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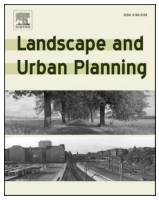

Review Article

Beyond growth management: A review of the wider functions and effects of urban growth management policies

Matthew G Kirby [a,*], Alister J Scott [a], Jason Luger [a], Claire L Walsh [b]

[a] Department of Geography and Environmental Science, Northumbria University, Newcastle upon Tyne, UK
[b] School of Engineering, Newcastle University, Newcastle upon Tyne, UK

HIGHLIGHTS

- Research into the functions and effects of UGMPs is growing across disciplines.
- UGMPs zones appear to provide wide social and environmental functions.
- We argue many, but not all functions and effects are beneficial to society.
- UGMPs also have complex effects on land and house prices.
- More interdisciplinary studies on the socio-ecological impacts of UGMPs are needed.

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ABSTRACT

Urban growth management policies (UGMPs), which include green belts and urban growth boundaries seek to prevent urban sprawl in neighbouring peri-urban and rural landscapes. However, the wider social, environmental, and economic impacts these policies have on the landscapes they govern is unclear and contested. This paper undertakes a structured review of academic literature in Scopus investigating these wider UGMPs functions, impacts and effects beyond urban sprawl. A systematic key word search and a two-stage sieving process of the global literature identified 115 relevant academic publications across disciplines. This review found a diverse range of social and environmental functions of UGMPs zones, including as ecological corridors, sinks for climate regulation and recreational landscapes. Mixed methods and interdisciplinary studies are lacking, but multiple ecosystem services provided by UGMP zones were found in limited examples. However, cultural ecosystem services were rarely assessed alongside regulating and provisioning services and multiple ecosystem services have not been explicitly studied in US and English UGMP zones. Conversely, UGMPs are shown to have complex economic effects on land and housing markets, as well as creating contentious spaces. Currently, these findings are largely location based, making it hard to distinguish between site-specific and cross-cutting effects and functions, presenting a potential challenge for policy makers. To better understand the value of these zones to society and unlock their potential as multifunctional opportunity spaces in addressing climate, biodiversity and health challenges, more holistic and interdisciplinary research is needed into UGMP zones.

1. Introduction

Urban Growth Management Policies (UGMPs), also known as urban containment policies (Rodriguez, Targa, & Aytur, 2006) are strategic planning instruments that seek to regulate land-use to reduce or prevent urban sprawl into neighbouring peri-urban landscapes (Fertner, Jørgensen, Nielsen, & Nilsson, 2016). Recent work investigating green belts in Europe have shown their effectiveness for preventing urban sprawl in the 21st century, especially around larger cities (Pourtaherian & Jaeger, 2022). However, these landscapes are host to a diversity of land-uses, stakeholders and interventions creating both challenges and opportunities for their optimal use (Shaw, van Vliet, & Verburg, 2020). UGMP zones are a core element of many peri-urban landscapes, but differ internationally in design, scope, and implementation. For

* Corresponding author at: Department of Geography and Environmental Science, Northumbria University, Newcastle Upon Tyne, NE1 8ST, UK.
E-mail addresses: matt.kirby@northumbria.ac.uk (M.G. Kirby), alister.scott@northumbria.ac.uk (A.J. Scott), jason.luger@northumbria.ac.uk (J. Luger), claire.walsh@ncl.ac.uk (C.L. Walsh).

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example, the Greater Golden Horseshoe (GGH) Green Belt in Ontario, Canada, has multiple objectives including nature conservation (L. Taylor, 2019). Others, especially in the USA are formed as part of land sparing and zoning to maintain several land-uses (Daniels, 2010). However, internationally many UGMPs lack wider goals to improve the multifunctionality of the landscapes they cover; instead acting as blanket policies to prevent sprawl (Amati & Taylor, 2010). With no review of the academic literature to date on the environmental, social, and economic effects of these UGMPs zones it is unclear what wider functions and effects they may or do provide. This is particularly relevant in understanding how UGMPs can contribute to tackling the triple climate, biodiversity and health emergencies (Chiabai, Quiroga, Martinez-Juarez, Higgins, & Taylor, 2018). Therefore, this paper seeks to address this significant policy and research deficit, via a review of the academic literature studying the wider functions and effects of UGMPs beyond controlling urban sprawl.

UGMPs have been described as "an example of the modernist impulse to govern through generalization…which has experienced a postmodern apotheosis" (Abbott & Margheim, 2008, p. 199). Yet they are highly contentious topics in land-use planning globally; frequently both criticised and praised for their effectiveness and wider impacts (Amati, 2007; Dawkins & Nelson, 2002; Kim, 2019; Mace, 2018). Early examples can be dated to 13th century BCE, such as the Levitical cities of Palestine, where agricultural land formed belts around cities (Ginsburg, 1956). More recently, UGMPs have been designed, adapted, and operationalised for local and regional contexts internationally (Amati, 2008). Examples of UGMPs include green belts (GBs), urban growth boundaries (UGBs) and green wedges (GWs) all of which can range in size (Fertner et al., 2016). A main difference between these types of UGMP is their spatial configuration, as visualised in Fig. 1. GBs tend to encircle urban and peri-urban areas and protect open space (Amati, 2008). Examples include: the London GB (Abercrombie, 1944), Seoul's GB (Bengston & Youn, 2006) and contemporary GBs such as the GGH GB in Ontario (Macdonald, Monstadt, & Friendly, 2021a). GWs are often narrower corridors extending out and between urban and peri-urban areas (Hedblom, Andersson, & Borgström, 2017). Examples include the Northern European GWs of Copenhagen, Stockholm, and Helsinki (Vejre, 2017) and Melbourne's Urban Wedge (Buxton & Goodman, 2008). UGBs are perhaps the most different; often simply demarcation lines which mark the extent that development is permitted, and are often, but not always, complemented by other protected reserves and/or zones for different land-uses (Woo & Guldmann, 2011), additionally they often move periodically to phase development opposed to preventing it (Nelson & Moore, 1993). The policies and zones adjacent to UGBs, therefore, are just as important as the UGMP in their influence on land-use. Examples include the metro plans in the USA, such as Oregon UGBs (Seltzer, 2009) and more recently the Chinese UGBs to replace failed GBs (Sun, Fertner, & Jørgensen, 2021). They are popular in the US where there are over 150 UGBs (Avin & Bayer, 2003).

As well as differing spatially, UGMP also differ in design and governance. For example, different GBs models include traditional pre-war GBs, modernist post-war GBs and a new generation of GBs emerging in the 1990s and 2000s; each with differing policy goals and motivations for implementation (Macdonald et al., 2021a). Pre-war GBs, such as those in England, primarily aim to prevent urban sprawl by keeping land permanently open (Bishop, Perez, Roggema, & Williams, 2020). In contrast, other GBs have broader policy goals, including environment protection and ecosystem service (ES) provision, such as, the GGH GB in Canada (L. Taylor, 2019). In Brazil, the São Paulo GB biosphere reserve is an example of a larger scale ecological GB (Ribeiro, 2015). Notably in England, GB regulations do not explicitly provide such outcomes. Critics of these single goal GBs have described them as "orphaned policy which has constrained land supply and is bluntly applied" (Mace, 2018, p. 1). Others have shown that they are internally complex, and in fact implemented for a range of factors locally (Amati & Yokohari, 2006). Nevertheless, their longevity is attributed to their uniqueness, legacy, and simplicity (Dockerill & Sturzaker, 2020; L. Taylor, 2019).

