy cases used two and fifty-two cases studies used just one approach. The most common combination was remote sensing with additional statistical data analysis, for example examining demographic trends.

Studies of change in peri-urban areas of Europe were featured in 61 different journals. Landscape and Urban Planning and Land Use Policy were equally prominent with 11% of articles each, followed by the Danish Journal of Geography (6%), Sustainability (4%). Cities, Landscape Research, the Norwegian Journal of Geography, Rendiconti Lincei-Scienze Fisiche e Naturali, Science of the Total Environment, and Urban Geography each had 3% of the articles. The remaining 61 articles came from 51 different journals. The top ten subject categories of the journals in which articles were published, according to Web of Science, which account for 84% of the cases include: Geography; Environmental Studies; Urban Studies; Ecology; Environmental Sciences; Geography Physical; Green Sustainable Science Technology; Planning Development; Geosciences Multidisciplinary and Forestry (details in Table S.2).

3.2. Processes of peri-urbanization

In total we identified 1002 different level 3 processes reported in 142 cases. Following our inclusion criteria, all studies recorded at least two processes per case, and most had three or more. On average, for each case, seven processes were described, and the median was six. Overall, land cover changes and socioeconomic changes accounted for 43% and 25% respectively of all processes recorded, while land use change represented 10%, planning change 9%, land management change 8% and environmental change 4% of all processes mentioned in the case studies (Table S.3).

In terms of frequency of occurrence in case studies, land cover change and socioeconomic processes were reported in 86% and 67% of all cases, respectively, while each case could include more than one type of land cover change or one type of socioeconomic change. Land use change, land management change, planning processes and changes in environmental outcomes were all reported in 29% to 45% of the cases, which confirms the impression that peri-urbanization is manifested in multiple different ways (see Table 1). For each case, we differentiated between the process represented as the most important process within a case, and other processes featuring in a case. The maps in Fig. 3 show that cases are generally well-distributed over Europe for all six types of change processes, although Environmental change and Planning processes are underrepresented in studies placed in eastern Europe.

Cases reported very frequently on land cover changes, which suggests a focus on spatial dynamics such as increases in built-up area and the impacts these changes have on existing agricultural and semi-natural landscapes. The restructuring of agricultural land was also represented in almost half of all case studies, often documenting the loss of agricultural land to built-up land but also changes between different agricultural land cover types such as annual crops and perennial grasslands. Cases in Athens, Madrid, Rome and Moscow showed losses and fragmentation of forest areas as a result of urban expansion (Boentje & Blinnikov, 2007; Gallardo & Martínez-Vega, 2016; Salvati & Ranalli, 2015; Salvati, Ferrara, Mavrakis, & Colantoni, 2016), while protective measures assigned to them were broadly effective in Flanders and Milan (Bomans, Steenberghen, Dewaelheyns, Leinfelder, & Gulinck, 2010; Sanesi, Colangelo, Lafortezza, Calvo, & Davies, 2017), and abandonment of agricultural land on slopes led to succession and increases in forest area around Lisbon, Catalonia, and Emilia Romagna (Abrantes, Fontes, Gomes, & Rocha, 2016; Parcerisas et al., 2012; Smiraglia, Ceccarelli, Bajocco, Perini, & Salvati, 2015).

Socioeconomic changes are also an important aspect of peri-urbanization, as an influx of new residents leads to changing social structures and changing relations between people and the landscape in an area. The most frequently reported socioeconomic changes relate to population dynamics and migration. Hirt found that new arrivals from Budapest to the peri-urban surroundings were markedly more educated and had higher incomes than those born there (Hirt, 2007). Many cases reported on the diffusion of population from urban cores to surrounding areas, either due to economic pressures (displaced urbanization) or for lifestyle reasons (amenity migration). However, both Van Der Vaart (2005) and Gkartzios and Scott (2010) challenge this narrative by showing that the majority of newcomers to a peri-urban area are from rural backgrounds originally. Further socioeconomic processes related to migration dynamics, such as place making and increased cultural and aesthetic functions. Both Alonso-Gonzalez (2017) and Solana-Solana

Table 1
Proportion of cases in which level 1 and level 2 peri-urban processes are featured. Sums of level 2 processes do not necessarily add up to level 1 percentages, as each case can include more than one level 2 process. Counts for level 3 processes can be found in the Supplementary material S2.