Another factor to understand the difference in UGMPs is their implementation (Amati, 2008; Sun et al., 2021). China has experimented with implementing different UGMPs throughout the past 50 years, including GBs and recently UGBs, but with mixed success (Sun et al., 2021; P. Zhao, 2011). Indeed, Yu, Wang, & Li (2011) argue that Chinese GBs largely failed due to not considering the wider socio-ecological system. Others such as the Paris GB, struggled to evolve beyond more than a policy aim and were never properly implemented (Roussel, Schulp, Verburg, & van Teeffelen, 2017). Likewise, the design,

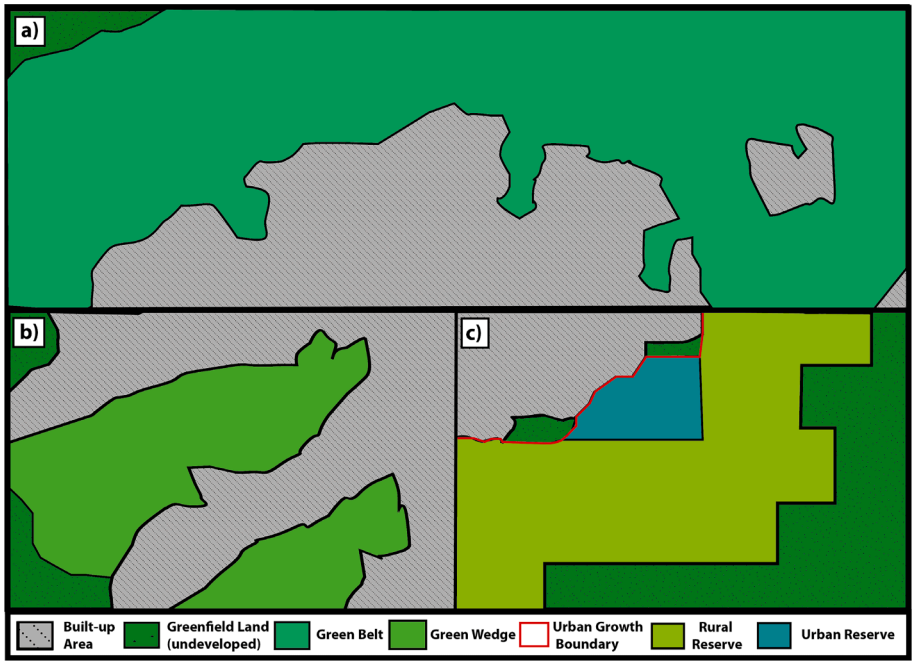

Fig. 1. Simplified spatial representation of a section of a) green belt, b) Green Wedge and c) Urban Growth Boundary and associated reserves, based on the Portland Metro UGB. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

implementation, and use of zoning of UGBs differs drastically even nationally, as seen in the US context (Woo & Guldmann, 2014). For example, while some UGBs are supported by strong zoning policies, others are effectively governed through supportive utility policies (Rusk, 1999).

UGMPs have been the subject of longstanding research attention but attempts to understand the wider and varied effects of UGMP zones are less certain. Early research into UGMPs in the 1970–90s focused mainly on the GBs of England and UGBs of the USA to understand their effectiveness in managing sprawl (Elson, Walker, Macdonald, & Edge, 1993; Kline & Alig, 1999; Nelson & Moore, 1993). Recent work has, in part, reviewed UGMP literature as part of its contribution to defining "sustainable landscape patterns" (Dong, Jiang, Gu, Liu, & Peng, 2021). A notable development in the discourse around wider functions of GBs was the special issue of *Planning Practice & Research on Green Belts* (Amati & Taylor, 2010). Multiple key academic books have in part collated some UGMPs research, exploring policy implementation (Elson et al., 1993), the development, performance, and future of GB policy (Bishop et al., 2020; Sturzaker & Mell, 2018) best practice growth management approaches in the US and influence on urban America (Rusk, 1999) and comparative assessments in selected international contexts (Amati, 2008) opposed to their wider functions and effects.

New and old discourses are once again (re)emerging around the purposes of UGMPs, including as spaces for housing, access to greenspace and adapting to the urgency of climate change (Bishop et al., 2020; Han, Daniels, & Kim, 2022; L. Taylor, 2019). Furthermore, some scholars argue for the repurposing of GBs towards a more multifunctional and environmental remit (Amati & Taylor, 2010; L. Taylor, 2019; Thomas & Littlewood, 2010). However, others have dismissed the wider functions, as having "questionable" environmental value (Xie, Kang, Behnisch, Baildon, & Krüger, 2020) and "busting myths" of them being "full of nature" (Mace, 2018). This discourse largely adds to the presumptions of these zones by critics as having little wider value.

To better understand to how UGMPs contribute to addressing the triple climate, biodiversity and health emergencies, this paper aims to synthesise the current knowledge and evidence of their wider functions and effects. To do this, and address the presented research gaps, UGMP articles are systematically searched and analysed. The following sections present the identified functions and effects, as well as argue that UGMP zone are important ES opportunity spaces as socio-ecological landscapes, that host different ecosystem types which provide benefits from their interactions with people and society.

2. Methods

The structured review process began by systematically searching the Scopus database to identify the sample of academic literature for screening. Scopus was selected due to being one of the largest peer-reviewed multidisciplinary abstract and citation databases. The search string of keywords and associated synonyms is shown in Fig. 2; this was developed to capture all urban containment academic literature in Scopus, not just those which may explicitly report wider functions or effects thereby returning a large amount of potentially relevant papers. Additional "AND" key words for specific functions and effects were not used due to the review's explorative nature. Any such words would involve predicting possible effects and functions, thereby restricting the scope of the review. Instead, the emphasis was put on a manual two-stage screening to assess suitability as shown in Fig. 2, along with the inclusion criteria. These were developed to identify documents within the scope of the research objective, namely research into existing UGMP zones and research which implicitly or explicitly researched UGMPs beyond urban containment. The review was limited to academic literature, and therefore potentially relevant grey literature were not included.

The database query was performed for Titles, Abstracts and Keywords in Scopus on the 11th October 2021. Results were limited to the English language, and to between 1960 and 2021. All subject areas were retained due to the review's exploratory nature, yielding 1465 documents for screening. Due to limitation to English language fluency and lack of access to translation, the English search language limited the scope of the study, a documented limitation in review processes (Neimann Rasmussen & Montgomery, 2018).