Level 1 processes	% Cases (n = 142)	Level 2 processes	% Cases (n = 142)
Land cover change	86%	Urban development	80%
		Change in agricultural land	49%
		Change in natural land cover	23%
Land use change	45%	Horsification	11%
		Increase in recreation	30%
		Economic diversification	17%
		Increase in land use multifunctionality	8%
Land management change	32%	Agricultural intensification	20%
		Agricultural disintensification	20%
Socioeconomic change	67%	Social change	63%
		Economic change	13%
		Conflict between stakeholders (e.g. inhabitants, land users, and owners)	13%
Planning processes	41%	Planning failure	19%
		Planning response	27%
Environmental change	29%	Environmental degradation	11%
		Change in biodiversity	11%
		Green infrastructure (connectivity and/or functioning)	6%
		Water supply	4%

(2010) found amenity migrants who highly valued the opportunity to live in a culturally rich environment and were investing in the restoration of vernacular architecture, however both cases also documented conflicts arising from these processes of rural gentrification. Many other conflicts were also found related to socioeconomic changes, such as integration problems between residents, increasing social conflicts associated with recreation and land-owners, and the changing spatial and social character of an area. For example, Wójcik (2016) found integration issues outside Lodz where new arrivals were seen as consumers of the peri-urban space rather than participants in it, and Hammer, Bonow, and Petersson (2017) reported that landowners were unhappy with the increasing intensity of recreation activities on their lands brought by an influx of new residents. Mattiucci observed that the densification of a peri-urban mountain town irreplaceably changed the character of the area, resulting in the dissolution of the qualities of what had attracted people to it in the first place (Mattiucci, 2015).