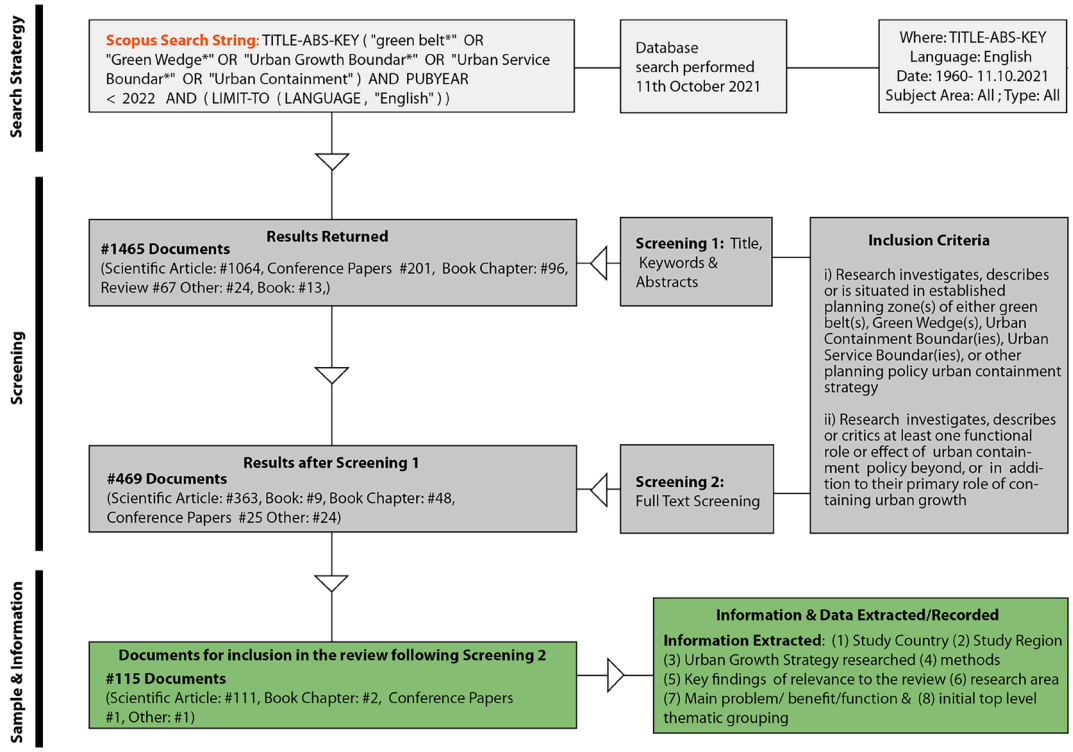

Fig. 2. Review process including search string, protocol, inclusion criteria and data extracted from the final literature sample.

The literature sample *meta*-data, including abstracts was exported to Microsoft Excel where screening and data extraction was conducted. Initially, the documents, title, abstract and key words were screened based on the inclusion criteria shown in Fig. 2. Most documents screened were outside the research scope. For example, they referred to "green belt" in non-planning contexts, including the Scandinavian Mountains Green Belt, the Chinese "Green Belt and Road" and "Sigma Six "green belt" manufacturing process". A substantial body of research was also identified, mainly from China, studying the delineation of future UGBs (see review by: Wang et al., 2020). This research focused on the models for delamination of UGMPs. Whereas this body of works often considers ecological constraints, they concentrate on future UGMPs and not the effects or functionalities of existing UGMPs. Therefore, they were not included. Stage 1 screening refined the sample to 469 documents for further screening of the full texts based on the same inclusion criteria. Key information and data were then extracted from the document included in the review, as shown in Fig. 2.

3. Results

Following the two-stage screening, 115 relevant documents (111 scientific articles, 2 book chapters, 1 conference paper and 1 working paper) met the inclusion criteria for this review, a record of which can be found in Appendix 1.

3.1. Trends and approaches

Publications meeting the inclusion criteria were published between 1979 and 2021. As illustrated in Fig. 3 there is a general, but non-consistent increase in the number of publications between this period, with 2019 being a 'peak year'. The search was performed in October 2021, therefore 2021 is slightly underrepresented. Whereas many UGMPs studies were identified from 1990 to 1999, most of these investigated their effectiveness for controlling sprawl, with fewer examples studying the wider functions and effects.

Globally, several clusters of countries' UGMPs were highly studied, as illustrated in Table 1. Notably UGMPs in North America and Europe were most studied, with the USA and UK accounting for 57 % of all cases studies identified. A hotspot for UGMP research in the global south was China, the third most represented country. However, this spatial distribution may also reflect where knowledge is available, that is, where anglophone research is being conducted and published, rather than an indication of the actual spatial distribution of UGMPs studied.

Table 1
Global distribution of UGMPs counties studied, showing frequency of case studies per country including studies which researched multiple countries UGMPs.

Country of UGMP Studied	Number of studies & (percentage)	City Regions Studied
Australia	7 (6.0 %)	Adelaide; Albury; Sydney; Melbourne
Brazil	3 (2.6 %)	Sao Paulo; Santa Cruz do Sul*
Canada	4 (3.4 %)	Toronto; Quebec; Vancouver
China	10 (8.6 %)	Beijing; Shanghai
Denmark	2 (1.7 %)	Copenhagen
Finland	1 (0.9 %)	Helsinki
France	1 (0.9 %)	Paris
Germany	1 (0.9 %)	Ruhr
Great Britain	26 (22.4 %)	Manchester; Merseyside; London; North-East; St Andrews; Bristol; Glasgow; Chester; Edinburgh
India	1 (0.9 %)	Bengaluru
Iran	1 (0.9 %)	Tehran
Netherlands	1 (0.9 %)	Green Heart
New Zealand	1 (0.9 %)	Christchurch
Poland	1 (0.9 %)	Olsztyn
Slovenia	1 (0.9 %)	Ljubljana
South Africa	3 (2.6 %)	Cape Town
South Korea	5 (2.6 %)	Seoul; Jeju; Chuncheon
Spain	1 (0.9 %)	Vitoria-Gasteiz
Sweden	3 (3.4 %)	Stockholm
United States of America	41 (35.3)	Portland Metro; Ventura; Sonoma; Marin; Boulder; Lexington-Fayette; Baltimore; Lancaster; Austin; Tennessee; Kings County; Denver; Miami

Of the UGMPs, GBs were the most studied (48 %), followed by UGBs (42 %) and GWs (6 %), as shown in Fig. 4. Only 4 % of the studies investigated different UGMPs comparatively. UGBs were studied primarily in the context of USA, and to a lesser extent China, whereas GBs were studied in much more varied international contexts, but most notably in the UK. At the sub-national level, 29 % of studies investigated multiple regions, and hotspots for research attention include Metropolitan Portland (Oregon), Beijing, Melbourne and London.

Across the studies, researchers employed a variety of methodological

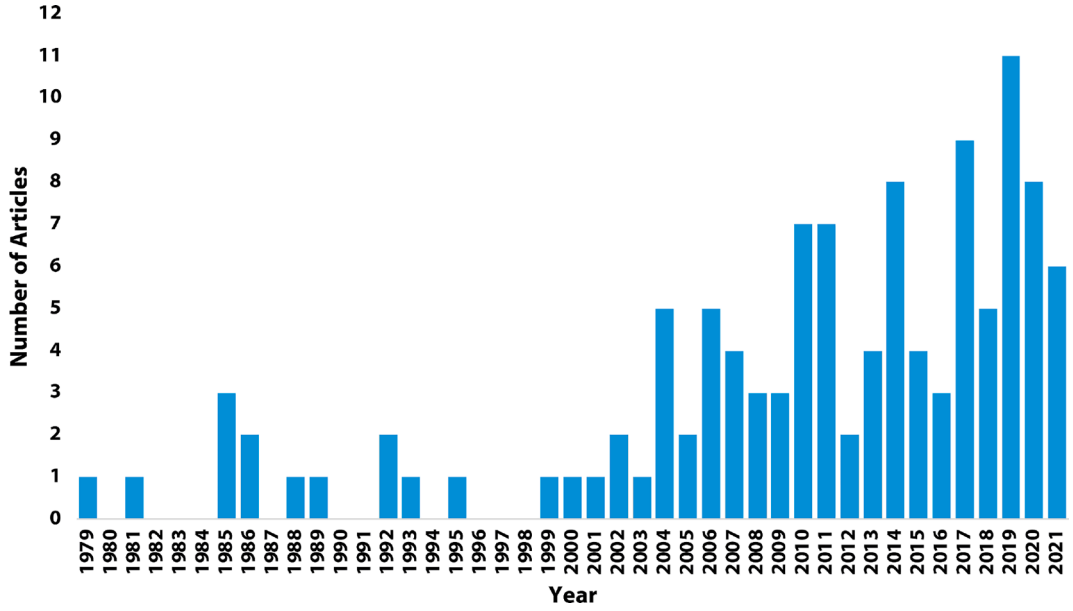

Fig. 3. Number of documents in the sample identified per publication year from 1979 to 2021. 2021 represents up to October 2021.

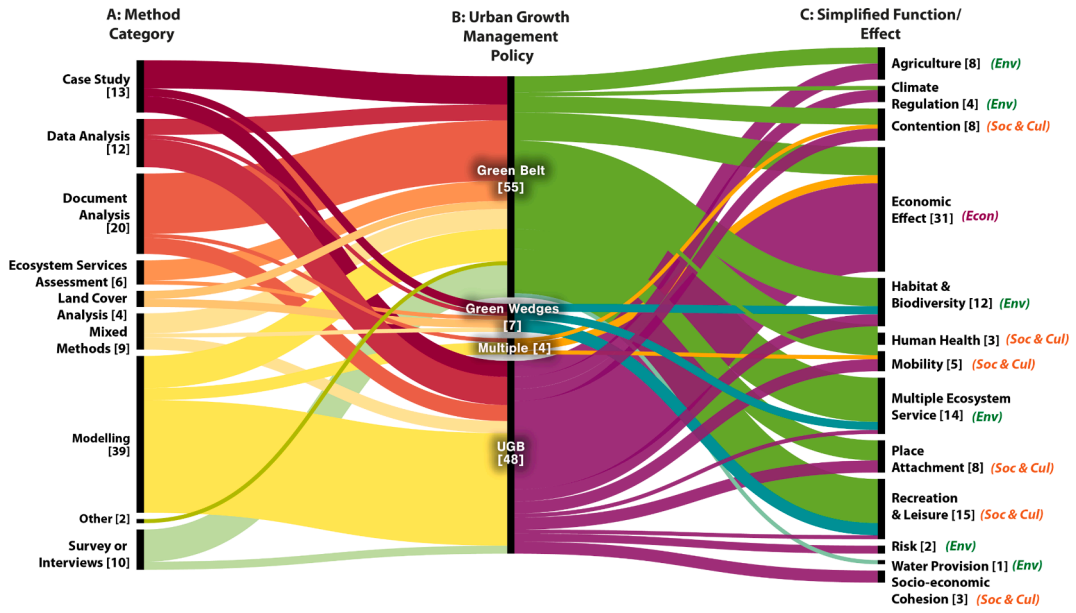

Fig. 4. Column A shows the category and frequency of the study methods employed, flowing proportionally to the corresponding UGMPs in **Column B**. The frequency of the function/effects identified from respective UGMPs are shown flowing to the right into respective groups in **Column C**. Frequency is represented as the size of flows and displayed as a number next to respective categories. Respective high-level groupings of functions and effects are also shown in column C, representing the discussion sub-sections they are unpacked in *Env* = environmental functions and effects; *Soc & Cul* = social and cultural functions and effects; *Econ* = Economic.

approaches, as illustrated in Fig. 4. The three most used methods were modelling (34 %), document analysis (17 %) and case study approaches (11 %). UGMPs were studied relatively equally in terms of both quantitative and qualitative methods. All categories of methods were used at least once to study both UGBs and GBs. Only 7 % of studies used a mixed-methods approach.

Studies were published in 66 different journals: the most popular being *Journal of Environmental Planning and Management* (#6), *Journal of the American Planning Association* (#6), *Landscape and Urban Planning* (#5) and *Land Use Policy* (#5). Many of these journals are multi/inter-disciplinary, highlighting the cross-disciplinary interest in UGMPs. Several effects and functions of UGMPs were identified from studies where the study locations were an UGMP zone, but not the primary focus of the research. For example, Gilchrist, Barker, & Handley (2016) investigated the range expansion of butterflies; here the GB was a study location, but not the focus in its own right. Other studies applied new methodological approaches, using UGMPs zones as case studies to test them (Moffett, Makido, & Shandas, 2019).

3.2. Wider functions and effects of UGMPs

A range of functions and economic effects were identified from UGMPs, as summarised in Fig. 4, showing the multifunctionality of UGMP. They can be grouped into: (1) environmental functions and effects (section 3.2.1), (2) social and cultural functions and effects (section 3.2.2) and (3) economic effects (3.2.3). Common themes within these groups, as well as more detailed case-specific findings are unpacked in the following sections respectively.

3.2.1. Environmental functions and effects

Several ecological and environmental functions were identified in 36 % of UGMPs studies including: agriculture, climate regulation, habitat & biodiversity, multiple ES, water provision and risk mitigation. GB and GWs zones were found to provide multiple ES in 12 % of studies. These studies differ from the majority, in that they investigate multiple functions of UGMPs holistically as socio-ecological landscapes. The earliest work was from GBs in England through the lens of environmental economics applying hedonic price and contingent valuation methods, capturing multiple non-market functions (Hanley & Knight, 1992; Willis & Whitby, 1985). However, a key gap found was no subsequent works quantifying multiple ES in English GBs or US UGMPs, which is surprising given the growth in studies elsewhere (Costanza et al., 2017). More recent studies did quantify multiple ES in UGMPs in Canada (Ruiz-Sandoval, Arana-Coronado, Godbout, Sandoval-Salas, & Brambila-Paz, 2019), China (Pan, Zhang, Zhen, & Yu, 2011), France (Roussel et al., 2017), Germany (Zepp, 2018) and Sweden (Furberg, Ban, & Nascetti, 2019). They showed that zones of GBs in Europe and Canada provide a range of regulating and provisioning ES to people (Roussel et al., 2017; Ruiz-Sandoval et al., 2019; Zepp, 2018). However, a key gap in the assessment of multiple ES is a lack of cultural ES (such as recreation, sense of place and scenic value) as part of those assessments with only one study doing this. Whereas not quantifying ES, several studies did report the multiple ES provided by zones of UGMPs through case study and document analysis approaches (Amati & Taylor, 2010; Hedblom et al., 2017; Ribeiro, 2015; Victor et al., 2004).