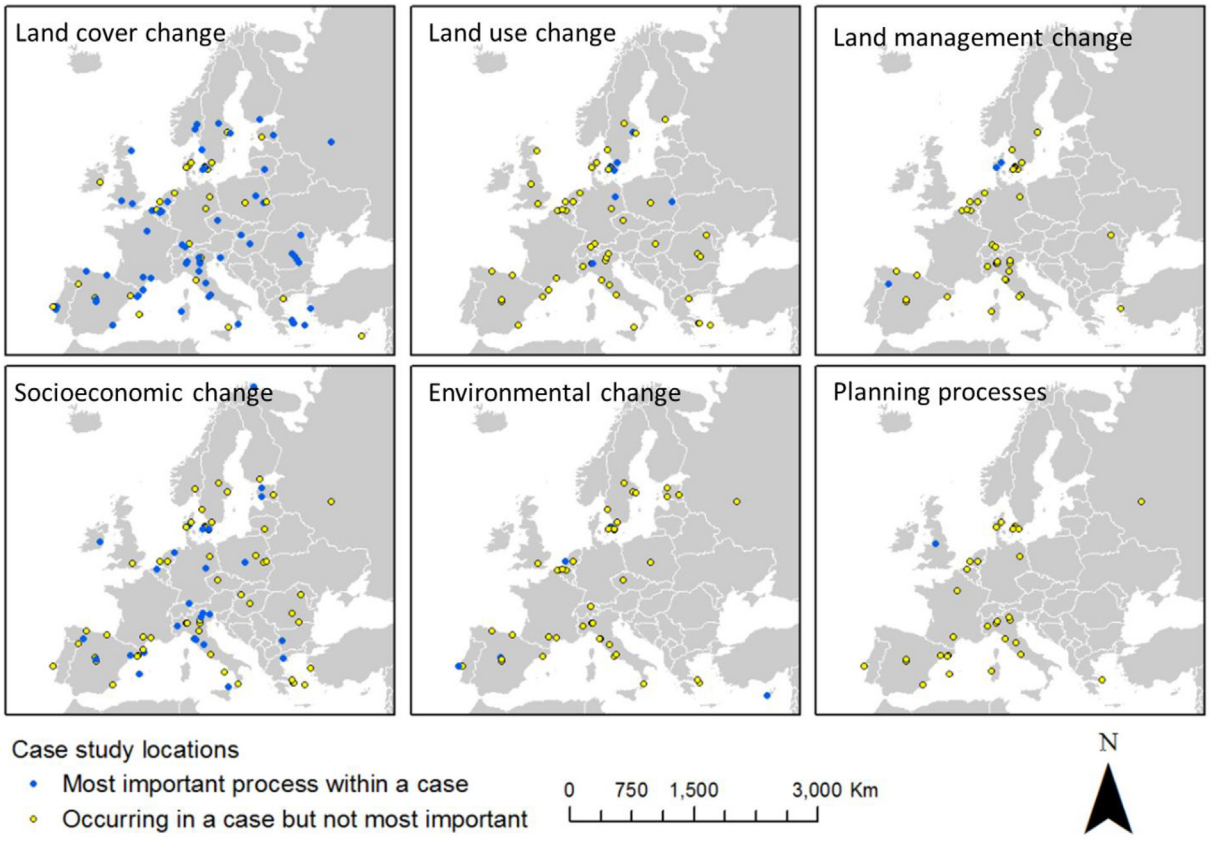

Fig. 3. Case study locations differentiated by process type, showing where a process is described as the most important within a case study, and where this process featured in a case but not as the most important process.