Several studies (11 %) from the landscape ecology and nature conservation literature studied elements of ecological functioning within UGMP zones, reporting their importance for biodiversity (Gilchrist et al., 2016; Gordon, Simondson, White, Moilanen, & Bekessy, 2009; Michael, Niedra, & McWhinney, 2021; Szczepańska & Senetra, 2019; Wilson et al., 2013; Xiu et al., 2017). Notably, the North-West GB in England and Stockholm's GWs were shown to provide an important pathway for the range expansion of butterflies, small birds and amphibians (Gilchrist et al., 2016; Xiu et al., 2017). Similarly, Australian UGBs provide ecological protection function for important habitat (Michael et al., 2021; Wilson et al., 2013). Some UGMPs have become to explicitly recognise these biodiversity functions, such as Helsinki's GWs (Hautamäki, 2021). Conversely, multiple negative ecological effects of UGMPs were found including as vectors for alien and invasive species (Fetter, Dörr, Moraes, Putzke, & Lobo, 2020), and the indirect loss of urban biodiversity from urban densification driven by English GB policy (Bibby, Henneberry, & Halleux, 2020). Additionally, existing policy design in some UGBs in Australia and China poorly account for the biodiversity present (Gordon et al., 2009; Yu et al., 2011).

Around 4 % of studies investigated singular provisioning and regulating ES provided by UGMPs. Mixed results were found with respect to the agricultural functions of UGMPs zones (Daniels, 2010; Fienup & Plantinga, 2021; Gant, Robinson, & Fazal, 2011; Lazzarini, 2018; Marin, 2007; Munton & Marsden, 1991; Nelson, 1992; Smith & Haid, 2004). UGBs in North America were found to be effective in supporting productive and prosperous agricultural sectors (Daniels, 2010; Nelson, 1992; Smith & Haid, 2004), and in some cases resulted in intensification (Fienup & Plantinga, 2021). However, in some cases this resulted in negative externalities including groundwater depletion and pesticide exposure (Fienup & Plantinga, 2021; Marin, 2007). Conversely, English GBs were shown to have generally negative effect on agriculture, attributed to low policy priority of agriculture in GB policy and subsequent reduction in GB farming and increased diversification (Gant et al., 2011; Lazzarini, 2018; Munton & Marsden, 1991). Another provisioning service: water supply was found to be a politically important function of UGMPs, and effectively protected when on par with growth management as an UGMP objective (Bunker & Houston, 2003).

Multiple regulating functions relating to climate were identified in the US and Asia from UGMPs, showing their potential to contribute to climate mitigation and adaptation, including a reduction in urban heating in the US and Korea (S. Jeon, Hong, & Kang, 2018; Moffett et al., 2019;) and increased carbon sequestration through landscape protected (Cathcart, Kline, Delaney, & Tilton, 2007; S. Jeon, Hong, & Kang, 2018; McDonald-Buller, Webb, Kockelman, & Zhou, 2010; Moffett et al., 2019). Additionally, UGMPs indirectly contributed to air pollution mitigation by reducing vehicle miles travelled and associated emissions (S. Jeon et al., 2018; McDonald-Buller, Webb, Kockelman, & Zhou, 2010). Two studies conversely framed the indirect regulating effects of UGBs in the context of environmental risk. Burby, Nelson, Parker, & Handmer (2001) argue that UGB increase urban density, thereby creating a greater risk from natural disasters such as earthquakes and flooding. Conversely, Nielsen-Pincus et al. (2010) showed that UGB reduced others risks such as wildfires by reducing the proximity of development away from risk vectors.

3.2.2. Social and cultural functions and effects

A variety of social and cultural functions and effect of UGMPs were found in 37 % of the studies identified, mainly from GBs and GWs and in a European context, including recreational & leisure, place attachment, human health, mobility, contention, and socio-economic cohesion. These can be seen as providing cultural ES and landscape amenity: the benefits citizens obtain from the open landscape for which UGMPs preserve (Harvey & Works, 2002; Hedblom et al., 2017).

UGMPs were found to contribute to landscape character, manifesting themselves as places where people form strong cultural and emotional attachments to, and in themselves forming distinct identifies (Abbott & Margheim, 2008; Amati & Yokohari, 2006; Bradley, 2019a; Clifford & Warren, 2005; Gopinath & Jackson, 2010; Harvey & Works, 2002; Zhang, Ling, & Da, 2012). These place attachments to UGMP landscapes were found to result in public protest over its protection (Bradley, 2019a; Harvey & Works, 2002). Demand for these living close to those amenities have also increased pressure on UGMPs, which in itself can exacerbate sprawl (Cadieux, 2008). There has been limited research on understanding the specific visual landscape qualities people value, but a scenic beauty estimation has shown high provision of scenic quality in Shanghai's GB (Zhang et al., 2012). Whereas such values are not an explicit policy aim of English GB policy, it was found that some local authorities in the London GBs placed a strong policy focus on landscape quality in their preservation (Amati & Yokohari, 2006).

Substantial recreational and leisure use of UGMP zones were found in the UK (Bradley, 2019b), Denmark (Caspersen, Konijnendijk, & Olafsson, 2006), Spain (Aguado-Moralejo, Echebarria, & Barrutia, 2013), Sweden (Elmqvist et al., 2004), Korea (Bengston & Youn, 2006), Iran (Mahmoudkhani, Feghhi, Makhdoum, & Bahmani, 2020), China (W. Zhao, Wang, Chen, Wang, & Tang, 2021) and Slovenia (Žlender & Ward Thompson, 2017). In nearly all these studies the recreational functions of UGMPs were found to be of great importance to local and regional populations. Some of the earliest research looked at the informal recreational use of London's GB in identifying informal (Ferguson & Munton, 1979) and formal recreational sites (Elson, 1986) as well as socio-economic disparity in their visitors (Harrison, 1981). Recent research suggest recreational use of green belt is linked to the notion of common rights to open space (Bradley, 2019b). Across Scandinavia UGMP zones are some of the most used and valued recreational sites (Caspersen et al., 2006; Elmqvist et al., 2004), promoted though formal planning (Caspersen & Olafsson, 2010). Interestingly, recreation was one of the few functions which has been studied comparatively internationally, with one study showing contrasting recreational use between the Edinburgh GB, which was less used than the more heavily used GWs of Ljubljana, (Žlender & Ward Thompson, 2017).

Positive human health functions were found to be linked to UGMP zones including reduced obesity levels in Korea's GBs (J. Jeon, Kim, & Kwon, 2020) and reduced levels of noise, and air pollution (Zhang & Zhang, 2013). Improved health and wellbeing has been an historic policy aim for some GBs, for example in Scotland GBs earlier use as an policy mechanism was to improve health (Lloyd & Peel, 2007).

UGMP have also been shown to affect the socio-economic functioning and dynamics of urban areas, most of which have been studied in the US context. One of the main areas of research has investigated if, and to what extent UGMP changed mobility patterns. Results, however, differ geographically. Crowd sourced mobility data from Beijing shows GB effectively contain human mobility (Long, Han, Tu, & Shu, 2015). Whereas comparative research across 25 US cities showed UGMPs did not reduce overall journeys (Rodriguez et al., 2006). More recent work found that UGB reduce commuting times, but benefits may be negligible (Durst, 2021). Whereas most research looked at motorised trips, non-leisure walking behaviour was shown to increase with distance from UGBs (Brown et al., 2014).

Other urban challenges such as social cohesion were shown to be potentially affected by UGMPs, with higher income inequality was found in regions of high sprawl, compared to compact development patterns (Lee, 2011). These compact development patterns resulting from UGBs are also shown to redistribute funding towards inner city areas, thereby reducing city-centre deterioration (Hortas-Rico, 2015). By reducing sprawl, UGMP may also contribute to declines in racial segregation, then those without such policies, due to increased cohesion resulting from densified development patterns (Nelson, Sanchez, & Dawkins, 2004).

The social and political contention created by UGMP implementation and planning decisions has attracted a wealth of academic attention (Calandrillo, Deliganis, & Woods, 2015; Dockerill & Sturzaker, 2020; Horn, 2019, 2020a, 2020b; Pacione, 2014; Y. Zhao, 2017). Notably, and in contrast to other UGMP effects and functions, Horn (2019, 2020a, 2020b) has investigated the global south from this perspective, where the lack of consistent implementation of UGB has created politically contentious policies as well as socially unequal access to their benefits. Contention over and disenfranchisement with UGMP, is perhaps no more prominent than in UK GBs where there is widespread opposition to GB development, but with a lack of brownfield land to meet existing/future housing needs GB have become highly political (Dockerill & Sturzaker, 2020). A perceived lack of public participation is one reason attributed to a disconnect between national and local priorities and resulting tensions (Pacione, 2014). An additional longstanding reported point of GB contention in England is the marginalisation of traveller communities that seek its temporary use, but often conflict with the policy goals resulting in contention (Kabachnik, 2014).

3.2.3. Economic effects and functions

The economic effects of UGMPs were one of the most studied areas of research accounting for 27 % of the studies, the majority of which studied the effects land and housing markets along with the

infrastructural importance. With regards to the former, most studies investigated the economic effects of UGBs, compared to GBs. No region has been studied more in this regard than the US State of Oregon, represented in 48 % of these studies. The economic effects of UGMPs show several tensions and complexities. For example, 60 % of studies report that UGMPs have to some degree increased house and/or land values (Ball, Cigdem, Taylor, & Wood, 2014; Bigelow & Plantinga, 2017; Cho, Chen, & Yen, 2008; Downs, 2002; Grout, Jaeger, & Plantinga, 2011; Hascic & Wu, 2012; Ma & Jin, 2019; Mace, 2018; Mathur, 2014; Nelson, 1985, 1986, 1988; Phillips & Goodstein, 2000; Woo & Guldmann, 2014; P. Zhao, 2011). However, these findings range substantially from ~$10,000 (Phillips & Goodstein, 2000) to ~$200,000 per house (Bigelow & Plantinga, 2017), and three studies found that the UGMP studies had no effect on land or housing markets (Buxton & Taylor, 2011; Jun 2006). One study also found that UGMPs increased the land price, but lowered housing prices explained by the requirement for higher density development (Mathur, 2019).

Despite the research effort to understand the economic impact of UGMPs, the results show of some inconsistencies both between and within regions. Early research found economic effects from one Oregon UGB but not another, suggesting local factors such as policy compliance are important (Knaap, 1985). Much of the inconsistency found may be explained by multiple factors including research and model design. For example, the strength of UGMP implementation was shown to be a determining factor in economic effects (Woo & Guldmann, 2011). Pendall (1995) showed that where strong UGB policies were coupled with affordable housing programmes, economic impacts were mitigated. There are also some contradictions found in Portland, for example, Jun (2006) found that for a 1-year period the UGB had no effect on house prices, however studies using larger temporal datasets showed the opposite (Downs, 2002; Hascic & Wu, 2012; Kim, 2013).

At the inter-regional scale, economic effects of UGMPs were found to differ. For example, multiple studies, in multiple states showed that different housing types were affected differently by UGBs (Mathur, 2019; McMillan & Lee, 2017) as well as where they were located regionally (Grout et al., 2011). Further research found that UGB effected house prices depending on residents preferred amenities; benefiting those who preferred urban amenities (Bigelow & Plantinga, 2017).

No comparative model-based research on the economic effects of existing UGMPs was identified outside of the US. Research on the economic impacts of GBs have mostly studied alternative scenarios to improve economic viability. Mace (2018) reports that London GB have created an economics imbalance in the region and a corridor approach to strategically develop part for the GB would have positive economic impacts, compared to present through and increased an affordable housing supply.

An additional important economic function of UGMPs zones identified in literature were as places for infrastructure and industry, much of which often require large amounts of space in peri-urban areas. Built infrastructure identified in the review includes mineral and energy extraction (Gant et al., 2011; Willis et al., 1993; Willis & Whitby, 1985) and reservoirs and transport infrastructure including airport expansion (Gant et al., 2011; Buxton & Goodman, 2008). Additionally, green infrastructure is seen as increasingly important infrastructure in GBs (Amati & Taylor, 2010). In contrast to studies on UGB, impacts on property and land economics, most infrastructural functions were studied within GB contexts. Infrastructure in some instances was shown to be self-propagating, for example Gant et al. (2011) notes that motorway expansion took advantage of existing landfilled gravel works and other degraded land for expanding into the GB. Where space is a scarcity in urban areas, UGMPs provide the space for large-scale infrastructure required for the same urban areas to flourish.

4. Discussion

4.1. Should UGMP be multifunctional?

This review identified the wider environmental, social, and economic functions and effects of UGMPs beyond their primary role in preventing urban sprawl, as reported in the previous section. Of the functions found, ES were explicitly studied in relation to UGMP zones, both as multiple ES, in limited cases, but more often as singular ES. Therefore, viewed through an ES lens, the identified functions of UGMP directly and indirectly contribute to human wellbeing (Costanza et al., 2017), thereby making them potentially important opportunity spaces for mitigating societal challenges. Indeed, many of the identified functions can be mapped to respective ES categories, as shown in the conceptualisation Fig. 5. The ES supplied from UGMP zones are part of the wider socio-ecological system which supports urban populations, and the challenges they face now and in the future. Specifically, we argue that they should viewed as important and beneficial assets in addressing the interconnected climate, biodiversity and health challenges (Chiabai et al., 2018). For example, the Covid-19 pandemic has fuelled an increased demand for local greenspaces, including peri-urban areas (Beckmann-Wübbelt et al., 2021), making UGMP recreational functions potentially important. However, the pandemic highlighted the disproportional access to greenspace, with minority and economically deprived communities suffering a significant greenspace deficit (Astell-Burt & Feng, 2021). Therefore, it is important for research to investigate how UGMPs zones can be utilised more equitably. Likewise, as illustrated in Fig. 5, UGMPs were shown to supply several regulating ES, which are important for climate change mitigation and adaptation. UGMP zones may therefore be an integral part of wider strategic natural capital assets, such as green infrastructure networks in planners' regional responses to climate change (Han et al., 2022; Honeck et al., 2020). Of the limited research undertaken, some UGMP zones provide important functional biodiversity corridors for the regional movement of species in the absence of complementary nature conservation designation (Gilchrist et al., 2016), thereby providing a potential resource for species to adapt to climate change. Central to the importance of UGMP zones for all these benefits is their proximity to large populations of people, and their reframing and operationalisation as multifunctional assets. Such demands will likely become greater given projected urban population growth (United Nation et al., 2019), and the importance of peri-urban areas as opportunity spaces to tackle these interconnected challenges (Hedblom et al., 2017; Scott, 2019). However, for the diversity of benefits to be provided these socio-ecological landscapes need to host a diversity of land-uses including agriculture, habitats for biodiversity, and some degree of public access, which will be dependent, to some extent, on size of the UGMP. UGBs especially may require complementary zoning to support this whilst GB and GW may require wider policy objectives.