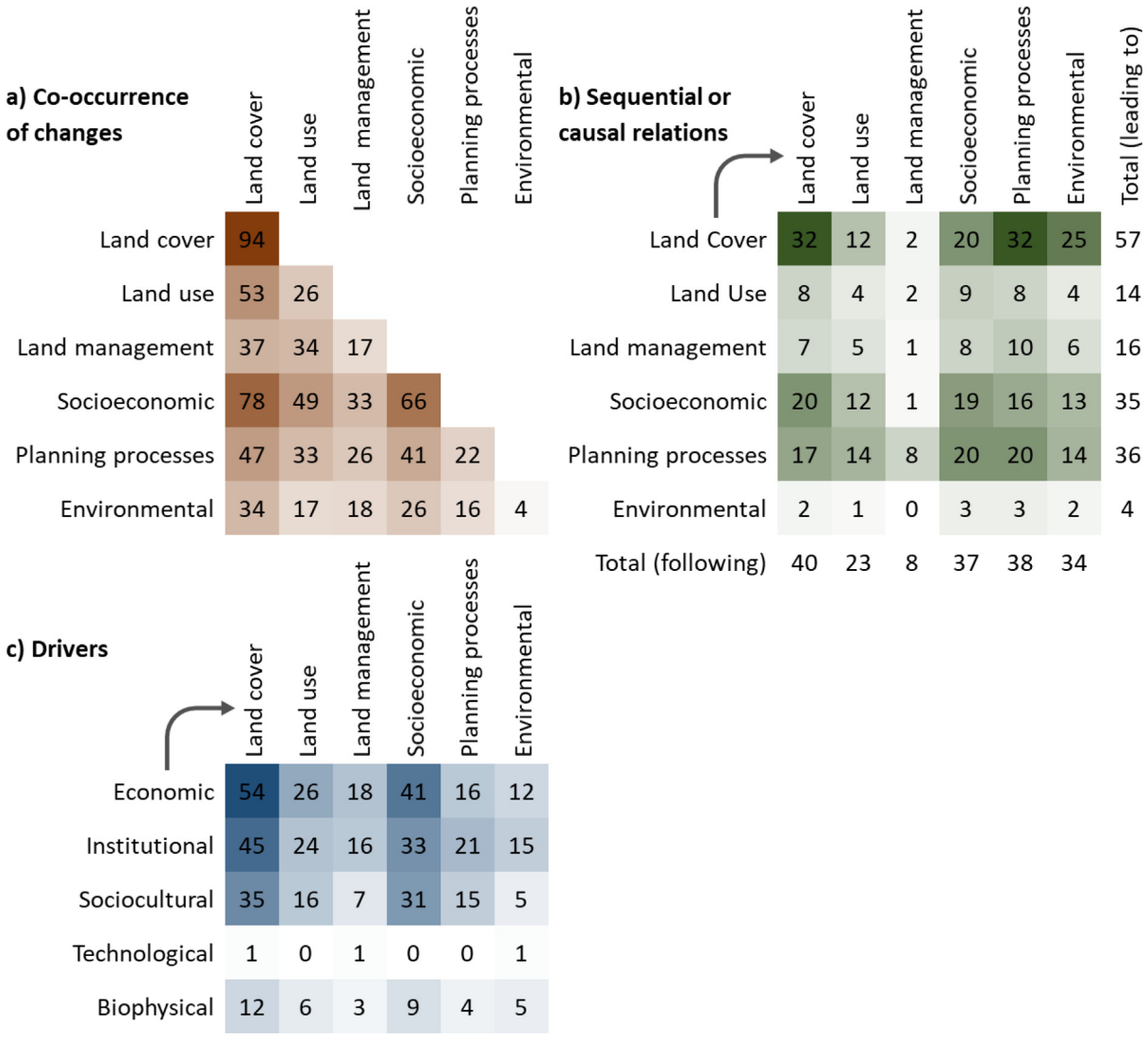

Fig. 4. Relations between multiple processes of peri-urbanization and their underlying drivers. 4a shows the co-occurrence of peri-urbanization processes as reported in all cases, 4b shows the sequential or causal relations between processes of peri-urbanization, and 4c show the reported drivers underlying peri-urbanization (N = 142). Relationships in Fig. 4b are binary and directional, reading from the leftmost column to the top row. The total column refers to the number of cases where the process precedes another. Row total refers to the number of cases where the process follows another. Totals can be lower than the sum of all reported relations, because one case can include multiple different sequential or causal relations, while the total column reports the total number of cases for which such relations were found.

Processes relating to land use change made up 10% of all processes found but featured in 45% of all case studies. The majority of these related to increased recreation activities, economic diversification and multifunctionality. The transition from a primary production economy to a more diversified and service orientated one is a key characteristic of peri-urbanization (Rauws & De Roo, 2011). Cheaper rents, decreasing travel times to urban centres, increased space availability, and local demand for products and services are all factors that attract businesses in PUA. Intersecting with this economic diversification are processes of agricultural consolidation and an aging farmer population, leading to many former agricultural buildings and farmhouses becoming obsolete and fit for repurpose (Busck, Hidding, Kristensen, Persson, & Praestholm, 2009; Præstholm & Kristensen, 2007; Sallay, Jombach, & Filepné Kovács, 2012). Increases in horse-keeping, and the associated conversion of production landscapes to recreational landscapes is a topic well covered in the peri-urbanization literature. The topic was addressed in the context of farm adaptation and diversification in the face of increasing urban pressure (Gordon, 2003; Olsson et al., 2016; Wästfelt & Zhang, 2016), as well as a part of hobby farming (Busck, Kristensen, Præstholm, Reenberg, & Primdahl, 2006; Primdahl, Andersen, Swaffield, & Kristensen, 2013), while Zasada, Berges, Hilgendorf, and Piorr (2013) show a diverse horse keeping sector around Berlin with varying degrees of land use intensity and specialisation.

Being neither rural nor urban in their character, and highly dynamic in nature, PUAs present particular challenges for governance and spatial planning (Allen, 2003; Piorr et al., 2011). Planning dynamics accounted for 9% of all processes found, and they were featured in 41% of the case studies. These related to the restriction of further development of built-up areas for the protection of nature and landscape character and the provision of recreation and other services through green infrastructure. In the Netherlands, protected areas were defined to provide a recreational hinterland to surrounding densely populated areas (Padt & Westerink, 2012). Planning authorities also worked together with local communities to develop collaborative frameworks for fostering peri-urban spaces that are places of production, recreation and education (e.g. Barthel, Colding, Elmqvist, & Folke, 2005; Morán Alonso, Obeso Muñiz, Hernández Aja, & Fernández García, 2017). A

second group of planning dynamics relate to the failure of existing planning guidelines or laws to effectively manage changes in PUAs. These may relate to undesirable outcomes of planning restrictions, such as the concentration of development along protected area boundaries found by de las Heras and colleagues (De Las Heras, Fernández-Sañudo, López-Estébanez, & Roldán, 2011), to management systems which focus on land cover changes and do not capture the nuances of land use changes (Bomans et al., 2010), as well as guidelines which anticipate and seek to avoid conflict between residents and horse users when no such guidelines are found (Elgåker, Pinzke, Lindholm, & Nilsson, 2010).

Environmental outcomes observed relate to environmental degradation as a result of peri-urbanization, such as increased forest fires (Salvati & Ranalli, 2015), increased land degradation sensitivity (Bajocco, De Angelis, Perini, Ferrara, & Salvati, 2012; Salvati, 2013), and increased pressure on water supply due to changing garden preferences (Domene, Saurí, & Parés, 2005; Parés, March, & Saurí, 2013) and dwelling types (Morote-Seguido & Hernandez-Hernandez, 2016). However, some PUAs also experienced increased habitat provision related to the shifting focus from production to multifunctional or hobby agriculture (García-Llorente, Rossignoli, Di Iacovo, & Moruzzo, 2016; Olsson et al., 2016; Pinna, 2017). In coastal Spain and a number of Mediterranean islands there is a marked trend from high-density coastal accommodation servicing a seasonal tourism industry towards more dispersed low density housing spreading inland for amenity migrants from other parts of Europe and second homes for Spanish people, resulting in a high amount of landscape fragmentation and increasing demands for water supply (Hof & Blázquez-Salom, 2015; Morote & Hernández, 2016).

3.3. Relations between peri-urbanization processes

Peri-urbanization is typically characterized by the co-occurrence of multiple change processes in the same region, as is shown in Fig. 4a. These co-occurrences include multiple instances of the same change process, such as horsification and economic diversification in the same area, but also often a combination of different peri-urbanization processes (Fig. 4a). Of all cases, 78 (55%) analysed or described land cover and socio-economic processes together. Commonly this is a result of the contextualisation of land cover changes such as low density dispersed urban expansion with changing demographic dynamics, but also many more nuanced social processes associated with the appreciation of or interaction with peri-urban landscapes were reported. Processes of urban development alongside the restructuring of agricultural land are also frequently reported. Many cases describe the development of urban land at the expense of agricultural land and the landscape fragmentation that occurs as a result (Cirtautas, 2015; Salvati, Ranalli, & Gitas, 2014). Co-occurrence is also found between urban development and transitions between cropland, perennial grasslands and fruit trees, as well as changes in the structure of the agricultural area through the addition or removal of landscape elements such as hedges and ponds. Land use changes, such as increasing recreation, were also reported alongside land cover changes. The analysis of tangible land cover changes alongside less tangible landscape perceptions is illustrative of peri-urban areas as an intimate mosaic of land-cover types with an array of social, environmental and productive functions.