Whilst we argued that UGMP zones should be seen as multifunctional opportunity spaces, it is important to highlight potential pitfalls and the inherent limiting tensions which may exist within some UGMP zones. Firstly, research in the US and Europe shows that some peri-urban landscapes within which UGMP are part, experience significant land-use conflict, often due to changes in landscape character, or between existing residents and the migration of new residents (Shaw et al., 2020), as well as between different interest groups (Pacione, 2014). It is likely that the creation and/or existence of UGMP may exacerbate them. For example, as well as providing benefits, ES can create disservices (Lyytimäki & Sipilä, 2009); such as the negative externalities from urban proximity to agriculture in UGMP zones (Marin, 2007). Additionally, where UGMP zones provide benefits from ES, trade-offs exist between them; UGMP zones cannot be maximised for agriculture or biodiversity whilst at the same time accommodating the recreational demands of urban populations (Spyra et al., 2020). The underlying ecological functioning of these zones may also be reduced whilst prioritising

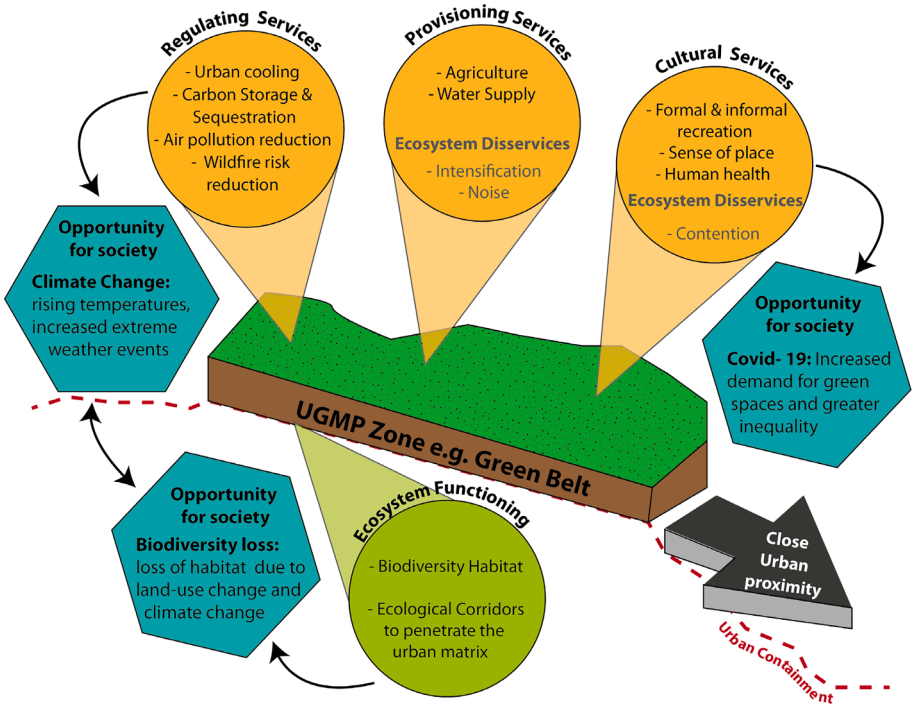

Fig. 5. Multifunctional UGMP zones: a conceptualisation of beneficial UGMP functions identified in the academic literature, framed as ES and key opportunities in tackling societal challenges of the triple climate, biodiversity, and health emergencies, including their proximity as protected open spaces to large urban populations.

intensive agriculture, thereby reducing their ability to provide other benefits (Marull, Cunfer, Sylvester, & Tello, 2018). The way these functions and ES interact is complex; often with discrepancies in supply of certain ES and demand for others (Castro et al., 2014). Therefore, the transparent and participatory identification and prioritisation of purposes is key for future UGMP governance. Additionally, the complexity of ES supply at this landscape scale requires trade-offs, as well as effective and innovative governance mechanisms, which are often absent in peri-urban landscapes (Spyra et al.,2020). In contrast to such complexities, some (but not all) UGMPs can be seen as the opposite: uncomplex blanket policies which are applied with little thought to the socio-ecological conditions of the land they seek to govern (Amati & Taylor, 2010). This means that UGMPs favour the status quo making them ineffective in governing and functioning to a greater potential as multifunctional zones that reflect the wider variety of benefits, than are currently being supplied in many UGMP zones and demanded by society. Tools such as complementary zoning may be one way to balance these land-uses.

Critics rightly point out that many UGMPs, such as English GBs are not required to provide benefits such as ES (Mace, 2018). Instead, several other landscape and nature conservation policies exist with these aims, such as Areas of Outstanding Natural Beauty (Powell, Selman, & Wragg, 2002). Thereby, instead of potentially diluting the primary function of GBs in preventing sprawl, other policies may be better suited to the task of enhancement. However, a key omission to this narrative is that such environmental policies are often stacked along with UGMPs, but work separately in their respective silos, requiring integration of policy domains to benefit society (Scott, Holtby, East, & Lannin, 2021). Instead, we argue that by rethinking and broadening GBs as a space for multifunctionality, the opportunity lies in bringing social and environmental agendas together through dedicated and joined up planning policies, thereby creating a potentially important role in breaking these silos. Innovative and leading examples of this can been seen in the GGH GB, Canada which integrates agricultural, water and nature conservation agendas within the bounds of multifunctional GB policy (Macdonald et al., 2021a). By understanding what benefits the UGMP landscape could and do provide it may be possible to have an informed and evidence-based discussion, about whether UGMPs should also explicitly aim to improve the multifunctionality of the land they govern, instead of simply preserving them.

An underlying premise of our argument is that multifunctional UGMP zones are an improvement. However, others argue that a land-sparing approach may be preferable and appropriate in some systems, especially in a zoning planning system where land-uses are separated. Countries such as the UK with higher population densities, arguably, may wish to maximise multiple functions of land around its towns and cities. However, there are contested view politically and academically on if multifunctionality is an improvement or not. For example, there is long-standing debate over land sharing (multifunctionality) or land-sparing which is based on a difference between compositional ethics and functionalist ethics (Loconto et al., 2020). Ultimately, it is for individual national, regional, and local governments to decide based on their context, planning system and demands if multifunctionality in the context of UGMPs is desirable. Whilst being supported by evidence to make such decisions.