The complex causal and temporal relationship between different processes were coded for case studies where these were described in sufficient detail. 78 Cases reported a sequence of or causality in multiple peri-urbanization processes, while 64 merely indicated co-occurrence of processes. Of the case studies that feature a causal or temporal relationship, Fig. 4b shows how often specific sequences or causal relations were found. Many cases detailed different phases prior to and during peri-urbanization, often by analysing land cover maps from different years. For example, Salvati and Sabbi (2011) show how in Rome a phase of slow growth on the urban fringes in the 1960s and 1970s was followed by a phase of accelerated low density discontinuous development and the emergence of a non-farm rural landscape.

Common combinations of land cover changes in PUAs are the development of housing or commercial areas preceded by the abandonment of agricultural land (e.g. Grădinaru et al., 2015; Salvati, Munafo, Morelli, & Sabbi, 2012), or resulting in fragmentation of the landscape (e.g. Recanatesi, 2015; Smiraglia et al., 2015). However, equally numerous were land-cover changes that led to changes in land use planning, and to a lesser extent to environmental changes. Sanesi et al. (2017) documents the policy responses to the fragmentation of green space near Milan. Similarly, in Portugal new policy interventions were designed to restrict further fragmentation and promote the remaining green-space as green infrastructure (Ribeiro & Barão, 2006).

A sequential relation found in many case studies across Europe is that of agricultural abandonment preceding urban development, and also that of fragmentation of landscapes as a result of the low-density discontinuous development associated with peri-urbanization. Our findings show that peri-urban development has occurred primarily on agricultural land where available, in line with findings by Zasada (2011) and the European Environment Agency (Agency, 2008). However, peri-urbanization has been shown to also bring new life and new uses to traditionally disadvantaged areas as new arrivals reclaim and reuse abandoned buildings and farms. Two key factors in this are proximity and infrastructure, reducing travel times and increasing accessibility.

A second trend found throughout Europe is conflict in peri-urban areas. Typically, conflict arises either due to changes to the character of a neighbourhood, or between existing and new residents, often as a result of new social practices and norms associated with rural gentrification. As Wójcik (2016) observed in an expanding village outside Lodz, Poland, new residents create their own social realities, not as participants in the community but as consumers of the lifestyle and rural aesthetic that the area offers, at a strong contrast to the tight-knit existing residents on the village. These conflicts found in our review are not accounted for in the typology developed by von der Dunk, Grêt-Regamey, Dalang, and Hersperger (2011) which focuses only on conflicts that are reported in print media.

Cases also documented planning dynamics leading to other outcomes. Abelairas-Etxebarria and Astorkiza (2012) show how planning restrictions designed to protect the loss of farmland near Bilbao have been followed by rising land prices linked to development potential, which negatively impact farm consolidation and environmental protection. Pinna (2017) presents for areas near Madrid a more holistic approach to halting abandonment where development restrictions are complemented with capacity building for the area, leading to the emergence of agricultural practices that successfully combine recreation, environmental protection and the production of locally marketed agricultural products. In Montpellier, commercial development and economic diversification was followed by amenity migration and the development of low density housing (Rauws & De Roo, 2011), while in Catalonia amenity migration was the starting point and its effects on community integration and local health and wellbeing the focus of investigation (Garcia-Llorente et al., 2012).

3.4. Underlying drivers of processes of peri-urbanization

Independent of the sequential or causal relations among processes of urbanization, many cases reported on the drivers underlying these processes. Of the 142 case studies, 27 mentioned no drivers underlying peri-urbanization processes, 77 listed a single driver, and 38 indicated two or more drivers. The most common drivers were economic (55), institutional (47), sociocultural (43), biophysical (12) and technological (1). The most common combinations of drivers are economic and institutional (18), economic and socio-cultural (11), and institutional and socio-cultural (9). Fig. 4c shows how drivers are related to processes of peri-urbanization. Relative to other systematic reviews of other land change processes (e.g. van Asselen et al., 2013; Plieninger et al., 2016),

technological and biophysical drivers play a smaller role while economic and sociocultural drivers play a larger role. These findings thus confirm that peri-urbanization is not only a landuse change process, but rather a multifaceted process that reflects the more fundamental socioeconomic processes in society.

4. Discussion

4.1. Peri-urbanization as a multifaceted process

This study aims to provide a comprehensive overview of peri-urbanization processes in Europe as reported in case study reports in peer-reviewed literature. Specifically, we ask what processes were reported, to what extent these processes co-occur, and how these processes are sequentially or causally related. The framework for analysis adopted in this study differs from several other reviews of land change processes starting from (Geist & Lambin, 2002) in that our outcomes are not restricted to land use and land cover changes only. Results show that, rather than being a land use change process, peri-urbanization can be characterized as a multifaceted process in which areas often experience multiple different types of changes. Although land cover and land use changes featured in 86% and 45% of our cases respectively, we have documented a breadth of other types of change in European PUAs. Especially socioeconomic aspects of land use and land cover change processes are understudied in most current reviews (van Vliet et al., 2016). Consistent with this multifaceted understanding, case studies are typically analysed using a combination of different methods, for example combining remote sensing image interpretation with interviews (Gant, Robinson, & Fazal, 2011; Wästfelt & Zhang, 2016) or combining statistical data analysis and fieldwork (Orsini, 2013; Padt & Westerink, 2012). Of course, the selected methodological approach determines the types of outcome that can be found. Yet, the observation that 63% of all cases employed multiple different methods, suggest that most researchers indeed expected to find multiple different processes in the same case-study area.

Contrary to the conventional conceptualization of land change processes (Geist & Lambin, 2002; Turner et al., 2007; van Vliet et al., 2016), processes of peri-urbanization cannot be conceptualized simply as a driver – land change – impact framework, as the results concerning the sequential and causal relations between multiple processes of peri-urbanization indicate. For example, Elena Huzui, Abdelkader, and Patru-Stupariu (2013) show that the increase in residential area in peri-urban Romania is followed by an increase in tourism and recreation, while Bański and Wesołowska (2010) show that an increase in tourism leads to the creation of low-density housing and the expansion of villages. In all case study evidence together, we found a more or less equal number of cases where socioeconomic changes lead to changes in land cover, land use, and land management, as we found cases where the sequential or causal relation was in the opposite direction. Sequential or causal relations reported in case studies are likely influenced by the research interest of the respective authors. Nonetheless, the fact that for all but one combination of processes such relations have been observed in both directions confirms that peri-urbanization needs to be characterized as a multifaceted process, where different types of change processes are related in multiple ways.

The exception to this finding are changes in the environment in peri-urban areas, such as the biodiversity or water supply. These changes were documented much less often, and mostly observed as a result of land cover, land use, and land management changes, while the inverse relations was hardly found. This suggests that environmental changes observed in peri-urban areas are mostly impacts, consistent to the drivers – land change – impact framework. For example, in northern Europe, multiple cases take a land use perspective, examining the nexus between increased recreation, hobby farming, horse keeping, economic diversification and agricultural dynamics and responses to peri-urbanization, and addressing the environmental implications of restructuring (Quetier & Gordon, 2003; Qviström, 2016).

While this review has analysed peri-urbanization processes in Europe, different co-occurring processes in peri-urban areas are also reported in case studies from other parts of the world. As an example, a review of studies for the Mekong region also found broad variation in patterns of changing urban growth and socioeconomic contexts, differentiated by local and national policies (Li, Wei, & Korinek, 2018), while in China, different spatiotemporal growth patterns were reported alongside socioeconomic changes such as access to education, clean water, urban green space and mobile phone use (Tong, Hu, Frazier, & Liu, 2017). This suggests that the multifaceted process of peri-urbanization is not a strictly European process, but instead a more generic phenomenon that manifests itself in multiple world regions.