In addition, the development, land and access rights which underpin planning systems differs internationally which may be a considerable factor in what the aims of UGMPs can be. Indeed, previous attempts of policy borrowing have not always been successful, including attempts to form GBs in Tokyo and New Zealand highlighting that GBs are not a universal solution (Amati, 2008). Even within states in the US such factors, especially politics, shape the varying approach or even existence of growth management (Feiock et al., 2008; Rusk, 1999). When implemented regionally such as Portland UGB or Ontario's GB, the local compliance and coordination of local municipalities though zoning is critical to success (Macdonald, Monstadt, & Friendly, 2021b). Therefore, these contexts, history and politics is of primary consideration in the design and implementation of any approach to UGMPs. One such factor to consider is the size and spatial scale which UGMP zones are governed. For example, whereas England GBs differ in size they are also planned at the local scale, due to a lack of statutory regional planning, which may affect their ability to deliver wider functions (Goode, 2022). However, further research is required to evaluate this.

4.2. Are UGMPs a good idea economically?

Not all identified functions and effects of UGMPs may be perceived as beneficial to wider society, making it important to understand how potentially negative effects of UGMP can be mitigated, or justified. As found in section 3.2.3, one of the biggest criticisms of UGMP relates to their economic effects on housing and land markets. The research to date suggests UGMPs increase housing prices to differing degrees making it of legitimate concern, especially for areas under extreme housing shortages such as Greater London (Mace, 2018). Complementary affordable housing policies have been shown to be capable of mitigating economic effects from UGMPs (Pendall, 1995), as well as growing in popularity as policies internationally (Czischke & van Bortel, 2018). Thus, they may be an option for policy makers to mitigate the economic effects of UGMPs. However, attempts to integrate affordable housing have been less successful in parts of the US where developers are allowed to contribute to affordable housing funds instead of actual housing (Rusk, 1999). Additionally, housing markets are complex, meaning it is unlikely-one factor, in this case UGMPs, are the sole reason for given market conditions (Mace, 2018). For example, the results suggest that different housing types were impacted differently in UGB areas, which is also likely to be a result of zoning policies. Again, these policies should respond to the local context and demands. Therefore, critics of UGMP may consider how other policies may complement and mitigate UGMP effects without undermining its policy scope. For example, English planning policy in the 1990 s and 2000 s supported the GB purpose of promoting inner city regeneration, with a raft of complementary targets and measure, suggesting joined up and complementary policy approaches can work (Bibby et al., 2020).

Economics have had a formative role in UGMPs adoption and implementation. Willis & Whitby (1985) notes that in England prior to the 1947 Planning Act, the designation of GBs was an economic activity, with local authorities purchasing land to protected it; thereby the consideration of the cost "benefits" was greater than today. Similarly, GBs in the US are implemented by the purchasing of land or conservation easements by local, state and federal governments, thereby recognising non-market value of the land and are often complemented by zoning (Daniels, 2010). Such perspectives are important as they broaden the economic arguments beyond the narrow impact of housing and land prices, but towards capturing the wider value of non-market goods, such as ES through ecological economic valuation methods (Kieslich & Salles, 2021). Conversely, it would be naïve to dismiss the need for land constrained by UGMPs both for development, especially the requirements for the infrastructure, including energy production, mineral extraction, and transport. Therefore, we argue that by widening the basis of capital that informs decisions, such decisions on land-use are made which can benefit society holistically, whilst at the same preventing sprawl. The importance of which is bleakly illustrated by Neel (2018) in the peri-urban zones of the US where in the absence of UGMP have become "subsidiary zones for global capital and for the particular cities that happen to be closest to them" (p. 17). Additionally, the temporary nature of some infrastructural activities provides a future opportunity for improvements to GBs for example, with the requirements in England to restore such sites, often for nature conservation (Blaen et al., 2015).

4.3. Gaps and future research priorities

From this review we have identified several key research gaps in the academic literature which require attention if UGMP are to be utilised as tools to deliver multiple benefits by policy makers. To date, most research has investigated a specific function or effect in isolation, with a lack of inter and *trans*-disciplinary studies. Furthermore, those studies which assessed multiple ES did not study cultural ES alongside provisioning and regulating ES (with only one exception) thereby failing to consider key social elements within socio-ecological systems. It is becoming increasingly accepted that inter and *trans*-disciplinary approaches are required to tackle key societal challenges due to their ability to break established disciplinary silos and facilitate integration and joined-up planning and delivery (Scott et al., 2021). Therefore, a key research priority for UGMPs is to better understand how ES within them function, interact, deliver and trade-off with each other as part of wider socio-ecological systems, including who may benefit and know may not.

The functions and effects that are found in the literature are mostly location-based making it unclear what functional characteristics are cross-cutting internationally. Here more comparative research approaches are required, as shown by Žlender & Ward Thompson (2017). Such comparative research also needs to consider the effects of the respective underlaying planning systems. For example, in England where development rights are nationalised planners have discretion to stop types of development. Comparatively in many US planning systems individuals have more freedom of what they develop. Therefore, UGMP have a different policy meaning contextually. This is especially important in terms of our review as 57 % of UGMPs studied in the literature identified were in the US and UK, but research tended to focus on different functions and effects of UGMPs. For example, economic effects of UGMP, which could provide a potentially important future priority for comparative UGMP research. Furthermore, the ability of alternative methods to organise planning and deliver wider functions merit further research, such as the form-based approach of "transects"; a concept in which areas are divided into six transects along the urban–rural gradient (Duany et al., 2020).

Additionally, many functions and effects have only been studied in limited geographies. ES assessments have not been conducted in an English GB context, but several other countries, which is surprising given the championing of the ES framework by the British Government (Defra, 2018) and the ongoing tensions over English GBs contributions to society (Mace, 2018). However, the biggest spatial imbalance in research distribution is clearly in the global south, with very few effects and functions published in dominant anglophone journals. Finally, many functions pertinent to urban and peri-urban resilience including flood regulation, mental health and habitat quality have not been directly researched in relation to UGMP zones but have received research attention in wider peri-urban landscapes (Spyra et al., 2020). As highlighted in Fig. 5 a unique opportunity of UGMPs zones is their proximity to urban populations which needs to be better understood through demand and supply ES assessments (Castro et al., 2014). Addressing these research gaps, to establish an evidence base on UGMP functionality may assist policy makers, politicians, and the public in answering the important question of how these zones can benefit the largest number of users and ecosystems?

5. Conclusions

This review sought to understand what wider environmental, social, and economic effects of UGMPs zones have been identified in the academic literature. The results show that a myriad of intended and unintended environmental, social, cultural, and economic effects and functions are provided internationally in a variety of UGMP zones; most of which are GBs and around UGBs whose primary purpose in most cases are urban containment. We argued that many of these functions should be seen as beneficial to society. Debates around reforming older GB models such as those in England to meet societies' current challenges are often polarised, with a lack of evidence as to the wider benefits. The results presented in this review should not be seen as a complete evidence base to catalyse that debate, but an indication that UGMP zones provide wide and varied benefits of cross-disciplinary interest, which need to be better understood and accounted for. But we stress the implementation of UGMPs to promote these benefits and functions needs to consider and account for the wider social and political contexts including the underlying governance systems as well as the development, land and access rights which exist, as UGMPs remain contentious

policies. Additionally, this review highlights the need for more inter and transdisciplinary and systems thinking which aim to better understand the connections and drivers between these functions, along with the role of policy in providing them.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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