4.2. Implications for planning and policy making

The multifaceted character of peri-urbanization processes provides a particular challenge for planning and policy making. Planning and policy making is often seen as an important tool for managing landscapes, whether urban or rural (e.g. Hersperger et al., 2018). The particular challenges for managing peri-urban areas have been highlighted before in other, more specific reviews. For example, Geneletti, La Rosa, Spyra, and Cortinovis (2017) find that planning in urban peripheries, often considered peri-urban landscapes, is rather context specific and difficult to synthesize, suggesting that no generic approach for peri-urban areas exists. In addition, they find that the complexity of these areas, and point that the multiple different stakes in peri-urban areas can yield trade-offs in planning outcomes. Consistently, Gallent and Shaw (2007) argue that local planning, for example through area action plans, are more appropriate for urban fringes than generic policies, amongst others because they allow for a more holistic approach that accounts for multi-functionality, which is typical for peri-urban areas. The multifunctional character of peri-urban landscapes, as well as the potential trade-offs that arise from this multi-functionality were also found in this review, as peri-urban development often lead to conflicts between stakeholders related to the different functions of peri-urban areas. In particular, conflicts between original inhabitants of peri-urban areas, mostly with a rural lifestyle, and newcomers, with more urban lifestyles have been observed around cities such as Sofia and Barcelona (Domene et al., 2005; Hirt, 2007). Often these conflicts between their origin in the different socioeconomic groups sharing the same areas but with different perspectives of this area and the desired development (Domene et al., 2005; Hirt, 2007). This illustrates how the socio-economic character of many change processes found in this review can be understood as responses to changing global socio-economic conditions, which are often brought to peri-urban areas by newcomers. The large number of socio-economic drivers underlying peri-urbanization processes confirm this relations. These more fundamental processes present challenges but also opportunities for planning, and has received considerable attention from policy-makers seeking to ensure effective and efficient land use management (Briquel & Collicard, 2005; Dühr, 2005).

Yet, while planning is often seen as a process that directs land use change, and thus as a process that could mitigate undesired aspects of peri-urbanization processes, this study finds that often planning processes are preceded by observed changes in land cover, land use, and land management in peri-urban areas. This suggests a reversed relation, in which planning changes are caused by peri-urban land change, or at least following these changes. Specifically, in this review we found slightly more cases reporting planning changes following or caused by changes in land cover, land use, and land management change than we found cases where planning changes preceded land cover, use or management changes. For instance, Gkartzios and Scott (2010) found that recent movers to rural areas do not necessarily have very different views on housing development in rural Ireland as the long term residents. Yet, their mix of attitudes and aspirations does affect the planning process itself thus illustrating how peri-urbanization actually

changes the planning process rather than the other way around. Another example was provided by Vejre, Jensen, and Thorsen (2010), who find that plans and policies for the peri-urban area around Copenhagen were adjusted to explicitly provide cultural ecosystem services such as landscape aesthetics and recreational value for urban dwellers. This example shows how urban lifestyles add a set of demands for land use in peri-urban areas.

5. Conclusions

The case study evidence analysed in this systematic review suggests that peri-urbanization is manifested in many different ways, including changes in land cover, land use, and land management, but also as changes in planning status of an area, socioeconomic changes, and environmental changes. While land change processes are often conceptualized as having underlying drivers and leading to one or more impacts, the reviewed case study evidence shows that peri-urbanization is allegedly more complex, as the directionality or causality of the various processes of urbanization differs across case studies. As a result, for example, land use change sometimes precedes socioeconomic changes, while in other areas it follows socioeconomic changes. This also suggests that new case studies would benefit from analysing multiple different change processes, in order to obtain a comprehensive understanding of peri-urbanization.

The multifaceted character of peri-urbanization processes provides particular challenges for managing peri-urban areas. Specifically, we found that planning follows peri-urban changes about as often as it precedes these changes. As planning and policy making are important tools to manage land use changes, there is a need to further explore this relation in order to manage peri-urban landscapes sustainably. Results of this review already suggest that managing peri-urban areas requires a more holistic approach, addressing both the socio-economic as well as the spatial aspects of peri-urban areas in the contexts of the demands and preferences of a diverse set of stakeholders.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.landurbplan.2019.103733.

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